Abstract Volume

World Water Week in Stockholm
August 12–18, 2007

Progress and Prospects on Water
Striving for Sustainability in a Changing World

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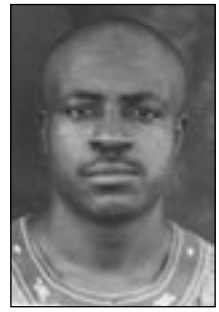

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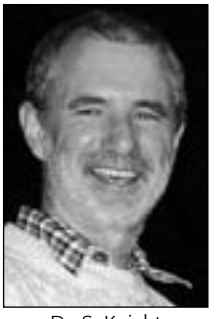
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Workshop 1: International Targets and National Implementation

"People have walked on the moon, I still dream of water": Water, The State and the Unrecognized Villages in the Negev

Author: **Mr. Wasim Abas**
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Keywords: Environmental Justice, Right to Water, Women's Health, Public Health Rights, Bedouin Arab Israeli citizens

This paper deals with the right to water of one of the most marginalized and discriminated groups within the state of Israel: The Bedouin-Arab residents of 45 "unrecognized" villages. It is based on a comprehensive report on the issue that can be found here: www.phr.org.il

Israel has a well-functioning national water supply system. 98% of the Israelis enjoy safe and potable water. Yet, in the Negev, Israel's semi-arid desert, over 80,000 people are not connected to water and suffer from severe shortage. This is due to the state policy that denies them access to water as a means to force them into state-established town(ship)s.

The described situation has far-reaching effects on the health of the population of these "unrecognized" villages. As with other human rights violations, it affects all. However, chronically ill, disabled, children and women are more severely affected. The effects on women's health are given special consideration due to their role in society. This includes their house and family hygiene, child-bearings and responsibility for all family members.

From a rights-based approach to health and using the concept of environmental justice, Israel's unwillingness (as oppose to inability) to connect these people to water is argued to be inconsistent with the core obligations to human rights and democratic governance.

The paper describes the current situation, analyzes it vis-à-vis human rights covenants and discusses its health ramifications. Since past struggles have not brought about the aspired change, a short discussion on alternative actions and recommendation for the medical and professional water community is presented.

Accordingly, PHR-Israel recommends the following actions to be taken:

In the short term, pending implementation of the long-term recommendations:

- The state must make an immediate and concerted effort to connect all the residents of the unrecognized villages to a water supply.
- The cost of connection to the water grid must be reasonable and acceptable in Israeli standards, so as not to discriminate between residents of the unrecognized villages and other residents of Israel in general, and between poor and well-off villagers specifically.
- The connections must allow for water use of average quantity and quality by Israeli standards.
- The Ministry of Health must initiate and implement periodic inspections of the fixed and mobile water sources in coordination with the agency directly responsible for the area, whether it be the Regional Council or the Ministry of the Interior's southern district office. These actions must be

performed in coordination with the local councils of villages where water sources are located, in every case, until all residents are connected.
- Water allocation needs to take into consideration the fact that the population is largely agricultural.
- Water should be allocated for agriculture at cost and terms that are equal to those offered other farmers in Israel.
- The Bedouin Authority's Water Committee should be cancelled and the responsibility for applications for water should be transferred to those directly responsible for water allocation: the Water Commission and the various government ministries.
- Security personnel (military, police and Green Patrol representatives)must be removed from the Water Committee as they have no bearing whatsoever on the villagers' right to water (pending the committee's cancellation).
- The Ministry of Health must demand representation in the Water Committee, pending its cancellation.

In the long term:
- The state must recognize the unrecognized villages in the Negev and actively pursue a comprehensive solution, with the agreement and cooperation of the residents' elected representatives, the local councils of the villages and the Regional Council for the Unrecognized Villages in the Negev.
- The Ministry of Health must recognize the right to water as an inseparable part of the right to health and initiate actions with the agencies responsible for it by law.
- A short film produced by PHR-Israel accompanies the oral presentation, thus offering a complimentary visual testimony to the discussion.

Water Quality Monitoring and Assessment to 2015. Good Example of One of the Assessments

Author: **Ms. Sabrina Barker**
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Keywords: water, quality, monitoring, targets, Google

This paper presents a snapshot of global water quality issues as they relate to achieving the internationally agreed goals on water, sanitation and biodiversity. Evidence suggests that there have been improvements in the quality of water in some parts of the world. However, there are serious problems that must be addressed for health and prosperity to be reached universally. There are five key points articulated in this discussion: 1. by improving water quality, the Millennium Goals can be met; 2. the quality of inland waters is generally improving; 3. responses to water environment problems are opportunities for development; 4. governments share the responsibility for keeping the global water environment under review; and 5. future needs for water quality monitoring should include links between in situ and space-based data sources.

Access to fresh water and sanitation services is a precondition to all the other internationally agreed goals and targets. By focusing on water quality, the water, sanitation and aquatic biodiversity targets can be met. Data from the Joint Monitoring Programme of WHO/Unicef show that since 1990, investments in public provision of safe water for consumption and sanitation facilities have improved coverage around the world. If current trends continue, then by 2015, global drinking water coverage could be 85% and global sanitation coverage could rise to 63%. However, more effort is required, particularly in Africa and parts of Asia, for the target to be achieved in full.

Well-managed water resources have helped to promote economic development, which in turn contributes to human well-being. Services provided by inland waters are vital for human well-being and poverty alleviation. It has been estimated that for each dollar invested in improving water and sanitation, a return of $3-34 can be expected. The economic benefits of simultaneously meeting the drinking water and sanitation targets on households and the health sector amounts to $84 billion per year, representing reduced health care costs, value of days gained from reduced illness, averted deaths, and time savings from proximity to drinking water and sanitation facilities for productive endeavour.

Improved scientific understanding of the interaction between hydrological, chemical and biological processes within aquatic ecosystems can be used to design and implement ecohydrological solutions to water use, treatment, and extraction. The ability to realize gains from investments are often constrained by lack of data and information on inland water quality. This means that more effort is required to strengthen monitoring and assessment in many parts of the world.

The primary objective of inland water quality monitoring is to provide safe water for human consumption. Depending on the scale of the issue, actions to ensure water sustainability can be effective at global, regional, national or local levels. Baseline monitoring data for aquatic ecosystems is a priority. Long-term monitoring is also required to track the effectiveness of policies and interventions.

At the global level, governments monitor and assess water quality by participating with UNEP's GEMS/Water Programme, and contributing data to GEMStat, the global water quality database. GEMStat provides environmental water quality data and information that is scientifically credible, accessible and interoperable. GEMStat shares surface and ground water quality data sets collected from the GEMS/Water Global Network, including over 2,800 stations, two million records, and over 100 parameters. These data serve to strengthen the scientific basis for global and regional water assessments, indicators and early warning. GEMStat is also geospatially referenced with Google Earth. This technology is a boon to developing and transitional countries, as it is openly accessible.

At the national level, the development of integrated water resource management (IWRM) approaches to regulate over-exploitation of water holds promise for helping to prevent and/or reverse the degradation of water resources in many countries. Although many challenges remain to properly protect aquatic ecosystem health, there is evidence that success can be achieved given sufficient planning, political and institutional will, and financial and technical resources.

Climate variability, biotic invasions and the introduction of new chemicals and microbes to water bodies continuously pose emerging threats to aquatic ecosystem health that must be addressed by regulatory authorities at local, national and global scales. Thus, new approaches and techniques need to be developed and applied to address emerging issues and to provide decision-makers with relevant and accurate assessment data and information.

Current water quality monitoring information and assessment are based on in situ data. An exciting future prospect is that such assessments can benefit from other sources of data, particularly spaced-based observations, in a reliable and operational matter. Linking the two sources of data would be a valuable scientific resource because of potentially extending the scope, scale and replicability of data gathering for assessment purposes, as well as of developing new models and methodologies.

The future of water quality at local, regional, and global scales depends on investments of individuals, communities, and governments at all levels to ensure that water resources are protected and managed in a sustainable manner.

Challenges Facing Achieving the Water and Sanitation MDG in the Occupied Palestinian Territories (OPT)

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Palestinian Hydrology Group (PHG), Palestine

Keywords: Occupied Palestinian Territories, Water Access, Monitoring Program, MDGs, Water Tankers

In a region already suffering severe water stress, the ongoing political, economic and social crisis in the Occupied Palestinian Territories (OPT) has resulted in near catastrophic consequences for the water and sanitation hygiene (WaSH) situation. The effects of Israeli Occupation on water access in the West Bank and Gaza Strip were severe, especially during the past six years of the Intifada (the Arabic term for 'uprising').

Israeli Occupation Forces have systematically destroyed water infrastructure and confiscated Palestinian water sources. Increasing economic deprivation in the OPT has meant that there is a concomitant increase in the number of Palestinians unable to pay their water bills. This has resulted in the Israeli water provider, Mekerot, which controls Palestine's water resources, cutting off supplies to the 30+% of all Palestinian communities connected to networks. A high percentage of families in almost all of these communities cannot afford to pay their water bills, in many cases the percentage of these people has reached 100% or 99% of the households. According to Palestinian Water Authority (PWA), the total quantity of water supplied to Palestinian communities by Mekorot is approximately 32.1 mcm / year, which is equivalent to 53% of the total quantity supplied to Palestinians in the West Bank. Since September 2000, the start of the current Intifada, it was reported that Mekorot has severely limited the water supply to the OPT. About 22% of communities are reported to receive their regular water supply, which in many cases already insufficient to meet basic needs, while 30% reported receipt of 50% or less of their "regular" supply. At least 5% of the communities have reported a complete cut in water supply during some periods.

The other +/-70% of the Palestinian population is forced to rely on harvesting rainwater, cisterns, springs and purchasing water from expensive, privately owned water tankers, the passage of which is vulnerable to closures, curfews and checkpoints. With the economic situation in accelerated decline, many Palestinian households are increasingly unable to buy supplies from tankers. Massive hikes in the cost of water forced many Palestinians to rely on often contaminated alternative water supplies. The current political hardship and closure have complicated the water transport via tankers which is considered a major way of water transport for communities not connected to a water network in the OPT. It often encountered some life risks of the drivers and they were obliged to follow much longer roads to fetch water from any available source. This in turn has caused substantial increase in the water price. The impact of such increase is even more dramatic when combined with the decrease in employment and income. According to the Palestinian Central Bureau of Statistics (PCBS), poor households amount to 58.1% in the OPT. The number of poor Palestinians is more than 2.2 million: approximately 1.27 million in WB and 945,000 in GS. Every working individual supports 6.4 none-employed persons. The average increase of water price at these communities is estimated at 8% of the Median family income. Therefore, many communities are suffering from very limited supply

of water and drop in per capita water use from the average daily per capita domestic water use. It must be borne in mind that limited domestic supplies inevitably adversely affect the collective health and hygiene of communities.

Wastewater collection and treatment in the rural areas is virtually non-existent. Almost 92% of these communities are unable to access a wastewater network, with 40% of urban areas similarly affected. The average household spends 16% of its monthly income on cesspit waste removal and in spite of this, an accumulation of solid waste in communities continues unabated as tankers transporting this waste are turned back at checkpoints. Water quality continues to deteriorate as Israeli settlers discharge untreated wastewater into valleys and open spaces resulting in environmental pollution and the spread of water borne diseases. It is no coincidence that 85% of Palestinians infected by such diseases originate from communities without a wastewater network.

The Joint Water Committee (JWC) which is, in actual effect, controlled by the Israeli Occupation Forces, continues to veto most Palestinian permit requests for water and sanitation projects. No permits are being granted to enable Palestinians to drill new wells. There are currently around 150 water and sanitation projects still pending JWC approval, delayed by 'technical' and 'security' reasons. Donors are deterred from funding the water sector in Palestine as new infrastructure is always under threat of destruction by the Occupation Forces and because applying for a permit to undertake a WaSH project is such a long and drawn-out process.

In adopting the Millennium Development Goals, countries of the world pledged to reduce by half the proportion of people without access to safe drinking water & basic sanitation by the year 2015. The Palestinian Hydrology Group (PHG) has set up the Water, Sanitation and Hygiene (WaSH) Monitoring Program to check the extent to which such goal can be attained in the OPT and to define the main constraints facing its realization. This paper will present major challenges affecting achieving these goals and will shed light on access of water and sanitation difficulties and draw up some conclusions to overcome such situation.

Innovative Water Awareness Model for New Generation to Achieve Millennium Development Goals (MDG) in Egypt

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Keywords: water, awareness, youth, children, Egypt

A rapidly growing population (the largest in the Arab world), limited arable land, and dependence on the Nile all continue to overtax resources and stress society. The government has struggled to ready the economy for the new millennium through economic reform and massive investment in communications and physical infrastructure.

The fields of investment are clothes and food industry, electrical appliances industry, land cultivation, animal production projects, establishing tourist villages, clays, glasses and crystal industries. Natural resources are sands, pebbles, lime stone, gypsum and pebble soil. The most important crops are clover, maize, sesame and wheat. Its fish catch amounts to 81.84% of the total figure for the country.

Agricultural land being lost to urbanization and windblown sands; increasing soil salination below Aswan High Dam; desertification; oil pollution threatening coral reefs, beaches, and marine habitats; other water pollution from agricultural pesticides, raw sewage, and industrial effluents; very limited natural fresh water resources away from the Nile, which is the only perennial water source; rapid growth in population overstraining the Nile and natural resources

These data serve to help the designer to give optimal distribution of water benefits. In addition to income, the survey should include other basic quality of life values including public health and nutrition.

Investigation methodologies are progressively changing from a static, piecemeal approach to one that reflects the dynamism of nature and the environment. Consequently, the trend is away from mere listing of potential impacts towards more complex modes whereby the methodology can identify feedback paths, higher-order impacts than merely those apparent. In short, the methodological trend is approaching an overall management perspective.

Each of the methodologies for the investigation has advantages and disadvantages. Usefulness is largely a matter of choice and judgment of the analyst. Still there are some general objective criteria for selection and these are stated below: such as (a) Simplicity, (b) time and budget constraints, (c) Flexibility, (d) Comprehensiveness, (e) Specificity, (f) Risk, (g) Objective criteria, (h) Depth of analysis, (i) Alternative comparison and (j) Public involvement.
Numerous techniques and methods have been developed for investigating and evaluating and presenting the effects of proposed and ongoing developmental activities.
The educational scientific perspective includes monitoring measures and describe the needed monitoring activity including discussion of applicable parameters, such as field sampling stations, measurements analyses, frequency of measurements/sampling, presentation and collation and interpretation of data, format for preparation of monitoring reports, suggested distribution of the reports, etc.)
Scoping occurs at an early stage of the investigation cycle, typically during general planning feasibility

studies. It is aimed at identifying the key water issues. Scoping is very important since it identifies the water problems at an early stage.

There is an urgent need to get Egyptian youth involved in environmental issues. The creation of a wider and deeper understanding of, and consensus around, water issues presents a valuable opportunity to bridge the gap between education and the real world. Through youth, as "agents of change," support Egypt's role in meeting the Millennium Development Goals and water/sanitation objectives. To be achieved, the MDGs must reflect local realities, engage people and be locally owned.

In the innovative water awareness model, youth do not merely learn about water issues but actually engage in hands-on problem-solving activities that benefit people in the real world. Egyptian Youth and Children were challenged to analyze and reflect upon personal and community behaviors required for water improvements in their daily lives.

The innovative water awareness model has good principal results. It helps to raise the awareness of Egyptian youth and their respective communities on, common water resource issues. Rally youth to collaborate with Egyptian Ministries, local authorities, agricultural groups, schools, NGOs, and special interest groups to adopt best management practices in water. Through youth, as "agents of change," support Egypt's role in meeting the Millennium Development Goals and water/sanitation objectives.

The Paper concludes that the innovative water awareness model can have a capacity building impact on the Egyptian people by influencing the next generation's attitudes and actions about water use. It can do this by teaching them scientific inquiry, showing them appropriate, sustainable water technologies, and helping them develop and recommend sustainable water policy changes. Egyptian Youth and Children can be very powerful "agents of change" via advocacy and democracy by proposing and campaigning practical solutions to water problems. They have to be given due emphasis in water ethics campaigns and its educational programs. This will contribute immensely in preparing new generations capable of affecting change in behavior for more ethical water use. They can accelerate progress toward the MDGs. Innovative water awareness model for Egypt's new generation is the engine for the process of localising MDGs and growth.

Ecological and Economic Aspects of Surface Run-off Management of Agricultural Areas

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Keywords: Agricultural areas, small rivers, surface run-off, management, economic rates

Presentation of Topic

Intensive exploitation of natural resources in the basins of small rivers of Ukraine, particularly melioration works, deforestation at the drainage areas, and ploughing valleys of rivers resulted in sharp degradation of their ecosystems, including water pollution, erosion of land etc.

Practically the whole complex of anthropogenic impacts on natural ecosystems effects on the hydrosphere by one or other way: through precipitations, surface run-off, infiltration into underground water, and other processes connected with the hydrological cycle in nature.

As getting pollutants to small rivers with the surface run-off from the agricultural areas is a result of activities of agricultural enterprises, they must be responsible for getting the pollutants to watercourses. It is supposed that such responsibility can effectively be introduced through economic rates, that is, the system of payments for disorganized disposal of pollutants with the surface run-off.

The paper is aimed at fitting the system approach to surface run-off management for agricultural areas of Ukraine, namely, for small rivers basins.

Discussion of Results/Findings

It is recommended that rates and calculation of amount of payments for pollution of water courses should be implemented on the basis of special permits of the local environmental protection departments. In these rates, it is necessary to take into account not only the presence of stationary or mobile sources of pollution, but also the agricultural land. The latter can be considered as a diffusive source of water pollution, if anti-erosion measures, water protection zones or riverside water protection strips are absent, that is, there are infringements of Water Code of Ukraine, points 80, 87-89. It is shown that the indicative characteristic of surface run-off disposal can be water turbidity (solid run-off) at the river part studied.

The payment for pollution of water courses with the surface run-off from agricultural areas can be calculated using the formula: (CONSULT AUTHOR FOR FORMULA)

where:Kd , coefficient of payment decrease, which takes into account the degree of implementation of anti-erosion and nature conservation measures; Kind, coefficient of payment indexation; H, rate of payment for the disposal of 1 ton of solid pollutant; Ci, water turbidity at the outset of the river

part studied; Ci+1, water turbidity at the end of the river part studied; n, the number of river parts studied; Q, volume of flow water per unit of time; Li, the length of the river part studied; V, water flow velocity.

Conclusions and Recommendations

To ensure the stimulation of introduction of land and water protection technologies in the agricultural sector, it is expediently to implement a complex of organizing and economic measures:

1. To organize the ecological control and inspecting riverside areas for making inventory of eroded and erosion dangerous lands, and for exposure of violation of nature protection laws of Ukraine in small river basins;
2. To create a list of nature users, which activity is connected with the use of land and water resources at the territories of small river basins;
3. To improve the monitoring system in the small river basins by means of an increase in the number of control posts, specifically, at the outfalls of small rivers and at the areas of eroded and erosion dangerous lands, on the main hydrological and hydrochemical characteristics;
4. To make inventory of unsanctioned places for solid wastes deposit located within the boundaries of small rivers basins, with posterior reabilitation and recultivation of them;
5. To introduce the system of standardization of diffusive disposal into water courses (specifically, with the surface run-off from agricultural territories), using the characteristic of turbidity of water (solid run-off);
6. To implement the renewable (soil conservation) system of farming proposed in Ukraine.
7. To create the separate ecological fund, which will be replenished with payments for unsanctioned disposals of pollutants into water courses.

Strengthening the Road to the Millennium Goals: An Approach to the Case of Spanish Cooperation in Latin America

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Keywords: Network, Effectiveness, Spanish water initiatives in LA, Dialogue, public-private projects

This paper presents the Spanish model of development aid in Latin America as an example of the different possible instruments for donors in the road of the Millennium Development Goal, which is "halve, by 2015, the proportion of people without sustainable access to safe drinking water".
Last years Spain has reinforced its commitment in water access in developing countries thought some initiatives in which the Spanish Agency for International Cooperation (AECI) has played a key role.

- Spain leads the Road Map on Water and Sanitation of the Helsinki Process, which establishes specific actions to be done around the World, in this sector. This Road Map will be presented in Tanzania at the end of the year.

- Spain is the host country of the International Exposition "Water and Sustainable Development" to be held in Saragossa 2008. One pavilion will be devoted to Latin America that will allow an area for dialogue and agreement between different LA and EU countries and stakeholders.

- The Master Plan of the Spanish Cooperation 2005-2008 identifies, for the first time, water as a key and differential issue, with the same importance as commerce, health or education, among others and according to the water related MDGs. Spain has prepared a Sector Strategy on Environmental Sustainability that includes a specific strategy on water and sanitation; this strategy is the result of a real dialogue between all Spanish Cooperation Stakeholders.

Just for the case of the Latin American region:

- Two regional Programs are already in progress: one in Andean Countries, with the support of the Andean Community, and another one in Central America, with the support of the Integration System for Central America. Workshops in Central America, in which the main stakeholders in water were, have allowed the identification of different actions that turned into a Water and Sanitation Action Plan. For the Andean Countries, an Integrated Water Resources Management Strategy was established and strategic alliances have been agreed with Multilateral Organisations.

- By the 6th Iberoamerican Forum of Ministers for the Environment, held in Buenos Aires on the 21st and 22nd of September, the Brussels Declaration was assumed. In fact, it was then agreed that the Ministers responsible for water of the three leading countries (Spain, Portugal and Mexico), would submit the Declaration to the European Commission and the European Parliament.

- During the XVI Summit of Latin American Heads of State, held in November in Montevideo a specific "Latin American Fund for Safe Water Supply" was created with a contribution of four million euros of Spain.

- The European Union Water Initiative-Latin American component (EUWI-LA) has been re-launched with new political commitments and more financial support.

- Finally, the AECI and the Ministry of Environment have prepared a training program to suit the needs of Latin American officials that will be presented during the 3rd Global Water meeting in April, coinciding with the 7th Conference of Lain American Water General Directorates.

However, the information between these initiatives, international donors and national institutions is not as good as could be desirable. Same projects are identified time after time by different actors. Money is spent in analyses of the resources and proposes that had been proposed several times, maybe in other part of the world. In the age of the information we have sometimes less communicated than an effective international aid would need.

Some of the Spanish institutions that take part of the Official Development Aid (ODA) (central administration, departments, councils, NGOs, companies…) are managing projects very close, doing the all process of the Logic Framework and spending money in identification, implementations or evaluations that could be make at the same time, which advantages for the home country. It happens, for example, in San Juan River (Nicaragua), in the Regional Strategy for Water Resources (identified by GWP, WWAP, CCAD and the Spanish Environment Ministry) or in the inventory of basins in Central America. These problems are similar in the international context, as the Paris Declaration or the Millennium Project states.

This paper shows some networks experiences in Spain in water and development in Latin America issue, which have been a great progress last year.

- "The Water Alliance" is composed by representatives of five sectors of the Spanish society (Public Administrations, Companies, Centres of Investigation and Opinion, NGOs and Citizenship), looking for synergies between them to contribute in a real way to the extension of the right to the drinkable water and to the basic sanitation of the five million of Central American people. The Water Alliance constitutes as example of initiative type 2 and it will present United Nations for its support and diffusion. These initiatives of public-private association has been stimulated by United Nations from the World Summit on Sustainable Development, and consist of adding forces and of achieving alliances between sectors for the fulfillment of an MDG.

- Araucaria XXI is the program of the Spanish Cooperation for the environmental sustainability in Latin America, funded in 1998. Araucaria XXI tries to stimulate models of development in the region economic, social and environmentally sustainable, that eradicate poverty and assure the well-being of the future generations. Araucaria XXI has constructed a shared vision between North and South designed by the Latin-American institutions (CAN, CCAD, InBio, MERCOSUR, Earth, OTCA…) and for the different actors of the Spanish cooperation (departments, ONGD, Universities, Companies, Ministries…) Although it is a program of the Spanish Cooperation and any actor in development could be part of this, is managed by the AECI. This network works as an information community, carrying out many activities together, which were presented last July in Madrid.

Sustainable Drinking Water and Sanitation Management Strategy for Madimba Eco-village Model, Localizing MDGs Targets

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Keywords: Livelihood, Madimba, Model, Peri-urban Ecology, Sustainability

Localising Millennium Development Goals (MDGs) can make meaningful achievements for the intended targets. The MDGs target number seven; ensure environmental sustainability, (reducing by half the proportion of people without access to safe drinking water and sanitation) as been well interpreted in Madimba. Effective drinking water supply and sanitation (waste management) greatly enhances improved livelihood, restoration of degraded peri-urban ecology (environment) and poverty reduction.

The paper discusses practical experiences of a sustainable drinking water supply and sanitation management strategy for Madimba eco-village model, a pilot project in one of the 33-peri urban communities (Slam) in Lusaka. The project is being implemented through Ecosan principles with the intentions to prevent ground water contamination, land degradation and improved livelihood. The paper points out negative and positive experiences on how integrated peri-urban water supply and sanitation (waste management) are implemented and achieved in Madimba through community participation: considering gender perspectives, cultural, ecological, and political as well as the socio-economic situations of the vulnerable groups of the poor. The project is aimed at enhancing improved livelihood, restoration of degraded peri urban environment and household food security among the peri urban households in Madimba.

The project findings reveal that the term Madimba is a vernacular name meaning farms or Gardens in a waterlogged area. This settlement was initially a farm owned by the missionaries during the 1960s. The population is now estimated at 6,000. 47% of these populations are male and 53% are female. The population occupy an area of about 1.2 Square Kilometres (km2), representing 0.33% of an estimated 360 Square Kilometres (km2), of Lusaka City, with the population of more than 2 million. The number of households is approximately 750 occupying more than 600 housing units. Madimba is actually located at the north-western side of the city of Lusaka about 10km from central business district. This area has a number of challenges in relation to water reticulation and sewer system.

Conclusions and Recommendations

Poor sanitation and inadequate drinking water supply are the major causes of most communicable, infectious, preventable diseases in Sub Saharan Africa, Zambia is not an exceptional.

Therefore, localising Millennium Development Goals (MDGs) can make meaningful achievements for the intended targets especially in the Sub-Saharan Africa. Under standing influencing factors

such gender perspectives, cultural, ecological, and political as well as the socio-economic situations of the target groups can speed up the implementation process of the localized MDGs. Developing localized variable indicators can practically result in true or reality achievements of the Millennium Development Goals at local level.

Localized Millennium Development Goals can partially if not wholly results in reality achievements the MDGs.

Household waste composting provides manure for back yard garden and promotes hygiene practices.

Integrated programmes implemented at community level should consider gender perspectives, cultural as well as the socio-economic situations.

Implicit experience and tacit knowledge, when effectively translated into shared experiences results into effective community participation.

Understanding influencing factors and developing variable indicators at local level can easily reveal the MDGs target achievement.

More Nutrition per Dropping: From Global Food Security to National 'Phosphorus Sovereignty'

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Keywords: phosphorus, food security, ecological sanitation, fertilizer, global analysis

This poster explores the many dimensions of the seldom-discussed phosphorus problem in the context of global food security, and why, unlike water, it is not being taken seriously at the international level. It also suggests that one possible solution – recirculating human excreta to agriculture – can work towards the global goal of food security, national 'phosphorus sovereignty' and the MDG of low-cost sanitation provision at the local level simultaneously.

Presentation of the topic and analysis of the issues

Food security is now a global priority, formalised in 2000 as the eighth Millennium Development Goal: to reduce poverty and hunger by 50% by 2015. Food insecurity is considered a consequence of numerous inextricably linked factors, including frequent illness, poor sanitation, limited access to safe water, lack of purchasing power and various other issues, highlighting the connections between the MDGs on hunger, poverty, water and sanitation.

Water is now understood to be a critical issue for meeting the future nutritional demand of a growing and undernourished global population, and it is predicted that demand will surpass supplies in the coming decades. This is currently the subject of much research and development, towards integrated strategies and policy options, such as the Comprehensive Assessment of Water in Agriculture (IWMI, 2006). However, just as food security faces 'hydroclimatic realities' (p.5 SIWI-IWMI, 2004) of water availability, so too does it face the 'geochemical realities' of limited phosphorus reserves. Yet the emerging phosphorus crisis is largely ignored in today's dominant discourses on food security.

Though seldom discussed, phosphorus supplies will also jeopardize this important goal of global food security. While phosphorus is a critical input to food production in the form of fertilizers, we are set to deplete our existing reserves – phosphate rock – within 50 -100 years. While quantity and quality of existing phosphate rock reserves are decreasing, the cost of this highly geographically concentrated resource is increasing. Furthermore, it we don't radically shift current practice, the advent of peak oil will exacerbate the cost and availability problem as phosphate rock mining relies on oil. The poor will inevitably suffer first from phosphorus scarcity - the same group already suffering from phosphorus-deficient soils (such as West Africa) and the target of Millennium Development Goal on eradicating hunger.

Like oil reserves, phosphate rock reserves exist only in a number of country's control, including China and West Sahara (controlled by Morocco), thus subjecting the remaining scarce reserves to political tensions. However what makes this situation even more pressing is that, unlike oil, there is no substitute for phosphorus in food production. This means it is a matter of necessity to both increase the efficiency of phosphorus use in agriculture, and, explore more readily available, local alternative sources of phosphorus to decouple food production from mined phosphate rock. The substantial potential of

recirculating human excreta (and other biomass fractions) to agriculture for their phosphorus value has yet to be explored on the global scale in a significant way.

Presentation of findings

An approximate analysis based on available data suggests an urgent need to change current practice. If we continue mining phosphate rock at the conservative rate of 2% we are likely to deplete existing reserves in 60 years, threatening the long term MDG of eradicating global hunger. However, if phosphate production follows the same dynamics of resource exploitation as oil, as highlighted by Hubbert in 1949, the rate of phosphorus production must eventually peak (at around 2040 based on industry data), after which production yields will progressively diminish relative to energy and cost input.

However, taking the definition of food security quite literally for the sake of argument, would equate to every person on the planet consuming the recommended daily intake (RDI) of phosphorus (estimated at 1.2 g/p/d average). Despite the current rate of undernourishment in the world, and a growing population, this cumulative RDI demand curve is still significantly lower than the supply curve based on business-as-usual.

While there will always be some food (and hence phosphorus) losses between the supply of phosphorus and actual phosphorus uptake by our bodies, what these scenarios reveal is that the gap between what is currently mined (supply) and what is actually required in the form of food (demand) can be significantly reduced through measures such as using readily available phosphorus stocks from human and animal excreta, more efficient agricultural practices and changing consumption behaviour (such as reducing overeating and meat and dairy consumption). Reusing human excreta, now formally acknowledged by WHO in the form of guidelines on the safe reuse of human excreta, in addition to manure and other biomass fractions can avert the otherwise pending phosphorus crisis.

Conclusions and recommendations

Despite the depletion of reserves of an essential ingredient to food production, phosphorus is not yet considered critical at the national or international policy level. If we hope to achieve the Millennium Development Goal associated with eradicating hunger, the role of phosphorus will at least need to become recognised in the food security debate. The potential of collecting and returning human excreta and other post-harvest food losses to agriculture as fertilizers to contribute to national food security certainly requires further research. Such an approach would simultaneously address the MDG on sanitation (through low-cost sanitation provision); facilitate 'phosphorus sovereignty' by replacing countries' dependence on increasingly costly phosphate imports with more readily available human excreta, in addition to reducing eutrophiciation.

The Relation of Forest Cover to Dry Season Flows in the Upper Basin of the Blue Nile: A Basis for Reconciling Upstream and Downstream Interests

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Keywords: Forest Hydrology, Flow Regime, Land-use Change, Transboundary Waters, Blue Nile

The highlands of northwestern Ethiopia are the source of most of the water in the Nile. It is a tragic irony that subsistence farmers in these highlands are afflicted by seasonal water scarcity. Changes in land use patterns over the last several decades are believed to have contributed to increased wet season flooding, associated soil erosion and dry season water shortages. Forest management is one component of many watershed management plans directed towards increasing dry season flows and checking erosion. These goals are international targets due to the importance of these waters for the Nile Basin as a whole, but require implementation at the national level.

Increasing forested areas in catchments from the very low percentages that now exist is advocated in the belief that more forest area will increase storage of water in the soil and thus moderate flow extremes. Reviews of the recent literature indicate that the direction of forest impact on baseflow, let alone the magnitude, defies simple generalizations. While several pioneering studies have been conducted in Ethiopia's northwestern highlands, there is still limited empirical data upon which to base the assumed positive relationship between forest area and mitigation of stream flow extremes. Therefore, it would be very desirable to better define the effects of forestry on the risk of drought and erosion in the region. This is of importance to both the headwater communities where land use changes are planned, and the downstream communities which also stand to gain or lose depending on actions taken in the headwaters. This paper presents the pilot study for a larger investigation on the relation of stream flow patterns to forest cover since 1960, as observed at stream gauges and in the perception of both upstream and downstream communities.

The complex interactions of land use, climate and seasonal flows makes the quantification of the forest's influence a daunting task. However, data on land use, river flows and climate spanning 4 decades is available for a number of catchments in this part of the country. The valuable combination of long-term data sets is only beginning to be capitalized upon. Hydrology is, of course, just one of the multifaceted roles of forests in catchments, but nonetheless a key one in assessment of the amount (and type) of forests included in watershed planning goals.

In this paper, the changes observed in flow patterns, over the period between 1960 and 2002 were determined in the 250 km2 Koga catchment in the Gojam region of Ethiopia. This catchment forms part of the upper basin of the Blue Nile. These data were compared to changes in land use over the same period (assessed from air photos and satellite imagery), climate records, and the judgment of local residents.

The Koga catchment (11º 10' North latitude) has many features which are typical of the situation in the northwestern highlands of Ethiopia. There is a distinct rainy season (Kiremet, June-September) and a dry period from November to May (Bega). The slopes range from flat and gentle in the lower

parts of the catchment, to steep (30- 50%) on the dissected hillsides higher up in the catchment. The elevation ranges from 1900 to 3200 m.a.s.l., with a mean annual temperature of 18°C, and a mean annual rainfall of just under 1600 mm. The underlying geology is extensive flow type, volcanic rocks of the Ashangi group. The major soil types are chromic cambisol for the upper reaches of the catchment, and haplic alisolfor in the lower parts.

The land use is subsistence farming, with a population density of ca 118/km2. Only small patches of natural forest remain. This together with small plantations of eucalyptus, comprise the few percent of closed canopy forest found on the catchment. One feature that is not typical for the region is that a dam is being built on the lower part of the catchment to support irrigation. Another distinctive feature of the catchment is a considerable area of wetland in the area where the reservoir will be created.

The results indicate that farmers in the catchment uplands believe that dry season flows and forest area have both decreased starting in the mid-1970]s when land tenure changed dramatically. Flow records at the catchment outlet, however, do not corroborate the report of reduced dry season flows. Our hypothesis for this inconsistency in perceptions and observations of baseflow is that the large wetland in the lowland portion of the catchment creates a flow regime at the outlet which differs from that experienced by farmers in the uplands. This possibility is supported by a clear trend of decreasing dry season flows on the adjacent Gilgel Abbay (1,600 km2) and Birr catchments over the period 1960-2002.

The methodology from this study will be applied to other catchments in the region during the coming three years in order to establish a better basis for defining forestry's role in integrated water resource management for the region.

Bangladesh for Drinking Water Millennium Development Goal (MDG): Policy and Program Disconnects

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Keywords: MDG, drinking-water, policy, program, arsenic

Global Water Supply and Sanitation Assessment 2000 Report included Bangladesh among the countries those had more than 90% access to safe drinking water. But the mid-term assessment of MDG recorded Bangladesh among the off-track countries of the world. Here we discuss the policy and program related opportunities and challenges towards meeting the MDG. We have included information from literatures and from projects conducted by us.

The country and its development partners undertook remarkable efforts to change the practice of drinking water from highly biologically contaminated surface water to almost microbiologically safe tube-well. About 95% of the people drink tube-well water. Majority of the tube-wells were privately owned. Arsenic was first detected in groundwater in 1993. The massive arsenic contamination of ground water, the worst in the world, was known before the end of last century. The level of contamination was officially estimated in early 2001 that 35-77 million of the populations (depending on Bangladesh or WHO standard) were at risk of being exposed to drinking arsenic contaminated water. Reportedly, drinking of arsenic contaminated water associated with skin cancers, respiratory, cardiovascular, neurological, reproductive, eye, diabetes, IQ, cancer of internal organs, and other health problems and social problems in Bangladesh and elsewhere. The interest and support of international and national development partners for arsenic mitigation water supply were remarkable during about 1998-2002. Screening of tubewells in most of the country and mass communication about the impacts as well as mitigation water supply were done. "National Policy for Safe Water Supply and Sanitation 1998'' (NPSWSS) and ''National Water Policy" clearly states the main agenda to ensure that all people have access to safe drinking water. The NPSWS&S NPSWSS was supplemented by the National Policy for Arsenic Mitigation 2004 and Implementation Plan (NPAM & IP). It defined contamination levels and mitigation time-frame for emergency, medium and long-term problem areas. Installation of alternative water supply technologies recommended, while arsenic removal water technologies developed. It suggests installation of at least one safe water option for drinking and cooking water for 50 families taking into consideration the available safe hand pumps and new facilities installed in emergency villages within a year. The policies also call for a ''safety net'' for the hard core poor. Research and development of appropriate technologies strongly suggested. Also PRSP clearly endorsed priorities, strategies and timeframe for safe drinking water. It may be mentioned that the national policies, strategies, plans and PRSP were developed based on extensive participation of policy makers, international and national development partners and other stakeholders.

Recent national reports and our findings suggest that arsenic mitigation water supply initiatives have been poor, slow and extremely limited. Almost negligible number of technologies installed and most of the populations in the 80% contaminated villages do not have access to safe drinking and cooking water. Needs and demands of poor people as well as organizations working at grass root levels in arsenic affected areas neglected. Moreover, the promotion of not properly planned and developed alternative

water technologies has significantly increased the risks for exposure to drinking of microbiologically contaminated water. The levels of effective beliefs about the needs for drinking arsenic safe water and/or participation in national programs for safe water among poor people are alarmingly decreasing. Attempts to develop appropriate arsenic removal technologies and/or alternative water technologies have been limited. The national interest has shifted from arsenic mitigation to rural water supply and privatization. Extremely limited research on: the development of appropriate water technologies, water safety and/or health impacts done. The guidelines, prioritization, timeframes and other important directions in national policies, management plan, or PRSP documents on access to safe drinking water have been often not followed by main programs, particularly in servicing the poor.

Overall, serious concerns exist about access to safe drinking water among the arsenic affected population. The country cannot reach the MDG, and more seriously, may experience drinking water related health and social disasters if it does not revisit and revise the programs based on the real situations. Probably the omission of arsenic issues in the Global Assessment 2000 report has contributed to the reduced interest in access to safe drinking water among the millions of affected populations in Bangladesh and other countries. Important strategic and financial analysis and planning for the scarce international resources were done based on the report. We appreciate that the mid-term assessment has alerted the off-track countries. Proper water quality monitoring and its effective considerations for all counties should be considered in the future reports. The national policies, management plans, and other opportunities be effectively recognized and followed by the programs. If needed, the national policies and its related directions may be upgraded through a proper process but not avoided. Programs for providing access to safe drinking should be undertaken based on appropriate and sustainable solutions; not through only low-cost or privatization models. Proper research and development of appropriate and sustainable solutions should be urgently encouraged. It is high time that Bangladesh and other countries faced with similar problems create enabling environment for effective access to safe drinking water based on connected local and international opportunities.

Putting Nigeria on Track and On Target for the Water and Sanitation MDG: Blueprint for Action

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Keywords: Millennium Dev. Goals, Water and sanitation, Water and poverty, water policy, water sector assessment

Introduction

The Bread of Life Development Foundation, a Water policy advocacy NGO in Nigeria, conducted a desk study in December 2006 to access Nigeria's progress towards achieving the MDG in the water and sanitation sector, and come up with advocacy strategies in this regard.

During the Desk study we syntheses the following five research reports on Nigeria's progress towards the MDGs.

(a) "Meeting the Water and Sanitation Millennium Development Goal. May 2005". Prepared for the Department for International Department by Environmental Resources Management.
(b) Meeting the MDG drinking water and sanitation target: the urban and rural challenge of the decade. Produced by the World Health Organization and UNICEF in 2006.
(c) A Project Performance Assessment reports on Nigeria Water Rehabilitation Project (LOAN 3322-UNI), First Multi State Water Supply Project (CREDIT 2372-UNI), and Small Towns Water Supply and Sanitation. Prepared by the Thematic and Global Evaluation Division Independent Evaluation Group (IEG) of the World Bank, and released on. June 13, 2006
(d) Human Development reports 2006. Beyond Scarcity: Power, poverty and the global water crisis Published by the United Nations Development Programme (UNDP)
(e) National Water Sector Assessment published by WaterAID in July 2006.

The 2005 DFID studied the situation in 11 Africa and Asia countries, and its findings state that Nigeria and six other countries (among the 11 studied) were "off track" towards achieving the MDG for the water and sanitation sector. The characteristics of the off track countries are:

External agents, e.g. donors and IFIs, drive water sector activities

NGOs provide services; yet coordination is weak, and programmes are off budget. There is a good diagnosis of water linkages at a central level, though this understanding tends to be weaker at de-centralized levels. Water tends to be a high priority in PRSPs and/or country strategies, though in practice, adequate governance to implement policies is weak.

The UNICEF/WHO Joint Monitoring Programme report 2006 also states that while". At the current pace of development, sub-Saharan Africa will fail to reach the MDG drinking water target". In particular reference to Nigeria, the report says unless current trends are reversed the country like several other African countries may not meet the MDG goals for water and sanitation. Buttressing this position, the report further states that drinking water coverage in Nigeria fell from 49% in 1990 to 48% in 2004, whereas coverage of 65% (by 2004) was required to keep Nigeria on track towards achieving the MDG. Also, though sanitation coverage rose from 39% in 1990 to 44% in 2004, coverage of 58% by 2004 was required to put Nigeria on track.

Similarly, the World Bank Project performance and assessment study produced by the Bank's Independent Evaluation in its June 13, 2006 report states inter alia:
"It is highly unlikely that Nigeria will meet its water supply and sanitation targets under the Millennium Development Goals (MDGs). It has long been thought that the service coverage in urban areas is 50 percent for water supply. Based on a sample of towns and cities included in the three projects it seems that water service is accessible to no more than a quarter of the urban population (in the case of Kaduna state) and often to as few as 10 percent. Thus there is a threat that service coverage seems to be dropping rather than rising as the country approaches the 2015 MDG target year"

The fourth study that confirmed Nigeria's rating as off track is the United Nations Development Programme (UNDP) Human development Index 2006 www.hdr.undp.org which says Nigeria has a 'Low human development water, sanitation and national status', and the UNDP rated it 159th out of the 177 countries studied. Specifically, the UNDP report says the Nigeria's population with sustainable access to improved sanitation is 39% in 1990 and 44% in 2004, while the population with sustainable access to improve water source was 49% in 1990 and48% in 2004. The report further says on current trends Sub-Saharan Africa will reach the water target in 2040 and the sanitation target in 2076.

The WaterAid report sun titled "Nigeria: Where local governments have the statutory responsibility, but cannot access sufficient funds to provide water and sanitation" states that: 'weakness and in some cases absence of appropriate policy instruments is one of the key problems impending the country from meeting the Millennium Development Goals. Weak institutions and persistent implementation failures have also been contributory factors, along with funding issues including in adequate national income and high, inefficient and unsustainable public sector spending'. The report also identified a water sector annual MDG spending gap of $61.4m

Recommendations

1. A comprehensive water assessment audit should be carried out by the Federal Government, which shows the state of water and sanitation infrastructure in Nigeria, state of access, the linkages between water and poverty, and the investment that needs to be made to meet the MDGs.
2. States and local governments should develop policies for development of the water and sanitation sector, as a step down of the National Policy on water and sanitation.
3. Increased sector coordination.
4. Increase revenue for local governments that are statutorily empowered to provide water services in the rural areas.
5. Increase emphasis on the implementation of demand driven, and community managed water and sanitation projects.
6. Increased coordination and networking by non state actors working in the water and sanitation sector.
7. Tracking and monitoring of Government expenditures in the water and sanitation sector, as the money does not presently reach the people.
8. Establishment of Monitoring and evaluation instrument for water and sanitation programmes in Nigeria.

Millennium Development Goals - Problem of Turning Commitment into Reality

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Keywords: Millennium Development Goals, water supply and sanitation, assessment, sector funding, Ukraine

Introduction

Ukraine is a party to United Nations Millennium Declaration. Achievement of MDGs will facilitate access to safe drinking water supply and sanitation and will secure good state of environmental public health, reduction of poverty and sustainable economic development. These goals are relevant even for Europe where 10% of people still do not have access to improved sanitation and about 5% still lack access to a safe drinking-water supply. Formally, Ukraine made a progress towards achieving Millennium Development Goals and is "on-track".

Problem

MDGs implementation and assessment of their efficiency show that there are some very serious problems. Monitoring of achievement of these goals shows that there is a failure to provide a true picture of the water supply and sanitation sector performance. One of the reasons is a problem of data interpretation and methodological issues accompanying MDGs monitoring. Lack of data leads to unreliable projections. To be credible, all such goals should be able to be effectively monitored. For this purpose the Joint Monitoring Programme (JMP) was established in the framework of the UN system. Unfortunately, the progress indicators applied by it for water supply and sanitation often give a distorted picture of the situation because they mainly are focused on whether people who previously did not have access to a water supply have acquired it. The latest (2004) JMP assessment indicates that in Ukraine access figure is estimated at 96% both for water supply and sanitation meaning that the country is " on track" to achieve MDG target of 98% in 2015. But this assessment results are unfortunately misleading. The reason is that indicators officially used to monitor MDG Target 10 progress are technology-based and do not cover such problems as quality, reliability, and sustainability of water supply and sanitation. For example, under the JMP monitoring system, any household connected to a centralized water supply system, even though it currently provides polluted water will be counted as having "sustainable access to safe drinking water". The baseline against which progress can be measured was selected to be the year 1990 when water and sanitation infrastructure was still fully functioning and services were provided at reasonably high level. In contradiction to JMP findings, data from other sources (e.g. World Bank) suggest that the water supply and sanitation sector in Ukraine is actually in acute crisis. Approach used by JMP ignores the question of whether existing water infrastructure is good enough to meet modern requirements. Ukraine has extensive water and sanitation infrastructure, which in theory provides safe drinking water and sanitation services. But about 20 to 50 per cent of infrastructure assets are physically worn-out and as a result the proportion of population having real access to improved drinking water sources or sanitation has actually decreased. Water quality does not meet basic chemical and microbiological standards at most water utilities, constituting a real health threat in the form, not only of contaminated drinking water, but also of a vector of diseases such as trachoma, cholera, typhoid, and hepatitis. Waterborne diseases are often

caused by infiltration of sewage water into idle water supply systems. Polluted water has become one of the most important environmental and public health problems. In this context, reaching MDG for water and sanitation appears to be even more of a challenge for this country. It calls for reassessment of projected costs of MDG compliance and ability of the country to actually achieve MDGs. They should be made less ambitious but practically achievable. The costs of achievement of the MDGs for water supply and sanitation in Ukraine by the year 2015 when 98% of population will have access to safe water and sanitation were estimated by WB and OECD.

- WB estimates - total of 2 955 US$, including 2179 for water services and 776 for sanitation services)
- OECD estimates – total of 1 273 Euro, including 871 million for water services and 402 million for sanitation services

The above figures differ considerably. The difference is probably due to variations in costs estimation approaches. Estimation of costs is made complicated because of population changes. For example, size of population has dramatically changed in Ukraine in the recent decade. In 1992 total population was 52.24 million but in 2007 it is only 46.60 million and still is falling down.

Funding sources

In case of Ukraine international funding covers only a small fraction of the WSS financing needs. It makes up only € 0.36 per capita per year. In real terms, bilateral commitments were in 2002 at their lowest level since 1985. In Ukraine public financing is scarce, user charges cannot be significantly increased due to affordability constraints, and domestic capital markets can not provide the needed long-term funding. The international private sector is no longer willing to invest in WSS infrastructure in CIS.

Conclusions:

- Assessment of access to safe water and sanitation, and sustainability of the safe supply, requires new indicators on quality and sustainability of water sources.
- Funding agencies should not base their fund allocation strategies in Ukrainian WSS sector on official MDG progress reports.
- Water and sanitation infrastructure investment will have to come from the public sector of the country, particularly for capital costs.

Mapping of Rainwater Harvesting Potentials for Africa, ten selected countries and cities: A geo-spatial decision support tool for policy makers

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Keywords: Rainwater harvesting, Millennium Development Goals, Economic water scarcity, GIS Mapping, Decision Support tool

The bias in planning, based on blue- at the expense of green water, has often depicted Africa as a physically water scarce continent – with projections for 2025 placing a gloomy picture for most countries. On the contrary, scrutiny of the continents climatological base maps reveals that Africa actually has more water resources per capita than Europe. The problem is therefore economic water scarcity – implying lack of capital investments to adequately access, conserve and utilize rainwater. Rainwater harvesting (RWH) can contribute in the attainment of wider aspirations, including the Millennium Development Goals (MDGs) as they relate to fighting poverty and hunger, delivering environmental sustainability and gender equality.

This paper provides spatial evidence of the huge potential for RWH in Africa, through thematic data and maps developed using Geo-referenced Information Systems (GIS). The need for this database was identified following the realization that despite the existence of numerous databases on Africa covering agriculture and water management, the potential for RWH has not been depicted at continental scales to provide a geo-spatial information tool that can be used for advocacy and decision support.

Thematic GIS databases were created from a criterion of baseline and hydro-physical factors associated with RWH such as rainfall, topography, soils, human settlements and land use. This was followed by development of composite maps through GIS overlays using filters created from stratified factors such as agro-climatic zones, soils, population densities, settlement and hydrological data. The resulting thematic data formed mapping criteria viz 'development domains' used as indicators for suitability of targeted RWH technologies. These were grouped as (i) rooftop RWH (ii) surface runoff with storage in ponds/pans (iii) flood-flow harvesting from water courses with storages in sand/sub-surface dams and (iv) in-situ soil water storage systems or green water. A total of 73 thematic maps were developed, of which 29 were continental-coverage while 44 were country specific thematic maps for ten selected countries i.e.: Botswana, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe as case studies. In addition, an in-depth spatial analysis of RWH potentials for Nairobi, Lusaka, Kampala and Addis Ababa was carried out.

As an example, country results show that Kenya, with a population of 34 million people, actually has enough rainfall to supply the needs of six to seven times its current population while Ethiopia, where just over a fifth of the 60 million people are supplied with domestic water with an estimated 46% suffering hunger, has a rainwater harvesting potential equivalent to the population needs of over 520 million inhabitants. The results were even more refined at localized scale of 25km2 in 10 selected cities i.e. Addis Ababa, Dar-es-Salaam, Gaborone, Harare, Kampala, Kigali, Lilongwe, Lusaka, Maputo

and Nairobi. Results of spatial data extracted from a high resolution quick bird image in the 25 km2 area shows that Lusaka has an annual RWH potential of 8, 3 million cubic metres with buildings contributing 3.5 million, roads 1 million and open grounds 3.8 million.

The geo-spatial potential of these maps as decision support tools are coming at a time when there is increased awareness on RWH. Already, the Kenyan Minister of Water and Irrigation has made policy pronouncements which will make it mandatory for RWH systems to be incorporated in architectural designs of all new houses. Similarly, the ministries of Agriculture for Kenya and Rwanda are providing budgetary support to invest in RWH. The RWH potential maps will thus be crucial in guiding the governments to prioritize on the right technologies at the right places. Through the Rainwater Partnership, UNEP and ICRAF are urging governments to invest widely on RWH technologies that can contribute in the transformation of landscapes and livelihoods across Africa.

Improving Project Sustainability through the Use of Life Cycle Thinking Tools

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Keywords: life cycle thinking, sustainability, water, sanitation, development projects

The challenge of the United Nations Millennium Development Goals is not only to achieve statistical improvements on paper, but to insure that they lead to lasting positive change in the field. Historically, international water and sanitation projects have had low sustainability rates. Of the water supply and sanitation projects evaluated by the World Bank in 2001, only 50-66% were deemed to be satisfactory and less than half were rated likely to be sustainable (World Bank, 2003). Overcoming these statistics means balancing the pressure for construction with careful attention to selecting appropriate technology and planning for long-term use. National implementation of water and sanitation projects needs to be supported by capacity building and planning for the operation and maintenance of the systems.

Successful implementation of international water and sanitation projects involves the management of many complex relationships. The success of the technology will depend on economic and environmental constraints, but the affects of the cultural and political climate can often have a greater impact on the outcome of the intervention. Project planners must learn to make appropriate adjustments for local economic, cultural and political conditions throughout the life of the project. Better management of the numerous risk-factors and greater focus on planning for the entire life of the project are perhaps the greatest steps that governments, donors and other development workers can take towards strengthening their contribution to meeting the United Nations Millennium Goals. Yet, these are also the most difficult steps to put into practice.

The research presented in this poster is based on information accepted for publication in Environmental Engineering Science (McConville and Mihelcic, 2007). It provides a systematic and practical approach to managing complex risk factors and planning for the sustainable use of technology. The poster illustrates how the concepts of sustainability and life cycle thinking can be used to build an inclusive framework for learning from and managing the multiple risk-factors in water and sanitation development projects. The sustainability movement recognizes the interdependence of economic, environmental, and social factors in achieving development that will benefit both current and future generations (United Nations, 2002). Life cycle tools are commonly used in industry for assessing the environmental aspect of sustainability over the entire life of a product or process. By integrating the other sustainability factors into life cycle assessments a logical framework is created for identifying and analyzing the factors that affect sustainable development of water and sanitation projects.

Recognizing the diversity of social issues that affect development projects, this methodology identifies five sustainability factors that are common in development literature and the policies of international aid organizations: 1) socio-cultural respect, 2) community participation, 3) political cohesion, 4) economic sustainability, and 5) environmental sustainability. The life cycle of a development project can be represented by five stages: 1) needs assessment, 2) conceptual designs and feasibility, 3) design and action planning, 4) implementation, and 5) operation and maintenance. Using the defined sustain-

ability factors and life cycle stages, an assessment matrix is developed. A series of guidelines, derived from best practice approaches to effective international development and practical experience of the author while working in Mali, are used to develop a quantitative method for scoring the sustainability of a project. The poster illustrates the structure of the matrix and how it can provide a rapid appraisal of strengths and weaknesses in a project approach. Full details of the scoring mechanism, guidelines, and case studies are available on the web and in press (McConville, 2006; McConville and Mihelcic, 2007).

The life cycle framework laid out in this research is meant to provide a practical tool for managing the complex relations needed for successful intervention. The framework can act as guidelines for project planning and implementation. It can also be applied as a learning tool for highlighting project strengths and weaknesses during evaluation. By learning to recognize and mitigate the multi-faceted factors that affect project sustainability governments, donors and development workers can strengthen their contribution towards meeting the Millennium Development Goals.

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Helping to Meet the Millennium Development Goal by Bringing Household Water Treatment to Scale: Designing for Sustainability

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Keywords: Waterborne Disease Prevention, Millennium Development Goals, Household Water Treatment, Chlorination, Kenya, Indonesia, Zambia

Millennium Development Goal 7, Target 10 calls for reducing by half the proportion of people without access to safe drinking water by 2015. Progress towards this target is measured by the proportion of households reporting the use of improved water supplies, such as piped household connections or protected wells. Many studies, including a recent survey by the WHO/UNICEF Joint Monitoring Programme suggest that depending on local conditions a significant proportion of water from these sources may be contaminated, or may become contaminated during collection, transport, and household storage and handling. Household-level interventions that improve and protect the microbiologic quality of water from both improved and unimproved sources can significantly contribute to meeting the Millennium Development Goal and preventing waterborne disease and death.

Household water treatment with dilute hypochlorite solution greatly reduces diarrheal disease incidence in developing countries. Chlorination of drinking water inactivates bacteria and some viral and protozoal pathogens that transmit disease. Although it does not reduce turbidity, chlorination of unfiltered surface water sources improves microbiologic quality and provides a residual barrier to recontamination during transport, storage and handling in the household. Point-of-use chlorination reduces the diarrheal disease burden without exceeding WHO standards for disinfection by-products.

After establishing the effectiveness of household chlorination and safe water storage, the Centers for Disease Control and Prevention (CDC) began working with partners to bring the "Safe Water System" to as many users as possible. CDC and the social marketing NGO, Population Services International (PSI) launched a branded, bottled, hypochlorite solution in Zambia in 1998. Sales steadily increased to nearly 200,000 bottles per month – providing water treatment for over 1 million residents, an estimated 10% of the Zambian population. PSI and CDC have since developed 22 country platforms, nearly all in Africa, selling branded hypochlorite solution. The most popular brands include "WaterGuard" in Anglophone, "Certeza" in Lusophone, and "Sûr'Eau" in Francophone countries. In 2006, PSI sold approximately 12 million bottles of hypochlorite, providing safe drinking water to an estimated 9 million people.

All brands are locally produced, bottled, marketed, and distributed, generating much-needed employment and revenue for the local private sector. The bottles are blow-molded by local plastics manufacturers, and the solution is produced and bottled by local chemical, beverage, or pharmaceutical companies. Local production yields an affordable product needed for long-term sustainability.

The Kenya experience is enlightening. Nairobi has a thriving industrial area, well-equipped to produce hypochlorite solution at low cost. Initially, CARE and PSI launched a 500 mL bottle of chlorine

solution which sold well in cities, but was too costly for rural users. To lower distribution costs and reach rural populations with a more affordable product, the initial product was modified to a higher-concentration solution in a 150 mL bottle. Rural sales increased, while independently, four Nairobi companies launched competing products to meet urban demand for the 500 mL hypochlorite solution product. Thus, PSI and CDC successfully created a sustainable market in Kenya for household drinking water treatment products that is profitable for numerous companies.

In Indonesia, a Safe Water System Program was launched in 2006 directly by the private sector, with support from USAID, CDC, Johns Hopkins University, and CARE, but without a social marketing partner. Over 1 million bottles of Air RahMat water treatment solution have been sold in the first year of the program.

These successes highlight the importance of designing for sustainability when considering household water treatment and storage technologies. Optimizing production, marketing, and distribution through private and public sector partnerships is critical to ensure that affordable, sustainable products will reach consumers and reduce their risk of waterborne disease.

Poverty, Policy and Pastoralism: Uganda's efforts to provide rural water in line with Poverty Reduction Strategies

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Keywords: rural water supply, poverty, policy, Uganda, pastoralism

If the MDGs are to be met, water policy and poverty policy need to interact at national and local levels. In the Ugandan Government's Poverty Eradication Action Plan (PEAP), increasing water provision is recognized as a key factor in poverty reduction and featured under the pillar of human development. This plan is the government's response to Poverty Strategy Reduction Papers implemented as part of the criteria under the Highly Indebted Poor Country debt-relief programme.

The PEAP has four principal goals, which are to provide a framework for economic growth, ensure good governance and security, increase the ability among the poor to raise their incomes, and improve their quality of life. Providing access to water for domestic and productive uses under human development links together poverty reduction, environmental conditions and access to a vital resource, all understood in the context of people's changing livelihoods.

Action outputs for the PEAP include providing thousands of new water systems, institutionalizing sector performance assessment by improving data collection and management at local government level and implementing operation and maintenance support to improve functionality of sources. However, reviews of the PEAP and poverty policies concerning the water sector show that current policies are not sufficient.

The 2004 concept paper of the Ministry of Water, Lands and Environment (MWLE) and the Directorate of Water Development (DWD) analyzed the pro-poor approach of current policy and practice in the water sector to determine whether the poor are targeted as a specific group, what strategies are likely to reduce poverty, which approaches could negatively affect the poor and whether there is evidence that the poor have been explicitly consulted while drawing up the policies. The paper found that recognition of the poor as a specific target group is weak and as a result there are few pro-poor policy measures. In a study done by the World Bank, the poor in Uganda also voiced frustration at their lack of influence on government policies, corruption and mistrust of state institutions.

DWD, which is responsible for rural and small town water supply, currently focuses its efforts on Rural Growth Centres, defined as rural settlements larger than 500 households. According to the 2002 Census, almost 90% of the people live in rural areas many of which live in small communities below the threshold for Rural Growth Centres and therefore are not a focus of DWD activities.

From May until December of 2006, research was conducted in three villages of formerly nomadic pastoralists who were settling in Kiruhura District in South-western Uganda to examine how the

government's poverty policy with respect to water has impacted the rural poor by obtaining information on their access to water, settlement and their concept of wealth and poverty, under immense livelihood change. These villages all fall below the threshold to be considered rural growth centres and were selected based on population livelihoods (percentages of pastoralists) since water is important for both domestic and livestock use and relative level of poverty based on sub-county assessments.

Central government sets policy and framework for allocation of funds while the Local Councils are legally mandated to initiate projects to address local needs. This decentralization is to promote responsible use of resources by establishing a clear link between provision of services and payment of taxes and to improve capacity of local mechanisms for the delivery of services. However, capacity of local communities to organize and finance operation and maintenance of individual water supply schemes is still poor.

Even as Sub-County plans in the study area reflect government policies in some instances such as "collected revenue will be allocated to PPA [Programme Priority Areas] and also to be accessed by the disadvantaged and the poor," funding shortfalls have made this difficult or impossible to implement. At times the documents reflect hopes more than realizable plans, such as "To ensure access to safe water sources for all people in the Parishes by June 2006." Suspension of the graduated tax and deficits in anticipated funding has sapped the incentive of local governments to developing water sources.

Settlement and land allocation have impeded access to traditional sources and there are those without resources of land or finances to develop water sources. None of the villages expressed having adequate water and many still migrate seasonally due to water shortages. Existing indicators that look at populations served per water source are not adequate, as they do not account for true population per water source, the actual functionality of the water source, and the importance of surface water in supplementing safe water sources for domestic use.

Insufficient funding of water supply activities and understanding of livelihood issues are key factors hampering development of water in small rural communities and meeting the goals of the PEAP. Interaction of land and water development affects the landless poor. Tax reductions exacerbate inadequate funding to meet water development needs and access to funds is now via higher levels of the political hierarchy. The necessarily dispersed farming villages lose priority as not meeting the definition of Rural Growth Centres, in spite of representing a large portion of the rural population. Inadequate district staffing hampers efforts to properly assess the water supply situation and needs of the villages.

If the PEAP is to achieve its goals in the water sector a greater and flexible focus on rural areas where the majority of the population and of the poor live, needs to be established. There also needs to be a greater understanding of livelihood water demands in planning water sources and more adequate funding to meet community needs.

Monitoring of sanitation Millennium Development Goals and Necessary Criteria Improvements

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Keywords: Joint Monitoring Programme, MDG, sustainability criteria, improved/unimproved sanitation, system performance

The global sanitation crisis has been recognised by the international community with the setting of a concrete target in the Millennium Development Goals (MDGs) to halve the number of people without access to adequate sanitation by 2015.

In order to monitor the MDGs the Joint Monitoring Programme for water supply and sanitation (JMP) has been implemented, managed by the WHO and UNICEF, in order to inform about the current state of development. The present data on sanitation gives a general overview of how many household in different areas are connected to water supply and sanitation systems. But there is still no information about performance and little about quality of the sanitation coverage. The sanitation coverage data often seem to be too positive, as performance of systems is not included. E.g. the inadequate performance of flush toilets in cases of low performance of water supply systems or frequent failure of wastewater treatment plants is neglected. Unofficial figures of the World Bank say e.g., that 3 out of 4 wastewater treatment plants in Developing Countries do not work properly or even not at all. Additionally the data does not inform about the reuse/final disposal, health and environmental impact, costs and sustainability. The present JMP data can state e.g. that a certain country has 90 % urban sanitation coverage but contains no information about the lack of containment and treatment. The impact is that often downstream communities and the environment are exposed to pollution and pathogens. The list of criteria for the assessment of improved or unimproved sanitation has to be extended to take sustainability aspects into account.

For the data collection a definition on improved sanitation had to be made. Hence an initial list of improved and unimproved sanitation facilities was elaborated. This list however was heavily criticised as on the one hand the list of facilities was not comprising all relevant sanitation options and on the other hand it concentrated too much on counting toilets only, without taking into account the necessary treatment of the effluents for avoiding downstream pollution and public health risks. As a result of this discussion, the list of improved/unimproved sanitation was finally reviewed in the last Joint Monitoring Report of 2006 and composting toilets were added to list of improved sanitation and flush toilets with no sewer connection were moved to the list of unimproved sanitation.

The following table contains the current JMP list of improved/unimproved sanitation facilities:

Improved sanitation facilities:
- Flush or pour – flush to:
    - piped sewer system

    - septic tank
    - pit latrine
- Ventilated improved pit latrine
- Pit latrine with slab
- Composting toilet

Unimproved sanitation facilities:
- Flush or pour–flush to elsewhere
- Pit latrine without slab or open pit
- Bucket
- Hanging toilet or hanging latrine
- No facilities or bush or field

In spite of this considerable improvement of the classification, there are further improvements required. Systems which use flush toilets that deliver excreta to a piped sewer connection should not be considered as improved sanitation, if the generated waste water is not at all treated and contributes on a high level to downstream environmental pollution and health risks. Pit toilets or VIP toilets should as well not be included in the list of improved sanitation as they contribute to groundwater pollution with nitrates, organics and pathogens. Recent studies also have shown that these systems have an additional effect on the acidification of soil which even may result in the dissolving of heavy metals contaminating the ground water.
On the other hand WHO has produced guidelines for reuse oriented and hygienic safe sanitation systems, which also should be included into the list of "improved sanitation". These comprise e.g. on-site ecosan systems such as urine diversion dehydration toilets and toilets connected to a biogas system.

Taking into account the proposed new parameters, the background of counting methods is completely changed and probably not only 2.6 billion people lack improved sanitation at current state, but many more.

Evaluation of Socio-Economic Consequences from Changing Water Availability in the Jordan Valley - an Example of Shared Cross-Border water resources

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Keywords: socio-economics, shared water resources, Jordan Valley, model-based prognoses, climate change

Presentation of the topic

The area of the Jordan River is one of the potential hot spots of expected Climate Change in the Mediterranean and at the same time a region of sensitive relations between the riparian states. Anticipated Climate Change comprises increasing temperatures and varying amounts and timing of precipitations. Any promising policy and political decision for coping with those changes will have to focus on the interest of the people in the concerned areas since the use of resources depend highly on the individual decisions of the end users. A simultaneous governmental objective is, however, the efficient use of the national resources within the framework of all sectors of its economy and all layers of its society. Cross-border sharing of natural resources adds the challenge of an interlinked regional development. Decisions on a sustainable, cross-border management requires therefore the mutual understanding of consequences from changes in resource availability.

Socio-economic impacts from changes in water resources vary significantly under the different frame conditions of the three riparian countries of the lower Jordan Valley. A working group of Palestinian, Israeli, Jordanian and German socio-economists develops models on both perspectives, i.e. the end users and the national point of view, under the umbrella of the GLOWA Jordan River Project, funded by the German Federal Ministry for Education and Research (BMBF). The objective is twofold: (a) to identify the leeway for national and cross-border policies towards a sustainable, efficient use of water and (b) to forecast impacts from Climate Change on the scope for policies and political decision making on water. Climate Change and related water availability set the frame for optimal resource use from the point of view of local individuals as well as for the optimal use from the national perspective. The gap between the both optimal solutions represents the room for manoeuvre by national policies.

Results and findings

A preliminary analysis of the situation showed that primary socio-economic impacts from expected changes in climate and waters from the Jordan River watershed will most likely arise via their consequences on agricultural production as the sector with the significantly highest share in water consumption. Other impacts, for example changes in natural vegetation, landscape and other sectors of the economy, are also expectable but will be – at the current state of knowledge – of far lower socio-economic importance. The results of the analyses allowed the establishment of models that focus on impacts on net revenues in the agricultural sector and the living standard of farming families. The results provide the basis for advanced evaluations of secondary impacts in the socio-economic watershed, such as impacts on migration, markets and infrastructure.

Key results from current model-based scenario analyses from the production perspective indicate that agriculture in Israel will have to cope predominantly with a shift of optimal locations for the cultivation of specific crops, which can be traced back to the supplementary nature of irrigation in most areas. This differs significantly from the major impacts on Jordanian and Palestinian agriculture, where changes in water availability translate directly into decreasing total revenues from agriculture due to the strong dependency on fully irrigated agriculture. Results from scenario analyses by means of farm and farming systems models show that, in average, farming enterprises in Israel would even profit from the rise in temperatures over the next 20 years, provided that water quotas for supplementary irrigation stay available. Farming systems in the Palestinian West Bank, which have in their majority a significantly higher relationship between household, farming and off-farm activities than Israeli farming systems, could cover for reduced revenues from agriculture due to lower water supply only by alternative off-farm incomes. Jordanian farming systems in Jordan Valley are very heterogeneous and show a variety of reactions to shrinking supplies in water for irrigation. Under the assumption of a reduction in water supply in the range of 15% or more, about 22% of these farming systems would come close to the brink of their existence, 47% would suffer from significant, but not threatening, losses in family income and the remaining one third would be able to compensate potential losses in agriculture by alternative use of their family resources.

Conclusions and recommendations

The results emphasize that water quantities and water productivity alone are insufficient scales for the evaluation of social and economic consequences from sharing joint water resources between riparian states. It stands to reason that those socio-economic impacts find their repercussions via the resulting land use and demographic density also on the level of environmental sustainability. Water is an element in the frame conditions under which people in concerned regions earn their income and the interaction with other elements in their individual systems decides on their capacity to compensate for changes in the water situation. These individual systems may be quite heterogeneous already within national borders as shown for example in the case of Jordan. The joint research of socio-economists from the three countries of the lower Jordan River shows that comparable results from quantitative modelling approaches may be obtained even if the initial situation of the involved areas and countries is significantly different from each other.

Workshop 2: Progress in Environmental Public Health

Arsenic Removal from Potable Water Using Ultrafiltration Membrane

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Keywords: Arsenic Removal, Ultrafiltration Membrane, Rejection Coefficient, Atomic Absorption Spectroscopy, pH and Cross flow Velocity

Arsenic, a potent carcinogen found in potable water in arsenic polluted areas is the twentieth most abundant element in the earth's crust and fourteenth in the seawater. The predominant forms of inorganic arsenic in aqueous environment are arsenite [As(III)] and arsenate [As(V)]. Arsenite [As(III)] is more toxic than arsenate [As(V)] and in environment the presence of trivalent arsenic is higher than the pentavalent due to their thermodynamic stability. Arsenic ingestion by drinking water and food washed with the contaminated water causes malignant cancers to the different organs like kidney, liver and lung, vascular disease, and non-malignant skin alterations. Arsenic concentration up to 3.4 ppm (parts per million) has been reported in some regions of the developing countries where as World Health Organization (WHO) has announced the permissible limit of arsenic in drinking water is 10 ppb (parts per billion). Removal processes are needed to bring down its concentrations in the potable water within the allowable limit. Different separation technologies are being used to remove arsenic from potable water like adsorption, electrodialysis and nanofiltration, reverse osmosis and ultrafiltration membrane technologies. The main objective of this research is to develop a process for effective and selective removal of arsenic. Membrane separation technology is a novel and highly innovative process engineering operation which can be applied for arsenic removal using novel ultrafiltration membranes which is more effective at low pressure operation than the other membrane techniques. Our Lab has demonstrated the removal of arsenic from potable water using ultrafiltration membranes with plate and frame module. Ultrafiltration membranes were subjected to arsenic concentration in the feed ranging from 1000 ppm to 50 ppb with different coupons to test its efficacy. The effects of physical and engineering parameters (pressure, temperature and cross flow velocity) as well as chemical parameter (pH) on the rejections of arsenic were studied as a function of time. The experiments were carried out by total recycle of retentate in a concentration mode and continuous flow mode in which permeates were collected separately and analyzed for arsenic content at different pressures, generally 0.25-2 bar. The samples were analyzed by Atomic Absorption Spectroscopy (AAS) as well as Colorimetric Method. The result of arsenic rejection for 1000 ppm concentration of pentavalent arsenic varies from as low as 40% to as high as 65%. Proportional variation of rejection coefficient with cross flow velocity was also observed which correlates well with the concept of concentration polarization where high cross flow velocity minimizes concentration polarization thus improving the membrane rejection property. Sample having concentration of 50 ppm pentavalent arsenic had shown the rejection of more than 95% at pH 7.0 and above at room temperature. The rejection coefficient of arsenic was as low as 35% at pH 4. At low temperatures ranging from 40C to 200C the operation decreased the rejection coefficient of arsenic in the range of 80-85%. For low concentration of arsenic in the feed

(i.e. ≤ 50ppm), the rejection coefficient was not dependent on cross flow velocity or transmembrane pressure. Feed having 1000 ppb concentration, the rejection coefficient of arsenic varied from less than 20% at pH 2.5 to as high as 95% and above for pH greater than 7.5. Observation shows that the arsenic rejection was very sensitive to pH. Similar experiments were carried out at 500 ppb and 325 ppb resulted more than 95% rejection of arsenic at pH higher than 7.5. The experiment with 50 ppb showed that arsenic rejection was close to 100% and remains constant up to 7 hours. Results showed that the membrane was not showing any fouling and would work for longer periods of time and give almost 100% rejections for ppb level concentration of arsenic in the feed. Cost efficacy is the major highlight of this research which can be employed in rural areas.

Interaction between Environmental and Human Health in North Jordan Valley

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Keywords: Household, Water Security, Sanitation, Diahrrea, Socio-economics

Human health is the utmost goal for environmental protection. The health status of human beings reflects the health of the environment or the ecosystem in which they live. As such, it is not only the physical environment but also the socioeconomic status that impact environmental health as well as human health. This paper presents data on the linkages between environmental and human health. Diarrhea disease is considered as it, in many cases, relates to environmental pollution such as poor sanitation and lack of clean drinking water. The study area is a 6000-capita village consortium in North Jordan Valley called Shaik Hussain.

The area was studied through four surveys: (1) a household survey to uncover socio-economic, demographic and health status, (2) an environmental surveillance of household water security and sanitation status, (3) a physiological stool and blood analysis survey, and (4) anthropometric survey of pre-school children's nutritional status.

Representative samples were determined through the national Department of Statistics (DOS) and SPSS was used to analyze collected data from surveys as well as laboratory test results. Various PRA (Participatory Rapid Appraisal) tools were also used to study the knowledge, attitudes and practices (KAP) of the local community towards health and environment.

The household survey has revealed that that 94.6 % of households in this sample are headed by males, compared to 90.4 % in rural Jordan, and that the community is characterized with a young family structure, median age of the house heads (42years) and the wives (35years).

The educational level of household heads is low. Illiteracy corresponds to >13%, while high school is the highest education level for 77% of the study population, and only 9.6% of the population have some college or university degree. The family size in this sample (7 members per household) is considered high compared to Jordan (6.2 members per household for rural, and 5.5 for urban), especially when knowing that the family type in this area is mostly simple or not extended (> 90% of households). This contributes to lower social status of this population, particularly involving high household crowding index (CI =2.3, ideally =1).

The average family income (JD178.0 = $252.0 per month) point out the social status of the residents in this area. Less than 12% work in farming, while the majority of more than 70% of the sample works as government employee. This area is a major agricultural source in Jordan, yet the residents are not interested in farming. Only 86.9 % of the sample owns any kind of residence; the insect and fly problem present in the majority of the households, and most of them have no window or door nets installed in their residences.

The women in this sample are mostly unemployed (92.5% housekeepers), and only 2.1% of sample women work in farming, compared to 6.7% of Jordanian women. Only 33.7% of women in the study sample have secondary or higher education.

It was found out that the community lacks any adequate sanitation services and that although most houses are connected to water distribution system, no collection or safe disposal of wastewater exists. Intermittent supply of piped water necessitates the storage of drinking water within the households and therefore jeopardizing household water security especially with the lower level of awareness and extremely low level of women education. Most of the houses have running water only once a week and for several hours only, this leads to some risky practices such as using the irrigation canal water for dish washing and using spring water for domestic purposes. Water quality testing of all 3 springs in the area has shown this water to be undrinkable.

For pre-school children (under 5 years old), measurements of wasting (weight for height), stunting (height for age), underweight (weight for age), and haemoglobin levels were done. The results revealed a significant higher prevalence of malnutrition among these children in comparison to the international and Jordanian standards. Thirty four percent of these children had mild to moderate anaemia (7-10.9g/dl).

For stool analysis, 153 individuals were included as they reported suffering from the disease during the recall period of 2 weeks. Another 121 individuals were also tested for stool analysis although they didn't have Diarrhea, as a control. The 274 individuals were voluntarily tested for stool analysis. 155 were females and 119 males. 165 individuals were of age 5 years and above 5 and 109 individuals were below 5 years of age.

Stool analysis has revealed 97 (35.4%) positive cases out of the 274 sample of the community. According to stool analysis, 52 cases were parasitic Diarrhea, 7 cases were associated with both bacteria and parasite known to cause Diarrhea, and 38 positive Diarrhea cases were not associated with any known agent that cause Diarrhea and may be caused by viral infections.

There were 153 cases that were proven as no Diarrhea cases according to stool analysis while 24 cases were associated with normal flora. Out of the 274 stool samples, 27 (9.9 %) were tested positive for E. Coli and 17 (6.2 %) for Salmonella.

Household water security was found to be inappropriate in the study community due to unhealthy water storing practices as well as occasional usage of contaminated springs for domestic uses. In addition, sanitation services are mostly absent in this community and domestic wastewater streams generally flow to the streets. These among other factors are believed to have caused the higher prevalence of Diarrhea diseases in this community compared to national figures for the prevalence of this disease in Jordan.

What Role Should Household Drinking Water Treatment and Safe Storage Play in Water Supply Activities and in Health Activities?

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Keywords: household, water quality, point-of-use, treatment, policy

Problem Statement and Introduction

Households drawing water from communal supplies must transport water to their homes and store it. Even those households with household-level taps may have intermittent service or poor quality water. Water stored in the home tends to be more contaminated than water at its collection point, suggesting that substantial contamination is taking place during transport, storage, and use.

Maintaining safe drinking water quality at the point of use, typically households but also schools, health facilities, and other locations, addresses one critical dimension for the prevention of diarrheal diseases, which kill an estimated 1.8 million children each year (out of a total under-five mortality of 10 to 11 million annually). Maintenance of water quality through proper handling and storage, and if necessary, household-level disinfection, is therefore an important public health concern.

There is clearly a persistent gap between the quality of drinking water actually used by consumers and internationally-accepted water quality guidelines. Evidence gathered over the past decade suggests that point-of-use (POU) water quality improvements typically effect a one-third or greater reduction in diarrheal disease morbidity. Nevertheless, interventions to directly improve water quality in the household, through point-of-use disinfection and safe storage, are often discounted both by those focused on improving access to improved water sources (who see it as a health intervention) and by those working on improving health (who see it as a water supply intervention). This paper directly addresses this policy conundrum, arguing that both the water supply and health communities should embrace point-of-use water treatment as a core component of their activities.

Approaches to the problem

Several options for POU water treatment to ensure safe water quality are available, including chlorination; combined flocculation and disinfection, usually with chlorine-based disinfectants; solar disinfection; and filtration. Currently, the U.S. Agency for International Development (USAID) focuses on point-of-use chlorination, and is supporting these activities in a number of countries where diarrhea remains a major public health problem. Geographic coverage includes sub-Saharan Africa (Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Nigeria, Rwanda, and Zambia), Asia (India and Indonesia), and the Americas (Haiti), with plans for expansion to additional countries over the next two years. The principal methods supported include adaptations of the Safe Water System (SWS) developed by U.S. Centers for Disease Control and Prevention (CDC) and the combined flocculent-chlorination sachet developed by Procter & Gamble ("PuR"). SWS includes point-of-use chlorination with dilute hypochlorite solution, water storage in an improved vessel, and related hygiene promotion.

Programmatic approaches have been largely focused on this intervention as an extension of health sector social marketing activities initiated for other public health problems, such as products for the control of malaria and family planning. In addition, USAID has begun supporting fully commercial models focused on disinfection using hypochlorite solution. The commercial model works with private sector partners who fully support all dimensions required to insure product availability and accessibility, including promotion and distribution, with USAID supporting product launch and technical assistance.

Discussion

Is it reasonable to expect water of potable quality to be delivered at household level through current systems, even if water quality at the source or treatment plant meets standards? Even if the answer to this question should be yes, the reality is often different and is likely to remain so for the foreseeable future. The role of POU water treatment under such circumstances therefore goes beyond traditional niches such as emergency/disaster situations or as an interim measure until a household can get a piped tap.

This paper argues that both the water supply sector and the health sector need to share responsibility for supporting POU water treatment, with human, financial, technical, and policy-level resources, if significant scale and public health impact is to be achieved. Incorporating point-of-use water treatment as a routine part of water supply activities would be supportive of a public health engineering approach to the water supply quality problem, with identification of hazards and taking defined steps at multiple barriers to minimize overall risk. This approach is fully consistent with the 2004 WHO Drinking Water Quality Guidelines and their recent manifestation as Water Safety Plans.

For the health sector, the 2002 World Health Report from WHO has already highlighted point-of-use water quality interventions as consistently among the most cost-effective interventions (in terms of health). The key program concern is ensuring implementation and sustainability of the adopted approaches at a scale sufficient for significant public health impact. The health sector has much experience to share in rolling out and taking to large scale high-impact interventions in key areas of public health concern, such as child health (e.g. oral rehydration, vaccination). Applying this experience and health sector support of POU interventions as part of mainstream child health activities would be an important contribution to the overall effort.

Conclusion

The commercial market already provides the tools for the middle classes and richer to protect themselves from the inadequacies of current water supply. If the poorest and most vulnerable populations are to have the same opportunity, then the roles of the water and health sectors outlined above in supporting point-of-use water treatment will be critical in achieving large-scale availability, accessibility, affordability, and use.

Gilbert White and the Integrated Study of People and Water

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At a time when much progress was made by specialization in small portions of the issues involving water, and when even those who worked in that broadest of academic disciplines, geography, were dividing up the subject and choosing either human or physical geography, Gilbert White was one of the greatest of those who thought differently. But his approach was not one of a vague or theoretical holism. His approach spanned both aspects of geography. It had a firm focus in at least three respects. First, he bridged human and physical geography by a firm concentration on the points at which the two intersect: the point at which floods meet people and how they cope; the point at which decisions are to be made about how to use the waters of the Colorado basin and how to decide amongst the possible choices; the point at which a woman decides from which source to fetch her family's drinking water in rural Africa. Second, Gilbert selected problems of great practical importance to people, in both the long and short term. Third, he encompassed complex interdisciplinary problems by assembling diverse people in committees which he chaired with extraordinary skill and wisdom. But it was even more by his personal attributes and the way he lived that his influence on water, on geography and on policy, through his effect on so many people's lives, was so great.

Gilbert White grew up in Chicago and on a ranch in Wyoming; these environments, his home background and the Quaker way to which he became attracted greatly influenced his whole life. He graduated in geography from Chicago University and went from his graduation into the US government for eight exciting years during the New Deal, at first with the inquiry into the Mississippi floods, then on the staff of the National Resources Committee and Planning Board, under Abel Wolman and Harlan Barrows, where he saw the struggles of water policy formulation at close range, before two years in the President's Office – concurrently with all this he worked on his hugely influential doctoral thesis 'Human Adjustment to Floods' so that flood problems remained a preoccupation throughout his long life: he was able to write a report on the recent Mississippi floods 60 years after his original assessment.

During 142-1955 Gilbert did other things: as a volunteer with the American Friends Service Committee (AFSC) he worked with refugees in France and was interned; and from 1946 he was a very young President of Haverford College. Returning to acamic work in 1956, he chaired his old Department of Geography for 13 stressful yearsin which his work on floods broadened out to flood-plain management, to natural hazards more broadly with his students, to include tsunamis and earthquakes, while helping to drive American water policy, as one of the two people who eventually turned the Corps of Engineers away from their tenacious preference for only infrastructural ways of flood management. His success with the UNESCO arid lands programme turned him towards developing country problems, especially the Lower Mekong Committee. He had become Chair of the AFSC as well and his understanding of SE Asia became highly relevant and exceedingly uncomfortable in the opposition to the Vietnam War, so that he eventually moved to the University of Colorado.

During this highly traumatic time, his decision to look at decisions about water on a small scale, to contrast with the big dam work that he had been doing, led Gilbert and his wife Anne to work on the relatively untrodden field of domestic water use in East Africa, and by good fortune I worked with

them. The eventual approach was broad, and interdisciplinary; it managed to set a pattern and an agenda which remained serviceable for several decades, while Gilbert's meticulous records and personal assistance made possible the follow-up study by John Thompson and his African colleagues, three decades later, while the book of the original 'Drawers of Water' study helped to move the World Bank into large-scale funding of rural water supply. It provided a framework for thinking about domestic water, hard data on use and sources, and a way to explain health issues to engineers.

If his role in the USA had been linked to floodplain management, his reputation internationally was particularly in relation to integrated river basin management. His success in both was often hard-won but depended on his remarkable ability to bring together people of diverse nationality, interests, ethnicity, and viewpoint and help them to a common position which they developed and he did not impose. There are many aspects to this ability which will be discussed as they have messages for us.

In Boulder, Colorado from 1970 Gilbert established the Natural Hazards Centre to bridge the gap between research and practitioners. His advice was sought over the Aswan High Dam, later the Aral Sea, global climate change, nuclear waste disposal, earthquake losses, and many other major natural resource issues. He chaired the Trustees of Resources for the Future and later the UNEP Committee on the State of the Environment. Yet he also continued to work on the needs for flood precautions locally in Boulder. Even into his 90th year he was exploring how to bring together water policy and environmental policy, which had tended to remain separate from each other.

This abstract gives a bare outline of Gilbert White's life and some of his contributions to water – the talk will explore the interaction of the basic issues in Gilbert's way of living and working, the great themes of his insights and the many lessons his life and work have for us today and we can improve the relations between people and water. It is hoped that during the discussion period those at the seminar who knew Gilbert will contribute from their own experiences and memories.

Linking Watershed and Coastal Management with Drinking Water Safety in Guyana

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Keywords: Watershed Management, Water Safety Plan, Drinking Water Quality, Coastal Management, Guyana

Linking Watershed and Coastal Management with Drinking Water Safety In Guyana - An Integrated WHO Water Safety Plan and a UNEP National Program of Action for the Protection of the Environment and Human Health from Land-Based Sources of Pollution in Guyana.

Nearly 1.2 billion people worldwide do not have access to safe drinking water, and approximately 2 million children die every year from water-related diseases. In Guyana, 17% of the population does not have access to an improved drinking water source, while 30% do not have access to adequate sanitation facilities. Clean drinking water access becomes more difficult when land-based sources of pollution are introduced. Water distribution system infrastructure and drinking water quality were primary concerns after the massive floods of January 2005 that affected more than half the population. Natural disasters and human activities both pose significant challenges to a watershed system, directly affecting drinking water quality.

Land-based activities are the main source of marine pollution in Guyana, affecting the coastal environment, including estuaries and inshore coastal waters. Pollution of water sources and associated alterations of coastal ecosystems are threatening the sustainability of coastal populations, which depend largely upon the maintenance of healthy coastal ecosystems. Throughout Guyana and the rest of the Caribbean Region, much of the human population lives in close proximity to the coast. In both urban centers and subsistence communities, improving the safety of water sources and the management of watersheds is vital to economic development, adequate nutrition, and public health.

A Combined National Program of Action and Water Safety Plan for Guyana:

The U.S. Centers for Disease Control and Prevention (CDC) has joined with the U.S. National Oceanic and Atmospheric Administration (NOAA), the Pan American Health Organization (PAHO), and the Caribbean Environmental Health Institute (CEHI) to promote and implement a complementary program for a National Program of Action (NPA) and the World Health Organization's Water Safety Plan (WSP) methodology, in collaboration with Guyanese government authorities for the environment. A NPA is a management tool that is designed to prevent, reduce, control and/or eliminate marine degradation from land-based activities. A NPA promotes an integrated watershed and coastal management approach built on existing National Development Plans. A NPA addresses nine pollutant categories: Nutrients, Sediment Mobilization, Physical Alteration / Destruction of Habitats, Sewage, Persistent Organic Pollutants, Radioactive Substances, Heavy Metals, Oils (Hydrocarbons), and Litter.

A WSP is a comprehensive approach to assuring drinking water safety that relies on environment and health sector collaboration to identify, assess, monitor, and manage risks inherent in a water delivery system from 'catchment to consumer.' The key components include a supply system assessment, effective operational monitoring, and management.

WSPs use a systematic preventive approach rather than a reactive approach to problem-solving by identifying all points in the drinking water system where contamination could compromise the water reaching consumers. The combined NPA/WSP strategy will result in an integrated water protection strategy to address land-based sources of pollution, and water safety as well as public health

The combined NPA/WSP project is being implemented in Linden, the second largest city in Guyana with a heavy bauxite mining industry. The results of the NPA/WSP project are twofold. One is to systemically map and document the water shed/source waters through the Linden treatment process and distribution system and to identify the critical control points that could cause harm to public health or to the ecosystem. The second is to demonstrate that linking an environmental program, such as the UNEP Nation Program of Action with a public health methodology, such as the WHO Water Safety Plan will both increase efficiency of local governments to focus holistically on the concerns and challenges related to drinking water quality and to stopping environmental degradation and decrease the amount of time and resources local governments need to address these vital issues.

Partner Organizations

In Guyana, the Ministries of Health, Housing and Water, and Local Governments will be involved. They will work in conjunction with the Guyana Environmental Protection Agency, the Guyana Water Utility and regional technical agencies:

CEHI is dedicated to finding cost effective solutions to environmental health problems in its 16 member states, one of which is Guyana. CEHI collaborates with national, regional, and international organizations to provide leadership to its member states in making effective environmental health policy decisions.

NOAA is dedicated to understanding and predicting changes in the Earth's environment and to conserving and managing coastal and marine resources to meet U.S. economic, social, and environmental goals. It works together with the United Nations Environmental Programme's Global Programme of Action for the Protection of the Marine Environment from Land Based Activities (GPA) to support NPA development in the Caribbean.

USGS, the U.S. Geological Survey, provides scientific information to manage water, biological, energy, and mineral resources.

PAHO is the World Health Organization's Regional Office for the Americas. It is dedicated to improving the health and living standards of the countries of the Americas and forms part of the United Nations system.

CDC's National Center for Environmental Health / Agency for Toxic Substances and Disease Registry assists national governments world-wide with technical assistance and expertise in how to prevent and control environmental health hazards that are detrimental to human health.

Environment and Health: Rio das Velhas and the case of the Córrego Santa Terezinha - Belo Horizonte, MG, Brazil

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Keywords: Health, Environment, Citizenship, Emporwerment, Polution

Background

Brazil has 10% of the global drinkable water and 70% is in the Amazon region and the remained 30% is in the rest of its territory. Brazilian economical development and its population growth lead to environmental degradation, drastically affecting its drinkable water reserves. The Rio das Velhas basin generates 45.8% of the State of Minas Gerais income (FJP, 1996), and covers five million inhabitants (IBGE, 2003). It runs from the SE to the NO of the state, in the 20`latitude S up to the St. Francisco River, in the 17 11` latitude S; it has 39Km^2, 38.3m width, releases 300m^3/s of water in its affluent, passes through, Belo Horizonte (BH), and serves 51 municipalities in the State. To bring life back to the Das Velhas basin, in 1997 was created the Manuelzao project. Its interventions in the communities around the river focus on raising environmental awareness, individual and community empowerment, capacity building, and youth leadership training and engagement. It integrates stakeholders such as academics, governments, organized civil society, and business entrepreneurs.

Analysis

The conventional epidemiology centers on the questions: who, where and when (Paim, 1997). The development of the social medicine (Rosen, 1980) particularly in the Latin America (Breilh & Gandra, 1985) and the emergency of the Critical Geography by Santos (1978) allowed questioning ecohealth (Lebel, 2003) process linking biological agent, their hosts and the environment and its social-economical determinants. Hence we decided to study the main diseases found in the Alto Vera Cruz Community Health Center (AVCCHC), BH, Brazil and the origin from where the patients came from. A direct correlation between certain illnesses such as diarrhea, parasitism, lepstospirosis, and the place patients lived, the surroundings of the Santa Terezinha River, was then established. So a descriptive epidemiological study was undertaken to characterize the awareness level of the population that live by the River. This was done through literature review, official date collection, interview with families and photographic studies.The main objectives of the study was to determine with the community the main health existing problems; to know the population perception of the environmental problems and its correlation with their disease; their perception about the needs to change the environment they live in; to correlate their daily activities with the environmental problems. The research took place in the second semester of 2005. 800 household and an estimated 4000 inhabitants live in the River surroundings, 10% of the families (84 families) were interviewed and the Epi-info processed the data.

Results

The infra-structure was poor, no garbage collection service and sewage system existed what explains so much garbage in the River. Over 90% of the participants were older than 20 years, 60% was male; the household irregularly distributed along the River. Their perception about the environment showed that 89.3% (n=75) related the presence of garbage in the River with the increase of the diseases in the community; 84.5% (n=71) thought that the waiting time in the AVCCHC had to do

with the garbage in the River; 98.8% (n=83) knew that mice and mosquito transmit diseases and 98.8 % (n=83) related water pollution with the increasing of vectors, and 97.6% (n=82) considered that their health depends on the environment and on their hygiene.When asked if they wanted to increase the number of doctors or improve their community quality of life, 74% (n= 60) answered that it is more important to avoid disease. About their daily activities and attitudes, 47 (58%) agreed that they polluted the River; whereas 34 (42%) denied it, 62 people (78.5%) said that children play in the River. 71% believed that the River existed before they lived there and that it was drinkable, and 54 % considered possible to clean the River.

Conclusions and Recommendations

The environmental and social decay influenced the health conditions of the population and possibly their psychological and cultural consciousness towards the environment and their power to transform it. A discussion with the participants about the health/disease phenomenon was brought up and they questioned the public government and their role to improver their relationship with the Santa Terezinha River. Basic public services and control over the noxious effluents produced by industries must be guaranteed by local government and the organized civil society urgently. Education and awareness program involving all stakeholders must be provided, mainly involving the youth (McOsano, 1998). The Manuelzao project is an encouraging example because it conceives the effort already made to remedy the catastrophic situation. It catalyses governmental action so that it has started to implement one of the greatest investments on the treatment of the water from the Das Velhas basin.

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DSI's Monitoring Activities on Water Quality

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Keywords: Water quality, monitoring activities, fresh water projects , environment, water pollution

Water Resources are one of the natural resources that heavily subject to environmental pollution and as it is seen in all over the world, pollution in some basins of Turkey has reached to important size. Thus, the increase in cost of water result of purification needs is raised. In order to specify the effects of pollutant elements on water environment, parameters which define water quality must be measured properly. Through water quality measurements that are conducted regularly in a water source, it is possible to catch the pollution source, time and location besides the effects on water sources by natural ways and human intervention is determined. In order to strengthen the control mechanism against water pollution, appropriateness of water parameters to standards are evaluated, mass carriage in rivers are monitored, preventive measures for water quality protection and control are taken in advance and finally basic contribution to integrated basin studies is provided.

For its own projects, evaluating through correct and reliable measurement method, storing and processing of water sources quality works, which are under responsibility of DSI, are continued since 1979. In present situation, there are 1150 water quality monitoring stations that 58% are for general objectives, 33% are for fresh water, 3% are for groundwater and 6% are for specific project measurements. The measurement frequency and parameter selections in stations are done through present and planned usage objectives. Forming a monitoring network in all over Turkey in order to define present water quality and in this way investigating possible effects of planned projects to water quality are aimed.

The General Directorate of State Hydraulic Works (DSI) is the main agency responsible for planning, constructing and operation of all water resources projects in Turkey. DSI activities are mainly at four groups; investigation and planning, design and construction (irrigation network, dams and hydropower plants, domestic water supply and rescue projects), quality control and operation. However supplying water to the end user is a collective process that should include all related bodies apart from DSI including Local Authorities, Municipalities and even water users.

DSI undertakes all stages from source to treatment plant for providing fresh water to big cities whose population is above 100,000. Works for decreasing possible effects of these projects to the nature are also considered by coordination with Ministry of Forestry and Environment, local authorities and other related bodies.

Turkey tries to make her all law system, including water and environment issues, harmonious with European Union's (EU) laws during entry period to EU. the Environmental Impact Assessment (EIA), has been in force in Turkey since 1993 with 3 amendments so far. Strategic Environment Assessment (SEA) Regulation draft is prepared in April 2005 but not in force yet.

By 2020, in Turkey, 72% of water is needed for irrigation,, 12% for industry and 16% is used as drinking water. Therefore, we need to increase domestic production and ensure sufficient and sustainable water supply. In this context an Energy Efficiency law is under preparation. Turkey develops 36% of

her water resources. The aim is to develop most of water resources by the 100th year of Republic of Turkey. Another aim is to create an energy-sufficient country with continuous, high quality, reliable and economic electricity supply and also to encourage sufficient investments to meet growing energy demand in the country.

Some constitutional constrains, have been enacted in order to increase foreign investments in the power sector and Restructuring studies have been completed to increase private sector participation in meeting increasing power demand. In this context, private sector interest for hydropower plant construction in Turkey will become as big as the private sector investments (12 686 MW which corresponds to approximately 13 billion US Dollar) in near future. Renewable energy will be at least as attractive as today's in the future and in this context, Turkish governments still undertake various measures to attract both the domestic and foreign private sectors for new investments.

DSI is aware of the importance of water related issues and problems and in this context will organize and host 5th World Water Forum by the year 2009 in Istanbul by close cooperation with World Water Council.

Occurrence of Ascaris, Giardia and Cryptosporidium, In Vaults of Urine Diversion Toilets in the eThekwini Municipal Area (Durban, South Africa)

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Keywords: urine diversion toilets, Ascaris, Giardia, Cryptosporidium, epidemiology

The City Health Department of eThekwini Municipality and UKZN School of Medicince recently completed a large-scale epidemiological study aimed at comparing the health of rural communities within eThekwini Municipality which: (a) had been provided with water supply, sanitation by means of UD toilets and health education, versus (b) had not yet been serviced. The major indicator of health status was taken to be diarrhoeal indicidence during the study period. The epidemiological project is in its final stages and has yielded a comprehensive database of information, which is potentially highly useful to the wider reseach community. Since the project was epidemiological in nature, no microbiological data regarding the possible agents of diarhoeal disease were gathered. A pilot project was therefore undertaken examining the incidence of helminthic and protozoan parasites in a sub-sample of the toilets of househlds included in the epidemiological study. Attention was focussed on these organisms because of the relative resistance of their reproductive structures to adverse environmental conditions, hence their relatively higher likelihood of surviving the standing phase of the UD toilet vaults. In addition, Ascaris is the major pathogen of concern along the KwaZulu-Natal coastline, with incidence as high as 70% recorded in some communities. The hypothesis tested in the pilot collaborative project was that households with high and low risks of diarrhoeal disease, as identified in the epidemiological study, would correlate with presence and numbers of parasites detectable in fresh waste from UD toilet. High risk and low risk areas were identified by the research team of the epidemiological study. The pilot project team was blinded to the nature of the households to be sampled, these being identified only by a reference number. Samples were collected from UD toilet vaults two rural communities outside Durban. Approximately 120 samples were collected over two weeks, with approximately equal numbers sampled from each of the two geographical areas. All samples were screened for presence of Giardia, Cryptosporidium and Ascaris. Initial screening for cysts and oocysts of protozoan parasites was conducted using fluoresent-stained antibodies to the walls of these organisms. The AMBIC protocol developed by the Pollution Research group was used to screen for Ascaris ova. Samples which screened positive for Ascaris ova were also scored for viability of ova, while samples which screened positive for Giardia and Cryptosporidium were subjected to genetic typing using PCR methodolgy. Results were analysed with respect to the frequency of parasite occurrence, correlation of incidences of the different parasites with each other, and of the overall occurrence of parasites with incidence of diarrhoeal disease as recorded in the epidemiological study.

Removal of Fluoride from Water by Coal and Tamarind Nut Powder and Development of Point-of-Use Candle-Type Filters

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Keywords: fluoride removal, Point-of-use filters, Sorptive-filtration, Coal, Tamarind Nut Powder

Preamble

Presence of natural and/or anthropogenic Fluoride in drinking water supplies has significant health implications and is a cause of concern of regulatory agencies worldwide. The following countries have been identified for the problem of Fluorosis: Pakisthan, Bangladesh, Argentina, United States of America, Marocco, Middle East Countries, Japan, South African Countries, Newzland, Thailand etc. In India, the states of Andhra Pradesh, Bihar, Chattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal are affected by fluoride contamination in water. This involves about 9000 villages affecting 30 million people. It must be noted that the problem of excess fluoride in drinking water is of recent origin in most parts. Digging up of shallow aquifers for irrigation has resulted in declining levels of ground water. As a result, deeper aquifers are used, and the water in these aquifers contains a higher level. Therefore, it is desirable to drink water having a fluoride concentration less than certain value. Hence, the concentration of Fluoride in drinking water > 1.5 mg/L (1.0mg /L in India) needs treatment.

Focused research efforts worldwide have resulted in development of methodologies/ technologies for removal of Fluoride from drinking water supplies both at community level and at individual household level. The technology for Fluoride removal for piped water supply is moderately costly and requires technical expertise and are in practice in several urban areas. Simple technologies for application/adaptation to isolated and small rural communities/habitations are few and requires adaptation to suit local requirements and are to be proven sustainable. Several types and models of point-of-use filters for household removal of Fluoride from water based on sorptive-filtration process employing Activated alumina, Activated carbon, Bone Char, etc. Filter units with cartridges filled with sorptive media or ion-exchange resins like Tulsion, A-27, Deaceodite, FF-IP, Lewatit, Mill-59 Amberlite, IRA-400.

Proposal

The motive of the present investigation is to develop an easy-to-use and cost effective point-of-use filter for household removal of Fluoride from water. Literature contains several reports on effect of Fluoride on environment and humans. Therefore, locally available materials like Bituminous coal, Lignite coal and Tamarind nut powder were selected and subjected detailed investigation. Sorption capacity and intensity of both the coal materials, effect of system parameters and influence of chemical environment like pH, presence of anions and cations (Chlorides, Sulphates, Carbonates, Sodium, Magnesium, Potassium and Calcium), regeneration, etc. were all investigated by conducting detailed batch kinetic and equilibrium adsorption experiments. Additionally, usefulness of these materials for application in continuous flow situations were evaluated by conducting down-flow column studies at

different flow rates. Tamarind pulp and nuts are found to be useful in defluoridation and hence it is proposed to investigate Tamarind nut powder extract for removal Fluoride by the process of coagulation and flocculation. Standard jar tests are proposed to be conducted to determine optimum coagulant dose, optimum pH and dose variations at optimum pH conditions.

Development of point-of-use filters

For development of point-of-use filters for domestic use, candle-type filters were selected. Candle-type domestic filters are two-tier two compartment stainless steel/ceramic/porcelain units; cylindrical in shape and are of 16-24 L capacity. The upper compartment contains 1 to 3 candles fitted to the bottom into which the water to be filtered is poured manually. The water after filtration through the candle(s) is collected in the bottom vessel to which a tap is fixed to facilitate use of the filtered water. Candles are hallow, cylindrical in shape and are made of high porosity ceramic materials with appropriate arrangement for fixing to the bottom of the vessel. These filters are strong and porous allowing a maximum water flow of 1L/h and are effective in filtering out solids of sizes as minute as 0.01 mm. Candles are generally cleaned by autoclaving in domestic pressure cookers (121±10C @ 15 psi). These filters are easy to operate, cheap and sustainable.

The hallow portion of the candle is filled with the sorbent material and the bottom opening is plugged with cotton. Tap water spiked with Fluoride is used as feed water. Filtered water was collected at regular intervals and analysed for residual Fluoride concentration by Atomic Absorption Spectrophotometer and the data is used for plotting of breakthrough curve from which breakthrough volume, breakthrough time, service volume and service time were computed. A single candle filter filled with 65 g of Treated Bituminous Coal or 63 g of Lignite Coal effectively remove Fluoride from 5 mg/L to less than permissible limit and was capable of producing 1.75 L and 1.5 L per run. A filter fitted with 3 candles thus would produce 5.25 and 4.5 L of Fluoride free water per run. The output of Fluoride free water depends on the concentration of Fluoride in feed water.

Epilogue

Regeneration of the exhausted media by treatment with NaOH and repeated use would reduce the cost of filtered Fluoride free water. To make the entire operation sustainable, the process of regeneration may be organised by evolving a suitable mechanism for collection, regeneration and refilling at community level with community participation.

Health Outcomes of Ecological Sanitation, Water Services and Hygiene Education in eThekwini District, Durban, South Africa.

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Keywords: epidemiology, ecological sanitation, health outcomes, evaluation, developing country

Introduction

Globally, an estimated 2.4 billion people do not have sanitation and 1.2 billion people live without access to safe water. Diarrhoea causes 2 million deaths per year, mainly affecting the most vulnerable part of the population. Water, sanitation, and hygiene interventions have been shown to reduce sickness, the incidence of diarrhoeal diseases and parasitic diseases, as well as hygiene related diseases such as skin & eye infections. In South Africa, one fifth of the population do not have access to an adequate and clean supply of potable water, and half of the population lacks basic sanitation, which causes a severe burden on the health system in addition to the individual suffering.

Sanitation is regarded as one of the most effective public health interventions. The year 2008 is the Global Year of Sanitation. Despite this, large populations in sub-Saharan Africa lack basic sanitation. The burden of water related infectious disease falls particularly on the vulnerable including the young, aged and those with HIV/AIDS.

With the consolidation of district boundaries around Durban, many homes with poor sanitation and unsafe water supply living on the per-urban fringe were incorporated into the eThekwini Metropolitan Council area. A comprehensive intervention by the Council saw the introduction of an extensive safe-water, sanitation and hygiene education programme in these under-served areas. By the end of 2007, urine diversion toilets, safe water and hygiene education would have been supplied to 50 000 households in previously under-served areas. The health effect of this intervention on the households and its occupants has not been evaluated. It is important for funders and policy makers to know whether this huge and novel intervention is effecting health.

Purpose: To evaluate the health outcomes of supplying urine diversion sanitation, safe water supply and hygiene education intervention in per-urban households in eThekwini.

Study design: Observational, analytic, prospective cohort study.

Sampling: Using a multistage random sampling process 639 households in three Intervention Areas and 668 households in three matched Control Areas where the intervention was still to be implemented were selected.

Data collection: Each household was visited by trained field workers every 2 weeks for six visits. A baseline household questionnaire and observation check list was completed, followed by 5 fortnightly visits to observe and question about householders health.

Exposure variables: Type of sanitation used, hygiene and sanitation knowledge, socio-economic education, occupational and literacy and demographic data.

Outcomes variables: Episodes of diarrhoea, vomiting, worms and skin infections as well as the duration of each episode.

Results: A total of 7199 householders were followed for 110 976 person-days over the study period of six weeks. The diarrhoea incidence rate was 12 per 1000 person days in Intervention Areas and 16 per 1000 person days in Control Areas. There was a significant risk (p = 0.003) of not having a urine diversion toilet and when adjusted for variables including socio-economic status indicators, safe-water access, education, literacy and crowding, the Incidence Rate Ratio was 1.7 (95% Confidence Interval: 1.2 to 2.5). For vomiting the adjusted IRR was 4.8 (95% CI: 1.5 to 15.9) for those note having a urine diversion toilet. Having a urine diversion toilet did not protect household members from reporting geohelminths (IRR = 0.3 (05% CI 0.2 to 0.5), or infectious skin sores (IRR = 0.3 (05% CI 0.2 to 0.5).

Households with safe water had an additional protection from diarrhoea, with households that had an inside safe water supply (IRR = 0.7 (05% CI 0.6 to 0.8), an outside safe water supply (IRR = 0.9 (95% CI: 0.7 to 1.0) significantly better off than those with unsafe water. Households with safe water had an additional protection from vomiting, with households that had an inside safe water supply (IRR = 0.3 (05% CI: 0.2 to 0.5), an outside safe water supply (IRR = 0.6 (95% CI: 0.4 to 1.0) significantly better off than those with unsafe water. Education and being actively literate (regular reading the paper) were not protective against water-related infectious disease.

Recall bias has been reduced by repeated household visits by field workers.

Conclusion and recommendations

Households with a urine diversion toilet have resulted in significantly fewer acute infectious water-related health outcomes. Hygiene education and safe water supply may modify this effect, but actually having a safe and functioning toilet is key to improved health in the peri-urban areas of eThekwini.

The Metropolitan Council should be encouraged to ensure that all householders have adequate sanitation, safe water and hygiene education as soon as possible.

Integrating Malaria Control Parameters into Reservoir Management: Evidence from Ethiopia

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Keywords: dam, reservoir, management, malaria, control

Dams and impounded water are important risk factors for malaria transmission (Hunter et al, 1993; Jobin, 1999; Keiser et al, 2005a). In tropical Africa, where the malaria burden is greatest (Malaney et al, 2004), evidence exists from Cameroon (Atangana et al., 1979), Kenya (Oomen, 1981; Roggeri, 1985) and Mali (King, 1996) and Ethiopia (Ghebreyesus et al, 1999; Lautze et al, in submission) demonstrating that the presence of impounded water has increased malaria transmission. The impending water resources development likely to take place in sub-Saharan Africa (World Bank, 2004; Grey and Sadoff, 2006), therefore, places a premium on achieving a better understanding of this increased malaria risk so that effective control measures are identified and employed in affected communities. In particular, the nature and causes of the greater malaria transmission call for investigation into disease reduction opportunities that can be incorporated into water management strategies.

Recent research (e.g., Utzinger et al, 2001; Konradsen et al, 2004; Keiser et al, 2005b; Lautze & Kirshen, 2007) has in fact devoted increasing attention to environmental or water management to reduce malaria prevalence. This body of research generally re-examines methods employed in the first half of the 20th century that sought to manipulate the environment to create conditions less conducive for vector reproduction. Examples are cited from the American South (TVA, 1947; Hackett et al, 1938), Zambia (Watson, 1953), and India (Henderson, 1955) that demonstrate how environmental or water management measures can reduce malaria transmission. Absent from the growing body of recent work, however, are specific guidelines for how these older techniques — often designed for regions with relatively particular sets of climates and mosquito species — can be adapted and applied around water reservoirs in tropical Africa.

The Koka dam in the Rift Valley of Ethiopia has created conditions that exacerbate malaria transmission in communities near the adjacent reservoir. Lautze et al (in submission) demonstrated that malaria case-rates are approximately 2.3 times greater in among people residing within 3 kilometers of the reservoir than those residing 6 to 9 kilometers from the reservoir. The greater malaria burden is presumably due to the increased numbers of Anopheles mosquitoes found in communities near the reservoir, the majority of which may not be susceptible to conventional malaria control methods due to their outdoor-feeding tendencies (Lautze et al., in preparation A).

Water management decisions appear to affect mosquito abundance and malaria transmission. Lautze et al (in preparation B) demonstrated that faster rates of water level increase (> 2.5 meters/month) at greater water levels (i.e., water levels falling into the greatest 50 percent of all water levels) and faster rates of water level decrease (< - 0.5 meters/month) at greater water levels are correlated with lower malaria transmission. Water level changes at low water levels wield little impact on malaria case-rates, likely because of the increased distance between the reservoir shoreline and nearby communities at

low water levels. The primary channel through which the malaria-enhancing effect of the reservoir operates when water levels are high are puddles at the reservoir shoreline, which typically range in depth from 10 to 30 centimeters (Lautze et al, in preparation A). Given that it takes on the order of 15 days at local temperatures for larvae to transform into mosquitoes, drawdown rates which exceed puddle depth over this time period (i.e., about 25 to 30 centimeters over 15 days or 50 to 60 centimeters/month) will cause puddles to desiccate before larvae transform into mosquitoes, thereby reducing the number of larvae, mosquitoes and malaria.

Since there is no major dam upstream of Koka to artificially facilitate a reservoir draw-up greater than 2.5 meters/month and natural inflow is generally insufficient, the primary policy implication for malaria control rests with timing drawdown rates to exceed the depth of larval positive puddles over the duration of larval development. Notably, the main impact of this measure is confined to months of high water levels. We developed five scenarios incorporating this malaria reduction tool into the broader framework for Koka reservoir management in order to examine tradeoffs between malaria prevention, hydropower production, and satisfaction of irrigation requirements. The results indicate that the principle conflict of objectives lies between malaria reduction and irrigation requirements. Depending on the value attached to malaria reduction and irrigation, incorporation of malaria control measures into reservoir management may be justified. The lack of conflict between malaria reduction and hydropower objectives, however, suggests that there is significant potential for incorporating malaria prevention objectives into reservoir management for dams currently operated solely to satisfy hydropower demands.

The greater malaria case-rates documented around reservoirs in Africa calls for use of a greater range of prevention strategies. Effective mitigation of malaria transmission around reservoirs is likely to require integrated approaches to water resources development that substantively incorporate health parameters into development plans and encourage ongoing collaboration between the water and health sectors. Alterations to reservoir operations, therefore, can play an important role in integrated malaria reduction strategies around impounded waters. Explicit recognition and internalization of the malaria effects of water resources infrastructure projects can strengthen developmental objectives by helping to ensure that they are not undermined by a critical public health burden.

Environmental of the Rural Schools and the Relation to Pupil's Health in a Municipality from Colombia

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Keywords: sanitary conditions, pupils' health, water quality, rural schools, Ecosan alternatives

Some of the eight Millennium Development Goals (MDGs) – like the second, which "ensure that all boys and girls complete a full course of primary schooling" or the fourth that "reduce by two thirds the mortality rate among children under five" concern direct to childhood, the others especially the first one and the fifth have an indirect relation with child population that for many reasons like poverty, lack of education or bad economical distribution, is one of the vulnerable population in the world. Also the conventions on the rights of the child recognize not only the right of the child to education (Article 28) but also to ensure that children are supported in the use of basic knowledge of child health and nutrition, hygiene and environmental sanitation (Article 24).

The real school situation for children, especially in developing countries, is far to be good, because for example, not all children receive education, have access to safe drinking water at home and school or live and study in a healthy environment.

The present study has been made in Colombia during the year 2006 and it is concerned about the environmental situation and its relation with pupils' health of 34 rural schools located in 2 municipalities 2 hours far from Bogotá (the capital city) by car.

The first objective was to establish the environmental conditions of those 34 rural schools as well as the common illnesses suffered by the pupils. The second objective was to formulate social proposals economically reliable, and environmentally friendly that improve the actual environmental situation and as consequence of these factors improvement the betterment of the pupils health conditions. The total number of pupils is about 1.500 and the age range is between 5-15 years old.

This diagnosis covers items like:
- Water supply regularity
- Water quality
- Water treatment for drinking water inside the school
- Sanitary installations (Basins, toilet)
- Food supplies, kitchen conditions.
- Solid waste management
- Principal illness suffering by the pupils.

The diagnosis has been made using a formulary (with 30 questions) that has been distributed in the rural schools of the 2 municipalities, visits to the half of the rural schools that include taking water samples for microbiological analysis and visits to the major's office of both municipalities. As soon as this period of data recollection was ready, the organization and analysis of the collected information has been made. For this purpose the normatively, health and environmental impact were taking as a basis.

A didactic and easy to understand tool with the 3 light colours (green, yellow and red) was choose to show the results. Every of the different aspects (water quality, quantity, solid waste management, sanitary installations, kitchen conditions and food supplies) depending on the situation in every school received one of this colours; green if there is not a problem, yellow if the situation its been a problem until now red if there is already a problem that affect directly health and environment. No one of the rural schools has every item in green, some of them have more than one aspect to improve (yellow and red) but some of the rural schools have many aspects in red. Every of this aspect that received red colour is a challenge to improve.

The principal results of this diagnosis show that in most of the 34 rural schools doesn't exist and adequate solid waste management, in many schools the water supply is not daily, some depends from rain water, although some schools have a water filter the drinking water quality is not good, and in many cases the sanitary installations are not enough for the number of children and doesn't work right.

These results should have a close relation with the pupil's health; for that reason general information about illness and vaccination registers from pupils in the rural schools have been also collected.

The proposals include the participation of many local actors like the municipality people, local leaders, local people that have receive training on health and sanitation from a NGO, teachers, pupils and parents.

The first proposal is suggested in order to repair all the small sanitary aspects like water connections, taps, water tanks etc. which are broken.

It is also important to evaluate the water filter conditions and to learn how to clean them. For those rural schools which don't have any water filter is important to define the boiling time and the management of the drinking water.

The second proposal is to establish an efficient recycling program, and the used of the biodegradable part of the solid waste as a raw material for a composting plan. The resulting compost will be used to improve the earth of a small vegetable garden.

In third proposal is related with the improvement of the water management in the rural schools and include a urine diversion and after storage time the application of it as a fertilizer. Also the reuse of grey water after a biofilter treatment is a method to give the water an efficient management.

And the last proposal is related to the health conditions of the pupils that should serve as indicator of the implementation of all the above mentioned proposals. Information about illnesses suffering by the pupils and measures of height and weight will be taken regularly in every rural school.

To conclude, this project is a good beginning to work with the new generation of children, to show the people or rural areas of a developing country that there is an easy way to have a better health and so a better life and that some waste products that are only waste right now can be reused protecting no only the human health but also the environment.

The Role of Health Clubs in Communicable Disease Reduction

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Keywords: role, health, clubs, disease, reduction

Children are among the vulnerable groups of people as far as infections are concerned majority of whom are from rural poor families.
Normally health needs of children in schools are usually ignored. School going children in Uganda suffer from a wide range of diseases like intestinal worms, skin diseases, diarrhorea, and malaria among others. These have affected the children's ability to learn in schools.
School sanitation and health education has been identified by World Health Organization as a key factor in the prevention and control of communicable diseases.

Voluntary Action for Development a non-governmental organization adopted the school health club approach in an effort to reduce the occurrence of communicable diseases through hygiene and sanitation education. SIMAVI along time partner of VAD has supported this cause.

Project area

Use of health club approach was first initiated in 2003 where to date over 20 schools have benefited. Over 20 School health clubs with 500 members have been formed and are operational.

These clubs are found in the rural areas in Wakiso district in the sub counties of Kakiri and Nsangi and parishes of Kamuli, Kikandwa, Luwuga, Katereke and Kitemu. All the 20 clubs were trained in good hygiene and sanitation practices, provided with I.E.C (Information Education Communication) materials to use during trainings addressing preventable diseases.

School health club (SHC) methodology

This intervention was initially designed as part of the one-year project of "Community Managed Water, Hygiene and Sanitation improvement". The school health club approach uses participatory methods, which have a potential to reach family members and the wider community.

The children form smaller groups of about 15-20 pupils which are trained in good hygiene / sanitation practices, simple monitoring and evaluation skills.

Child to child approach has also been fostered where by the older children take care of other children.

Competitions are held between various schools on hygiene and sanitation through the use of drama, debates and music.

Outreach programmes are also conducted through drama and music where the pupils make performances relating to water, hygiene and sanitation for the community members.

Development of I.E.C materials. Training materials are produced with the active participation of the pupils and teachers, which are utilized during trainings and demonstrations.

Health clubs have enabled schools to conduct health parades where hygiene and sanitation messages are recited. These parades are conducted weekly to facilitate personal hygiene inspection and education.

Results

- Increased awareness about hygiene and sanitation, which has enabled the pupils to adopt good practices.
- Reduced diseases associated with poor hygiene and sanitation conditions.
- Increased involvement of communities in school sanitation improvement. They have also ensured that the pupils practice what is learnt at school back home.
- Increased enrollment due to the fact that parents feel more comfortable with school environment.

Recommendations

At the school level, water, sanitation needs to be given priority regarding allocation of school funds putting emphasis on good hygiene practices and life skills. More so collaborating with local community through outreach programmes like drama, general cleaning of water points among others.

The school and community need to work together to remedy sanitation problems and to ensure the child adopts good hygiene/sanitation practices during childhood. The community also needs to contribute finances and materials needed to ensure good sanitation standards in the school. This will build their commitment to the project and in turn leading to sustainability and behavioral change.

Conclusion

This poster will highlight the various avenues used by school health clubs to promote good hygiene and sanitation practices for improved health conditions in schools, outcomes of the intervention, recommendations for replication and improvement of the initiative.

The Inactivation of Ascaris Ova and Bacterial Indicator Organisms in Urine Diversion Toilets in the eThekwini Municipal Area (Durban, South Africa)

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Keywords: urine diversion toilets, Ascaris ova, E. coli, total coliforms, microbial die-off

In South Africa, as in most developing countries there exists a backlog in the provision of certain basic services, particularly water supply and sanitation. Ventilated Improved Pit Latrines (VIPs) have been identified by government as an example of the minimum acceptable on-site sanitation provision. In the rural areas around Durban (South Africa), eThekwini Municipality has installed urine diversion (UD) toilets in preference to VIPs because topography, housing density, access and other factors make VIPs infeasible. In the variation of UD toilets adopted by eThekwini Municipality, urine is directed to a shallow soak-way and the faecal component is stored in an aboveground vault beneath the toilet, where it is covered with sand after each deposition of fresh faeces. The version of the UD toilet adopted by eThekwini is a two-vault system, with a moveable pedestal. This is initially positioned over one vault and is used until the vault is full. The pedestal is then moved over the second vault until it is full. The material in the first vault thus undergoes a standing period equal to the time it takes to fill the second vault. This is usually nine to eighteen months. During this time, the waste heap is intended to desiccate, thereby contributing to pathogen die-off. The most significant pathogen in the KwaZulu-Natal coastal region in Ascaris, with infestation rates up to 70% reported in some communities. The present study focused on the inactivation of Ascaris ova, and of the bacterial indicator species Escherichia coli and total coliforms, in vaults of UD toilets after varying standing periods. The AMBIC protocol developed by the Pollution Research Group (UKZN) was used to detect Ascaris ova, and standard methods were used for the detection of E. coli and total coliforms. The AMBIC protocol relies on disruption of electrostatic interactions between ova and charged soil particles by a solution of ammonuim bicarbonate, followed by zinc sulphate flotation. It does not seem to destroy or damage the Ascaris ova. Therefore viability of the ova could be assessed directly at the stage of light microscope-based enumeration of the ova. Samples of vault contents were collected from twenty-five randomly selected toilets of known usage history in a rural area outside Durban (South Africa). Samples were taken from the top, bottom and middle layers of the waste heap in each vault. Initial analysis of each layer (top, middle or bottom) showed no significant difference in either the Ascaris load (/g UD waste) or bacterial counts. However, more viable Ascaris ova were detected in the top layer, compared to the middle and bottom layers. The total Ascaris load (/g UD waste) decreased over time, but there was evidence of potentially viable, and therefore potentially infective, ova even after a year of standing. The indicator organisms showed a gradual decrease in counts but there was no significant difference from the initial values. This suggests that there were sufficient nutrients in the waste heap to maintain minimal levels of growth (sufficient to almost balance death) in the indicator species monitored. This result is unexpected for E. coli, which is meant to ve specific to the intestinal environment and subject to die-off outside that environment. Since total coliforms include bacterial species which occur naturally in the environment, it is not as surprising that UD waste provided sufficient nourishment to this group to allow it to persist at essentially unchanged levels over extended periods of time.

Meteorological and Harsh Weather Conditions in Nigeria: Implications on Public Health and Food Security

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Keywords: public health, food security, climatic change, desertification, ecological hazards

The sudden changes in weather and climatic conditions from Northern to Southern Nigeria for some time now have precipitated ecological and health disturbances all over the country. The two major reasons; rainy and dry seasons occur. While the dry season is experienced from the months of November-March, the rainy season occur from April-October. Temperature has been on the increase ranging from 27oC in the South to over 40oC in parts of North Nigeria. Drought condition signifying periods of severe dryness is frequently experienced. Excessive deforestation and devegetation exacerbates environmental conditions exposing the fragile environment to the prevailing inclement weather. Several wind storms transport heavy silty and sand grain dusts particles from the Sahara down south all resulting in negative impacts of desertification by the ensuing climatic change. Surface waters are severely affected by siltation or drying up in the last 30yrs. Lake chad of Nigeria have been reduced to less than 10% of its original size while many rivers, lakes and streams such as Sokoto Lake, Ali stream etc have totally dried up. Low crop yields exacerbated by intense dry weather results in food insecurity and increase in poverty level. The severe climatic changes with attendant desertification have resulted in the excessive migration of humans (men, women, and children) and their farm animals (cow, sheep, goats and poultry). Many ensuing disease such as malaria, meningitis, diarrhea, trachea diseases such bronchitis, Asthma, eye problems etc are commonplace. Excessive deaths are suffered by farm animals due to animal diseases, lack of water supply and vegetation for feeding. The southward migration causes conflicts that often result in flights, injuries and fatalities. Public health and food security implications of the recent meteorological and weather changes also abound in the south. The severe heat wave and dust storm cause enormous environmental consequents with attendant water resources implications. Excessive surface water evaporation result in heavy and thunderous rainfalls that cause water pollution, erosion and landslide during the rainy season. The economic, social and psychological implications of the resultant gully and landslides abound. Arable farmlands are now infertile. Pollution/contamination of rivers and streams are commonplace. Inhalation of the dusts catalyzes the spread of trachea diseases, catarrh and cough. High child mortality and adult morbidity attributed to the prevalent inclement weather have been recorded. The resultant implications of weather changes are more severe in the rural areas and disproportionately affect the rural poor especially women and children that depend on subsistence crop/fish farming for means of livelihood and food security. Irrigation agriculture is also affected due to siltation and drying up of available water bodies. Salinization of the coastal environment also exacerbates agricultural practices and other means of livelihood.

Desertification process should be contained through massive greenbelt/vegetation development at various locations in the Northern parts of Nigeria. The Government should look into the migration of

human, materials and animals from one part to the country to the other to solve the social ecological implications. Construction of catchment pits in farmlands and rainwater harvesting structures at homes to store water during the rainy season for use in the dry season is suggested. The ecological scourge of heat waves, desertification, wind storms, flood disasters, soil and gully erosion and pollution of water resource require multi-technique, multi-objective and integrated approach and management measures. Appropriate containment measures should be put in place to stop the excess water loss through mass evaporation. Involvement of expertise from relevant fields in the meteorological and climatic change study for the containment of the resultant global implications is recommended.

Water Related Disease and Water Handling Practices: A Case of Trachoma and Water Supply in The Gambia

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Keywords: Trachoma, Water Supply, Environment, Blindness, Global Health

Presentation of the project/topic and analysis of the issue(s)

Trachoma, world's leading cause of preventable blindness, affects the inner upper eyelid and cornea. Repeated infection leads to scarring, thickening of the conjunctiva, and distortion of the eyelid. The eyelashes begin to rub the eye, leading to corneal opacity and blindness, typically in adulthood. The World Health Organization (WHO) designed 'SAFE' strategy (Surgery, Antibiotics, Facial Cleanliness, and Environment) toward the eradication of Trachoma by the year 2020; in a bid termed Global Elimination of Blinding Trachoma by the year 2020 (GET 2020). Despite a seemingly well designed initiative, there are concerns over the mechanism of the association between water supply/handling practices and trachoma disease. Studies suggest an association between trachoma, environmental sanitation and personal hygiene, but the details of how water supply may impact trachoma have not been well studied.

This study, conducted in rural Gambia, explored epidemiologic relationship between household trachoma and domestic water handling practices in Gambian villages during 2003 and 2004 summers amongst villages with considerably high prevalence of trachoma. More specifically, the objectives of this study were: to appraise the water-handling situation in terms of procurement, transportation and usage; and draw plausible connections between the water situation and trachoma disease. Primary investigators were part of the Center for International Rural & Environmental Health (University of Iowa); Gambian Medical Research Council's Trachoma Research Team contributed to the study design and the retrieval of disease status data; and Gambian Department of State for Health & Social Services provided logistic support for fieldwork exercises.

Presentation of the results/findings

Cross-sectional study conducted in six Gambian villages where every household in each of the six villages was included in study. We conducted a follow-up survey of water use and handling practices on indigenes that had participated in previous trachoma surveillance. Data collection involved a combination of community sensitization outreach, questionnaire interviews, and informal interviews with governmental and non-governmental organizations. Univariate analyses were conducted using a combination of statistical tests to examine the association of water supply to trachoma disease. Favorable water use attributes were assigned 'least exposed', and thereafter used as the reference group to which all other groups were compared.

It is generally expected that traveling long distances to water source would invariably cause households to become stringent with water use. Households that travel 10-180 meters to wells are less likely to have trachoma disease than are those that travel 181m – 280m, 281m – 480m, and more than 480m. Although, distance is generally assumed to be the most critical factor that affects time spent on water collection, other factors like; the time of the day and condition at the water source, number of collec-

tors, individual attitude may all contribute to water collection duration. Households that spend less than 15 minutes/trip for water were less likely to have trachoma than those spending 16-30 minutes, 31-59 minutes, and 1-2 hours. As a general practice across rural Gambia, households fetch water twice a day; in the morning and evening time. This study was designed to probe further into frequency of water collection. Comparing households that visit water source 4-8 times/day to thrice/day, twice/day, and once/day, our analyses show that households collecting water multiple times in a single day may be less likely to have trachoma. We explored water and hygiene issues by focusing purely on face washing. Given that households generally observe face-washing 6 times/day as a religious practice, we explored face washing further by comparing households that wash 6 times or less to those that wash more than 6 times daily and found that households that observe face-washing more than 6 times/day are less likely to have trachoma disease than are those washing 6 times or less. Another quite notable observation was in terms of water consumption pattern. When we stratified per capita water consumption by study villages, we found that the village with both highest number and proportion of trachoma cases in the study area also has the lowest per capita water consumption.

Conclusions and recommendations

We are certain that if significant association can be substantiated, then we can also stress intervention towards trachoma elimination in the form of provision of adequate water supply. There is need for further research on identifying and establishing details about environmental risk factors of trachoma in order to design appropriate interventions for trachoma elimination by 2020 as prescribed by the WHO. Results from this research certainly contribute to the body of knowledge on issues pertinent to the local connection between water and trachoma in Gambia, and the study quite replicable in other parts of the world as trachoma remains leading cause of preventable blindness globally.

The partnership forged during this study emphasized multidisciplinary approaches to addressing public (global) health, and added tremendous value to our study in its entirety. An "Environmental Health Symposium" held in Gambia through the course of this study allowed investigators to share findings with stakeholders from governmental and non-governmental institutions in Gambia. It also allowed for brainstorming on interdisciplinary approaches to addressing the problem of trachoma – especially as it may relate to water issues. This symposium was to us a step toward bridging the gap between research and policy, and therefore reinforces the need for such practice in other research endeavors.

Water, Health and Environment in Urban Poverty Stricken Areas of Latin America

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Keywords: Health, Poverty, Urban, Infrastructure, Development

The health impact of environmental degradation in poor urban areas of Latin America is a critical issue from many points of view. For equity reasons, environmental grounds, or as a policy rationale (as well as for any combination of these factors), the matter is a vital one. Water-related matters within this broad outlook are key. The paper proposed for presentation draws comparative and wide-ranging conclusions related to water issues from a series of case studies recently carried out in the cities of Lima (Peru), Cochabamba (Bolivia), Sao Paulo (Brazil), and Moreno (Argentina) that examined (from an integrated perspective) the inter - connected issues of health, environment, and poverty in these urban areas. A series of policy and general recommendations do also emerge from the comparison of the case situations and progress identified in several specific situations.

The case studies point to crucial problems related to water and health in Latin America's poor urban areas, with the evident differences between and among different urban configurations within the metropolitan areas that have been analyzed. The general conclusion, however, remains that environmental burden of disease for the poor is very high and increasing in Latin America. Of this, a great deal is related to the access (or lack of access) to safe water and of water-borne illnesses.

Concrete evidence of these links is illustrated in the following data:
The lack of safe water in Lima is linked to diseases associated to this matter have increased to reach an estimated 22 percent in the last few years.
In several cases in Argentina it has been found that even water provided by municipal systems is non potable due to a high content of arsenic and nitrates, among other contaminants, as well as bacteria in unsafe water. Specifically in Moreno (Argentina) water-related gastrointestinal pathologies represent nearly 40% of all pathologies reported within the municipal health system.

In Cochabamba, the case study also identified the perception of illness by the urban poor related to the lack of safe water, indicating that 63 percent of the poor (with a slight gender differential) perceive that the lack of safe water is associated to illnesses.
And in Sao Paulo, a tendency of poor urban settlements developing close to highly contaminated courses of water is highly visible, with health issues associated to this adjacency.

The case studies have also analyzed the issue of water, health and poverty from an equity point of view. With concrete data from Cochabamba and Lima, it has been found that water provided by informal means (for example, through water cistern trucks) is not only highly contaminated but also it costs the poor up to eight times more than water provided by municipal systems.

Some general conclusions vis-à-vis the knowledge that links issues such as water, health and poverty in urban Latin America can be schematized as follows (following the findings in the aforementioned case studies):

Under reporting of water – related illnesses for the poor is a weighty issue, not only from a research point of view, but (importantly) from an equity and policy standpoint. It is recommended that progress in this matter be pressed by analysis to be carried out that confronts under reporting as well as unreliable official data in many circumstances.

Lack of holistic and integrated urban planning continues to plague the poorer urban regions in Latin American cities, increasing informality, meager infrastructure and their associated health problems. It is recommended that proactive policy alternatives that link health issues for the poor as related to water problems be furthered.

Lack of safe water provision has been associated in many cities with the informal property rights on land, and that progress is evident when tenure is secured. It has been recommended that a move forward to more formal situations of land tenure can lead to better water provision infrastructures and (as a result) to situations where access to safe water is also improved and progress evidenced.

Positive experiences and progress have also been identified in the case studies, and it is suggested that several of these experiences (programs of infrastructure in shanty towns, community projects, health vigilance programs, etc.) should also be analyzed in the future as to recognize the opportunities that these experiences bring to better provide for water-related issues in relation with health as well as their possible replication in other urban areas.

Public Attitude to Environmental Health: Case from Ukraine

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Keywords: nitrates, drinking water, Cherkassy region, breath system diseases, alternative drinking water

Opportunities under the Protocol on Water and Health [1] which is in force since 2005 include following issues:

- strengthening health systems
- improving the planning and management of water resources
- improving the quality of water supply and sanitation services
- addressing future health risks
- ensuring safe recreational water environments

From that perspective public involvement in the management of water resources, strengthening public participation and access to information are among priorities, in particular across Eastern European countries including Ukraine where limited traditions exist [2-3].

Public attitude to the environmental health has been researched in Cherkassy region (Central Ukraine). Selected region is a typical agricultural with constantly reported environmental threats caused by agriculture: water and soil contamination, soil erosion, biodiversity loss, reflected in aggravation health state of inhabitants. Among regional environmental problems a negative impact of warehouse of obsolete pesticides is essential: region rates forth position in terms of DDT loan per inhabitant across the county recently estimated as 0,048 kg/per person [4].Also a number of communities have a constant problems with the quality of drinking water [5].

In years 2005-2006 the quality of water in the region were tested and results were interpreted correspondently with the state of regional public heath. Research was done in cooperation with local municipal sanitation. Water samples were collected from the surface water, shallow water and selected wells. Results for shallow water taken from wells (mainly used for drinking and domestic purposes) showed an extremely high contaminated level of nitrates, iron, and manganese. Nitrates concentrations in all tested examples were over 200mg/l and exceed the maximum permissible level in a country in 5-6 times. It was concluded that population of Cherkassy region, especially children, are at the high risk of different diseases caused by nitrates, such us shortness of breath, blue baby syndrome, cardio-vascular system diseases.

Statistical data about diseases prevalence by different types of diseases in Cherkassy region were collected and analyzed. Obtained results showed the dramatic increasing in prevalence of breath system diseases, in particular for children, which can be related to drinking water contamination by nitrates.

This fact clearly identifies the necessity of further epidemiological study in order to investigate the cause-effect relations between drinking water contamination and breath and cardio-vascular systems diseases. This study was accomplished by Kyiv Medical School and fact of interconnection between contamination of drinking water by nitrates and deterioration of health state of 120 citizens of Zashkiv city, Cherkassy region was confirmed [6].

Data of analysis and their interpretation were presented for local communities during an educational campaign organized in Zashkiv, Cherkassy region in fall 2006. The necessity of using an alternative water sources for drinking purpose, in particular for children, were discussed and authority has been called to deliver a bottled water to the schools in a city or to use a water treatment system "point-of entry" at each of the schools.

The public campaign and decision made are going to improve the state of environmental health across the region and assist in avoiding and/or elimination a negative environmental impact of contaminated drinking water to the public health in the region.

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The Role of Water-Related Radiation Risk Factors in Formation of Public Health

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Keywords: radiation risk factors, population, risk, perception, public health

Presentation of the topic

The last decades are characterized by an increase of impact of different risk factors: technogenic, social and natural ones. When studying the risk factors of extraordinary situations and their consequences, an ever-growing attention is concentrated on the social and psychological factors. As known from the studies, the latter's, on their significance, sometimes exceed the impact of direct biological effects that particularly concerns radiation accidents, such as the Chernobyl accident. It is considered that the radiation security is not only a scientific and technical problem, but also, for the most part, a social and psychological problem.

In solving problems of social and psychological consequences of the Chernobyl accident, the problem of radiation risk perception by the population has been and remains the most complicated one. The rise of psychical stress can be caused by not only objective reasons, but also by subjective peculiarities of perception and individual stereotype of reacting.

The paper is intended to identify the perception of radiation risk factors of different characters by separate groups of population (adults and youth, inhabiting radiation polluted and conditionally- pure areas) and the effect of key factors, such as water-related ones, on the formation of public health.

Presentation of the results

The category of health, as a final result of the complex study, has been considered, in accordance with the determination of WHO (World Health Organization), as condition of perfect physical, spiritual and social well–being.

The express questionnaire with the points, grouped on the risk factors (technogenic, social and natural, the total number of factors has been 32) has been developed. The danger of the factors, on increasing, has been assessed on the scale from 0 to 4 points (0 is safe). To characterize the general state of health "The General Health Questionnaire" (Goldberg and Williams) has been used.

It has been shown that technogenic risks associated with environmental pollution perceive by different groups of populations (adults to 60 and students from 16 to 24) as more dangerous in comparison with social and natural risks. Radioactive and chemical pollution of the environment, as well as the diseases caused by the pollution, take up the first place. The assessments of danger caused by environmental pollution are in the range of 2.5 … 3.3 points.

For inhabitants of radiation- polluted areas, irrespective of age, sex and profession, the radiation factor remains as the main risk factor both for to- day and the future; it is estimated in average from 2.75 to 3.7 points. The presence of constant subjective radiation risk for population of these areas enhances impacts of other factors.

Among all groups of respondents, the highest assessments have got the risks connected with the presence of radioactive matters in water, soil, and food products (up to 3.88 points). The danger caused by chemical pollution of water is appreciated by the respondents to 2.47 points in average.

Unqualitative water and food products, as a total risk factor, have got the assessment in the range of 2.26 … 2.64 points by all groups of respondents.

On the whole, on the data of factor analysis of the respondents assessments, among the risk factors, which influence the formation of public health, the all-national problems, such as unfavorable ecological situation, low life level, unstable situation in the country, much exceed (their contribution makes up 70.2%) the contribution of the other factors.

The correlation between perception of radiation risk factors by the population, and the public health has been established. The greatest contribution to the total indicator of public health brings in the psycho- emotional component (72,8 %), which characterizes the conditions of anxiety , nervous stress and fear.

Conclusion

The category of health is connected with the vital activity of a human and reflects all transformations of the society. In this context, it is important to expose the interaction of environmental factors and peculiarity of individual. That gives the possibility to the society to form directedly the public health.

How to Help Self-Restoring of Water Sources

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Keywords: Uranium, Biosorbent, Mine water, microalgae, radionuclides

Environmental protection is the main problem facing humanity nowadays. There is no doubt that water, soil, and others objectives of the environment are contaminated with toxic wastes.

Mining and processing of mineral raw materials are connected at present with increasing negative effect on environment. Heavy metals and radionuclides are among the most dangerous toxicants which pass to natural ecosystems in that way. As a result perilous region transformations take place at industrial centres that may cause global breach of steady geochemical equilibrium. The Chernobyl atomic power station twenty years ago also makes the ecological situation in Ukraine and others countries worse.

Radionuclides of three radioactive groups ^{238}U, ^{235}U and ^{232}Th migrate to the environment during exploitation of the uranium deposits. But the radioactivity is mostly connected with ^{238}U group in which other natural radionuclides are the most radioactive.

A specific problem associated with heavy metals and radionuclides in the environment is accumulation in the food chain and persistence in the environment. Physical and chemical methods have been designed to remove metal ions from wastewater, but, in general, these methods are commercially impractical, either because of high operating cost or difficulty in treating the solid wastes generated.

A development in the past decade has been the use of many microbial specials such as fungi, yeast, algae and bacteria to accumulate large amounts of heavy metals and radionuclides. The principal techniques that are available in literature for the application of biosorption are based on adsorption on inert supports, on entrapment in polymeric matrix, on covalent bond in vector compounds, or on cell cross-linking. Compared with conventional methods the biosorption process offers a low operating cost, minimization of the volume of chemical and/or biological sludge to be disposed of, high efficiency in detoxifying very dilute wastewater, no toxic effect on microorganisms and no maintenance and nutrition requirements.

The aim of this work was to study the capacity of uranium sorption on the immobilized microalgae on the clay minerals.

The microalgae used in these experiments were Neocystis broadiensis obtained from Cultures collection Institute of Botany and algal biomass Scenedesmus acutus, Chlorella vulgaris and Microcoleus vaginatus obtained from joint-stock company SATER.

Microalgae were immobilized on the clay minerals too. Uranium sorption on microalgae and immobilized microalgae were adjusted to pH 6,0 (≈ natural water pH). Equilibrium isoterms were obtained from batch equilibrium experiments. The initial concentration of uranium was 100-1500

μmol/l. Desorption experiments were done using reagent solution: H_2O, NaOH, HNO_3, EDTA, HCl, Na_2CO_3, $NaHCO_3$, humic acid.

The sorption pH has been identified as the most important variable governing uranium adsorption in biosorbents. Uranium exists in solution at pH ≤ 5,0 mostly in the form of UO_2^{2+} ions. However, if the pH of the solution is increased up to 6,0-6,5, only hydrolyzed forms such as $UO_2(OH)_2$, $(UO_2)_2(OH)_3CO_3^-$ and $UO_2(OH)^+$ are present.

The carboxylic groups are generally the most abundant acidic functional group in the microalgae. Sulfonic acid groups play a secondary role. Hydroxyl groups are also present in all polysaccharides but they are less abundant and only become negatively charged at pH ≥ 10, thereby, also playing a secondary role in metal binding at low pH.

Consequently, the following experiment was conducted at pH 6 to comply with requirements maximum of uranium sorption and suitable pH of nature water. The model used to describe the results should be capable of predicting uranium binding at both low and high concentrations. The Langmuir adsorption isoterm has traditionally been used to quantify and contrast the performance of different biosorbents.

Depicts the main data obtained from studies of the sorption of uranium ions at pH values of 6,0 on the algal biomass (Scenedesmus acutus, Chlorella vulgaris and Microcoleus vaginatus), algae Neocystis broadiensis and montmorillonite (in next experiments used as material for algal biomass immobilization). Algal biomass and algae Neocystis broadiensis demonstrated high efficiency to uranium sorption (500 and 400 μmol/g accordingly) is an excellent candidate for use as material for mobilization to remove uranium from wastewater.

Sorption isoterm of uranium on immobilized algal biomass are illustrated maximum sorption of uranium and quantities of uranium forms with negative charge are insignificant.

The methods for biosorbent desorption whith have been demonstrated comprise washing with reagent such as dilute mineral acids, sodium hydroxide, carbonate, hydrocarbonate, chelating compounds (humic acid, EDTA).

Approximately 45-55 % of U was desorbed from the algal biomass. A 30-40 % desorption was obtained on clay minerals. Sodium carbonate and hydrocarbonate has the best desorption efficient among the chemical reagent tested. Desorption of U from immobilized microalgae on clay minerals was decreased comparatively on algal biomass and clay minerals. The removal of uranium from aqueous solution by immobilized microalgae at pH of nature water was influenced markedly by speciation of uranium concerned. Fixing uranium on immobilized microalgae is efficient then on clay minerals and microalgae individual.

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Valuing Health Effects of Wastewater Use in Irrigated Agriculture: A Study in Hyderabad, India

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Keywords: wastewater use, health, irrigation, human capital approach, cost of illness

Many cities in developing countries are increasingly using untreated or partially treated wastewater to irrigate their cities' own food, fodder and green spaces. Water supply ensures wastewater because the depleted fraction of domestic and residential water use is typically only 15-25 per cent with the remainder returning as wastewater. Given the rate of urban growth in developing countries and the lack of adequate wastewater treatment facilities, the use of wastewater for agriculture where cultivable land is available in the peri urban areas is likely to increase in the future. It is more and more realized that wastewater is a complex resource, which has both strong positive and negative aspects. While the nutrient rich wastewater is a reliable source of irrigation for farmers in the peri urban and semi arid regions, it is accompanied by various environmental and health hazards.

Wastewater is sometimes referred to as 'marginal quality water' in irrigation terms. This refers to water whose quality might pose a threat to sustainable agriculture and / or human health, but which can be used safely for irrigation provided certain precautions are taken. It is the toxic substances contained in the wastewater that imposes environmental and health hazards. These hazards depends on a range of factors such as volume and source of wastewater, composition of wastewater, degree or level of treatment before use, management aspects related to disposal/ distribution of wastewater and management aspects including methods of application, related to farm level use of wastewater, etc.

It is known that wastewater contains pathogenic micro-organisms such as bacteria, viruses and parasites which is a public health hazard. The present paper based on a case study of Musi River in Hyderabad deals with the health hazards related to the use of wastewater for irrigation. While wastewater irrigation poses health hazards to the producers due to exposure and proximity to wastewater, the consumption of crops produced using wastewater poses risks to the health of the. In this paper, the specific focus in on the health of the producers who are constantly exposed to wastewater by way of irrigation.

A survey was conducted in the peri-urban areas of Hyderabad where the use of wastewater is an important source of livelihood. The first round of the survey was carried out during December 2005. The study area selected for this study comprises of six villages in and around Hyderabad along the Musi River belt. In this survey, baseline information on the demographic and socio-economic characteristics as well as those related to the involvement of households in various wastewater based activities has been collected using a short questionnaire. The study area had over 2312 households with a population of 10860.

The households reported agriculture and related activities as their main income generating activity. The important crops grown in this area are vegetables, paddy and paragrass for cattle. Roughly about 40 per cent of the households are either farmers or agricultural labourers. We estimated the total workforce in these villages as 44 per cent of the total population. Out of these, majority are exposed

to various types of wastewater-based activities. Largest number of people is exposed to wastewater by way of their own farming activities. Nearly 3228 people are exposed to wastewater in this way. Agricultural operations such as land preparation, irrigation, transplanting etc are major pathways of various health problems. Various agricultural practices, which are mainly without any protective measures, expose the population to various kinds of infections like Helminth infections. Moreover, it is seen that considerable number of women are engaged in agricultural practices who are also engaged in various household activities. With generally low levels of hygienic and sanitation facilities available in these villages, women and children are more exposed to health problem. Besides the population engaged in own farm activities as many as 1900 people are engaged in agricultural activities as labourers. Dairy is found to be another important wastewater based activity in terms of labour absorption where nearly 971 people were reported to work either as owners or as labourers. A large number of people also depend upon wastewater for washing clothes, which is mostly done by washer men and not specifically for domestic purposes.

Health cost is an important cost identified with the use of wastewater. An indepth second round of survey covering about 400 households has been carried out during 2006-07. Using the data from this survey, economic costs of illness is estimated using human capital approach. This approach considers people as the economic capital and earnings as returns to investment. Here the focus is on the impact on human health due to bad environmental conditions and the effect this has on the individuals and society's productive potential. To estimate the economic costs, two variants are tried. One is the loss of earning due to wastewater and cost of medical treatment. Using this information, the present value of labour productivity losses due to wastewater related diseases is estimated. It is seen that those who are directly exposed to wastewater with poor in-house hygienic conditions are suffering more from wastewater related illness than those who are exposed to wastewater with somewhat better in-house hygienic conditions. It is also seen that very few households were incurring costs for medical treatment as where as loss of earnings due to illness was quite substantial. The low medical treatment costs is due to the fact the households are not having proper access to medical facilities in the vicinity and therefore, they are suffering in silence as result of which the loss of productive days is very high.

Quality Aspects of Reclaimed Water & Reuse in Jordan

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Keywords: reclaimed water, reuse, marginal water, standard, sustainable

In this paper, I will present a summary about Jordan experience as a developing country in quality aspects of reclaimed wastewater and wastewater reuse and the following subjects will be discussed, wastewater quality & quantity, Reclaimed wastewater standard, monitoring activities, treatment plants efficiencies, cost of treatment, a full description of Wadi Mousa reuse pilot project that shows, Jordan Experience in Reclaimed Water Management and the successful progress of safe water and sanitation programmes carried out in Jordan.

In Jordan water is becoming an increasingly scarce resource and planners are forced to consider any sources of water which might be used economically and effectively to promote further development. Whenever good quality water is scarce, water of marginal quality will have to be considered for use in agriculture. Although there is no universal definition of 'marginal quality' water, for all practical purposes it can be defined as water that possesses certain characteristics which have the potential to cause problems when it is used for an intended purpose. For example, municipal wastewater is a marginal quality water because of the associated health hazards. From the viewpoint of irrigation, use of' marginal' quality water requires more complex management practices and more stringent monitoring procedures than when good quality water is used.

This important resource, reclaimed water, has been considered from the highest level of Jordan government that it has a full value to the overall water resources of the country as stated in the Jordan's water Strategy, formally adopted by the council of Ministers in May 1997. Since the early 1980s the general approach has been to treat the wastewater and either discharges it to the environment where it mixes with fresh water flows and indirectly reused downstream, or to use the resulting effluent to irrigate restricted crops. Jordan is in the process of rehabilitating and expanding its wastewater treatment plants and reclaimed water, appropriately managed, is viewed as a major component of the water resources supply to meet the needs of growing economy. Appropriate standards and guidelines has been set to allow for a wide range of wastewater reuse activities including, highly treated reclaimed water for landscapes and high value crops.

Almost 60% of the country's population is connected to the sewer system and the the volume of treated wastewater available in Jordan in 2006 was 111.8MCM/year pumped to 22 treatment plants and the discharged water was about86.2 MCM\ year. The Characteristics of wastewater is mainly comprised of water (99.9%) together with relatively small concentrations of suspended and dissolved organic and inorganic solids. Among the organic substances present in sewage are carbohydrates, lignin, fats, soaps, synthetic detergents, proteins and their decomposition products, as well as various natural and synthetic organic chemicals from the process industries. Municipal wastewater also contains a variety of inorganic substances from domestic and industrial sources including a number of potentially toxic elements such as arsenic, cadmium, chromium, copper, lead, mercury, zinc,… etc. However, from the point of view of health, a very important consideration in agricultural use of

wastewater, the contaminants of greatest concern are the pathogenic micro- and macro-organisms. For example Escherichia coli are the most widely adopted indicator of faecal pollution and they can also be isolated and identified fairly simply. With the current emphasis on environmental health and water pollution issues, there is an increasing awareness of the need to dispose of these wastewaters safely and beneficially. Use of wastewater in agriculture could be an important consideration when its disposal is being planned in arid and semi-arid regions. However, it should be realized that the quantity of wastewater available in Jordan will account for only a small fraction of the total irrigation water requirements. Nevertheless, wastewater use will result in the conservation of higher quality water and its use for purposes other than irrigation. Properly planned use of municipal wastewater alleviates ground and surface water pollution problems and not only conserves valuable water resources but also takes advantage of the nutrients contained in sewage to grow crops. Ministry of Water & Irrigation / WAJ inaugurated a waste water pilot project at Wadi Mousa in collaboration with the US Agency for International Development (USAID) and it is one of the three similar schemes under way in the kingdom, the others in Aqaba and Jordan University of Science and Technology. The primary objectives of this national project are to implement direct reclaimed water reuse that is reliable, commercially viable, socially, acceptable, environmentally sustainable, to demonstrate the safe, reliable and sustainable use of reclaimed water, maximizing limited water resources and ensuring compliance with standard and allow Ministry experts to plan, mange and monitor sustainable water reuse projects throughout Jordan. The project is focusing on water reuse applications that have a direct benefit for agriculture and it has successfully established approximately 1069dunums for cultivation including fodder and forages, as well as edible nuts of several varieties palm trees and olunamental plants for landscaping and the activities of the project will be shown during the presentation.

Solvatten - A Portable Container with Inbuilt Purification System Using Solar Energy and a Built-in Filter

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Keywords: drinking water, solar energy, purifying, house hold perspective, portable container

Background

More than 1,2 billion people in poor areas of the globe lack access to safe drinking water. This in spite of that safe drinking water is a fundamental human need – our health and life depends on it. In areas with insufficient or unsafe water access to safe water must be arranged locally or at household level.

We have developed and tested a new system for purifying water at household level. The patented invention is a specially designed container for water cleaning using solar energy. The container consists of an absorbent surface, an UV transparent lid, a re-settable temperature indicator and a textile filter. This unique combination has in the lab and in field testing been able to purify contaminated water and making it safe. The Solvatten is an improvement of earlier tested water cleaning systems.

Material and methods

The unit

The Solvatten consist of a rectangular, thin plastic box with a foldable double container, with a re-settable temperature indicator inside. The total capacity is 6 litres (3 l in each container). Through the transparent side the water is exposed to the heat and UV radiation of the sun. The opposite side of the container is in a heat absorbing black colour. Each unit has two wide, sealable openings for filling and pouring. The openings for pouring and filling are covered with a fine woven cloth filter. Between the two openings, an bimetal device indicating when the temperature has reached 60 ºC. The two container units are attached by a hinge and can be closed as a book making the two transparent sides face each other. Folded open, the transparent sides are directed towards the sun. The Solvatten instructions are easy to understand and are attached to the container.

When used, each container is filled with potentially unsafe water through one of the openings. The filter cleans the water from larger organisms carrying pathogenic microbes, e.g. plankton with cholera bacteria, amoebae, etc. The unfolded container is placed with the transparent sides facing the sun and its energy id absorbed by the opposite black sides In a sunny environment. The water's temperature reaches 60 ºC within 3 hours, which is enough to kill harmful bacteria and water born viruses, such as Rotavirus, Salmonella, Shigella, E-coli, V. cholerae, worms and Protozoa. The UV radiation also inactivates the DNA of the bacteria. A re-settable, easy to read temperature indicator indicates with a "happy face" when the water temperature has reached 60 ºC.

Results

Laboratory tests

Laboratory Manager, Pär Ahlejung, at Norrvatten, Stockholm Sweden has undertaken laboratory test with contaminated water. A solution with 100.000 E. coli bacteria / ml was added to the water. The Solvatten was used according to instructions and repeated standardized tests showed that within

3 hours of artificial sun-light (UV-A radiation) exposure all bacteria were inactivated. This is in line with WHO benchmark standard for safe water.

Field studies

Tests have been undertaken in Indonesia and South Africa and within 3 hours of sun exposure the water temperature reached 60°C.

Tests were also made in Sweden during the month of July. A total of 6l container was sun exposed during 3 hours. The temperature reached 60°C in all of the containers. Simultaneous comparative tests between the Sodis (solar disinfection using PET bottle) showed that the temperature in the Sodis never reached above 49°C while Solvatten reached 60°C.

In cooperation with UN Habitat and Vi Skogen, Sweden more test have been planned in rural and other parts of Africa during spring 2007. Preliminary results from these studies will be presented at the meeting.

Conclusions

A new 6 litres container for both storage and cleaning water using solar energy, with an innovative thermometer and a built in filter system will be presented. During optimal conditions water can be made safe within 4 hours. The intended user of Solvatten is household and it can easily be used by all family members, including children. Preliminary tests have been promising. More advanced tests in poor rural settings are planned for spring 2007. Solvatten is a significant improvement of earlier water cleaning system at house hold level.

Economic Analyses of Use of Wastewater in Agriculture: Ethiopia

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Keywords: wastwewater irrigation, Health risk, Livelihood, Cost-benefit, Ethiopia

Sub-Saharan countries, in general and Ethiopia in particular, are facing major challenges with regard to alleviating the persistent problem of poverty. Agriculture is the backbone of the economies of these countries, and yet it is rain fed, hence, their people are subject to frequent droughts. With a population of 75 million, growing at 3% per year, Ethiopia's economy is dominated by subsistence smallholder agriculture, which accounts for 44% of GDP and 85% of employment (SDPRP of Ethiopia, 2005).

The increase in population coupled with the high dependency on agriculture contributes to increased demand and competition for the limited water resource, which calls for an efficient management of the resource. Therefore, in light of this scarcity and competition, there are different options for developing and using water for different use including food production. The options include, among others, rainwater harvesting, development of wetlands, use of surface water and ground water, reuse of municipal wastewater and desalination. The reuse of wastewater in agriculture is a common practice in the world that has both positive and negative impacts, which are reflected through impacts on crop production, public health, soil and property values (Scott, C.A.; et al 2004.)

Addis Ababa, with a population of about 5 million, is the capital of Ethiopia and the seat of the African Union and other international organizations. It is the economic center of the country but offers limited access to basic social service to its people. Rivers and streams flowing within the city serve as sink for both solid and liquid wastes. The wastewater from the city is used for vegetable production within the city and in its vicinity, and serves as source of livelihood for many poor people. It is estimated that at least 60% of the vegetable market is supplied from wastewater-irrigated urban and peri-urban agriculture. Despite this fact, the use of wastewater from the city is being condemned and denied by government officials and health professionals due to the health impacts from the consumption of these vegetables. However, important policy questions such as: 'whether the practice of wastewater use in agriculture in the city and downstream should be discontinued?' cannot be answered because of lack of reliable information, especially on the importance of wastewater irrigation in (peri) urban livelihoods.

This paper reports on on-going research on how to maximize the economic benefits and minimize the health risks of wastewater use in agriculture and thereby improve the livelihoods of the poor farm households through better management of the wastewater resources. In the study both quantitative and qualitative data are used from household level surveys and focus group discussions in areas of wastewater and freshwater irrigation. Currently both univariate and multivariate econometric methods are used to analyze the data.

Preliminary study result revealed that wastewater-irrigation practices started in and around the city in 1948. The farmers are producing different high-valued vegetables including cabbage and lettuce. About 69% of the farmers acquire their farm plot through government allocation and small propor-

tion lease to grow vegetables. Though higher proportion of the farmers are envisaged to farm on the plot at least for the next 10 years, some are not secured to farm on their current plot even for next year due to fear of losing their plot by the government and the fast rate of horizontal expansion of the city with in the last few years. About 21% believe that wastewater use in agriculture can pose health problem on both producers and consumers, whilst the majority strongly agree the presence of bad smell or odor in their village due to the wastewater especially during the dry season. However, 88% respond that they are benefited from the wastewater by growing vegetables and used as source of livestock drinking water despite its bad odor. Given its potential health risk, almost all farmers are willing to practice safe irrigation methods to minimize the potential health problem associated with working on wastewater farm plot and eating vegetables produced using wastewater if techniques are available for them through training and other means. Overall, the wastewater does not only serve as means of survival for wastewater irrigators, it is also benefiting the residences of the city as source of employment through marketing channels and source of vegetable food. The public health risk due to the discharge of industrial and other establishments' waste can be minimized using safe irrigation method and introducing enforcing mechanisms to control industrial pollution.

Workshop 3: Progress on Management Reforms for Better Services

Reforming Nigeria's Urban Water Sector for Better Services Delivery

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Co-Author: **Ms. Ifeoma Charles-Monwuba**
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Keywords: Water sector reform, Public Private Partnerships, Millennium Development Goals, Water management, civic engagement

The Bread of Life Development Foundation and WaterAid Nigeria submit this abstract jointly.

The Bread of Life Development Foundation is a Water policy advocacy NGO and monitors the implementation of the urban water sector reform projects in Nigerian to mainstream pro poor concerns. WaterAid Nigeria Urban work seeks to support urban utilities in their reform process while facilitating the setting up of community involvement in governance, which will ensure sustainability and protect the interest of the poor.

Introduction

In Nigeria, Water supply is a state responsibility. And to this end state governments have created State Water Agencies (SWAs) to manage and operate systems for water service delivery in all Urban and in some semi-urban areas. Generally, the SWAs have failed to water services to the people. Most SWAs do not recover their operating expenses from their own revenues, and remain dependent on state governments for subsidies.

To address this problem, the Federal Government in 2002, launched the 1st National Urban Water Sector Reform Project in 2004 at the Federal level in Ogun and Kaduna states, and the 2nd NUWSRP 2005, at the National level and in Lagos and Cross Rivers.

The Urban Sector Reform projects are aimed at improving water governance, encouraging private sector financing of water supply projects throughout the Federation; and specifically to improve delivery of water services to urban residents in the four states by launching Public- Private Partnerships (PPPs) for the management of the water boards. The states are to serve as model states, and if the PPP experience is successful in the states, project will be replicated in other states in the country in the future. The World Bank is financing the 1st and 2nd NUWSRP with a $120m and $220m International Development Association IDA credit respectively.

Issues

The perfomances of almost all previously finaced World Bank financed water projects in Nigeria have been unsatisfactorily and the projects unsustainable. There is therefore an apprehension within civil society groups that this may be another of such. Moreover, the implementation of the on going National Urban Water Sector reform projects raises critical questions of water pricing and water access to the Urban poor within the water distribution areas. There exists therefore a need to mainstream pro-poor concerns into the project, and also increase public understating and participation in the project. The citizens need to be armed with adequate

information to monitor the Water Sector reform projects, and ensure its transparency and openness.

In November 2006, WaterAid Nigeria commissioned the Bread of Life Development Foundation to carry out a research on the on going 1st and 2nd World Bank financed Urban Water sector reform programme, particulalry its implementation in Lagos, Nigeria's most populous state. The objectives of the study include: to outline key contextual issues relevant to the success of the implementation of the 2nd NUWSRP; and also to analyzes the project components with a view to identifying its strengths and/or shortcomings in relation to pro poor programming among other objectives.

Presentation of the results/findings

1. The study confirms the widely held belief that the performance of the public water utility in terms of regular supply, water quality and customers service is poor, appalling and dismal.
2. Public acceptance of the reform agenda: one of the findings of the study is that quite substantial number of households users surveyed offered support for private sector participation in water services delivery. What accounts for this? Consumers have been offered very poor services by the public water utility, and they felt if Public Private Partnerships in water supply could solve the problem, so be it.
3. The Lagos State Government does not strictly adhere to World Bank's policy and recommendations on project implementation. These include proper constitution of a Water Governance Structures- State Project Implementation Unit, a Project Steering Committee, public disclosure of environmental impact assessment, civic engagement, transparency and openness, and surprisingly on pro poor focus.
4. The level of project implementation is low partly because the World Bank Country office in Nigeria does not have the human capacity to monitor project implementation in an effective and timely manner. Most projects preparation documents are often referred to the World Bank Headquarters in Washington resulting in delays in project implementation. Also partly because an independent State Project Implementation Unit had not been properly constituted by the client.
5. Water consumers and the urban poor are ignorant of the reform process. They are largely uninformed on the reform process by the Government and also excluded from civil society debates on the reform process.

Conclusions and recommendations

Civil Society groups and in deed the World Bank should ensure that the Nigeria Government and Government agencies at the Federal and in the Client states implementing the Urban Water Sector strictly adhere to project guidelines and waters State be properly constituted immediately and be allowed to independently run its activities.

As part of the reform process, there should be an organizational restructuring within the State Water Board, to accommodate the set up of a "Pro poor unit".

Training courses should be organized to increase the technical capacity civil society groups to monitor the project and they are also expected to initiate programmes of engagement

The convocation of a Stakeholders Forum on water sector reform as a platform for civil society-government engagement.

The World Bank should increase the human capacity of its Country office in Nigeria to supervise project implementation in an effective and timely manner.

Water Services Management in Latin America: Public or Private? Discussion Based on Four Cases Studies

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Keywords: Latin America, public-private partnerships, water services , management, water governance

Presentation of the topic of the research paper

This research paper reviews and discusses elements within the water services sector with the aim of analyzing the appropriateness of public versus private models of providing and managing water and sanitation services. It advocates for reforms to inadequate national water policies and management frameworks that do not aim for cost-efficient use and reliable universal access to potable water. To achieve efficiency in the use and allocation of water, and affordability of prices in its delivery to consumers, private participation in the water services sector might bring benefits and should not be discarded just because of a political or ideological position. Better management practices, along with well-suited institutional arrangements, are needed to meet the Millennium Development Goals (MDGs) on water supply and sanitation; it does not matter if water services are run by a public or a private entity, what matters is what type of arrangement is best suited to provide the service efficiently, improving coverage and at the lowest costs possible, while taking into consideration the socioeconomic, cultural, and physiological importance of water for every person.

In Latin America, where the four case studies presented in this paper take place, the subject of privatization of public services is still today a source of controversy within the debates of public administration reform. The design, or redesign, of institutional and regulatory frameworks to manage water resources and services is in a transitional phase.

Findings and Conclusions

The case studies presented in this paper, Buenos Aires, Cochabamba, Cartagena de Indias, and Santiago de Chile, are cases in which there has been private participation in the water services sector. Each case presented shows its own particular experience with regards to governance, the institutional arrangements, and the particular socioeconomic conditions that were in place at the time of the private sector's participation. They also have particular results of that experience. Indicators that are measured include the percentage of population with access to water and sanitation services before private sector's particpation, the trigger to promote change and include the private sector in a traditionally public-managed sector, type of bidding process to contract the private sector, the institutional arrangement set up, challeneges during the period of performance, percentage of population with access to water and sanitation at time 2, and its relation with the Millenium Development Goals. The paper concludes that private sector participation in water services in Latin America may increase the possibility of reaching the targets established in the MDGs, but that can only happen if: 1) an appropriate financial scheme for water tariffs is in tune with the costumers ability to pay, 2) a solid institutional arrangement and a regulatory framework are in place, 3) an active citizen participation at the community level is present, where solutions for water problems should grow (bottom-up perspective) byconsensus.

Phnom Penh Water Supply Authority: Radical Reforms Transform War-Torn Utility

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Keywords: Phnom Penh Water Supply Authority, nonrevenue water reduction, cost recovery, urban water supply, institutional reform

Cambodia 's Phnom Penh Water Supply Authority (PPWSA) can now proudly claim service efficiency, greater water productivity, and increasing consumer base. But it needed radical measures to transform itself from a decrepit and war-torn water supply system with missing water and missing customers.

Looking Back

In 1993, the state of Phnom Penh's water supply system was prime evidence of the devastation left by Cambodia's 20-year civil war and the Khmer Rouge rule.

PPWSA, the Government-owned water supply utility whose capacity has shrunk to 40% between the 60's and early 90's, was barely functioning. Employees were demoralized and underpaid. Only 25% of the population had water, and only 13% of connections were metered. Only 28% of the water produced for the system was actually sold, with the collection rate not even reaching 50%. Illegal connections were rampant, contributing to the 72% nonrevenue water. Even worse, the authority's employees were responsible for much of the water theft. They were installing illegal connections at US$1,000 per connection and receiving kickbacks from large consumers in exchange for lower meter readings.

Culture of Change

Upon his appointment to PPWSA in 1993, Ek Sonn Chan, with assistance from external funding agencies like the Asian Development Bank, initiated a "culture of change" within the organization, starting with the education and motivation of PPWSA's staff. This was followed by a flurry of reforms, including

- streamlining the organization's workforce
- improving collection levels
- rehabilitating the whole distribution network and treatment plants
- minimizing illegal connections and reducing unaccounted for water
- increasing water tariffs

Today, PPWSA's water service covers 100% of the inner city Phnom Penh and is being expanded to surrounding districts, with priority given to urban poor communities. In particular, PPWSA now serves 15,000 families in 123 urban poor communities, giving the poor extra privileges such as subsidized tariffs or connection fees, installment connection fees and more.

Non-revenue water has also decreased from 72% to 8%, while collection efficiency is now at 99.9%. Its 147,000 connections, up from 26,881 in 1993, bring reliable and safe drinking water to all of Phnom Penh's one million inhabitants 24 hours a day.

Lessons from PPWSA's Experience

Here are some lessons from PPWSA's experience:

- Water Doesn't Have To Be Free. PPWSA demonstrates that access to water does doesn't have to be free and that the urban poor will be considerably better-off paying for safe, piped water than they would be buying water of questionable quality from private vendors.

- Cost Recovery is Vital. By developing a tariff structure where the utility fully recovers its cost of water production and transmission as well as operation and maintenance, PPWSA has become financially viable and is now able to invest in the water infrastructure.

- The Operator Must Be Autonomous. Although the PPWSA is still government-owned, it has enough autonomy to develop its payment structure and culture with an enthusiastic and motivated staff responsive to consumer demand, and efficient operations where revenues pay for infrastructure development.

- Government Support is Crucial. The tariff restructuring, which paved the way for PPWSA's greater revenues, would not be possible without the support of the Government of Cambodia and the development agencies.

- Civil Society Must Be Involved. The remarkable increase in bill collection and reduction in illegal connections highlights the importance of involving users and civil society in a service that they want and are willing to pay for.

- Investing in Staff Yields Radical Results. Today's PPWSA employees are hardworking, responsible and self-motivated. PPWSA professionalized its workforce, building its technical capacity and instilling in its employees a work ethic of discipline, competence and teamwork.

When Ek Sonn Chan introduced the "culture of change" to PPWSA, he started the utility on the road to recovery. With each reform that PPWSA has taken, he has been its driving force, leading his staff and the community by example, and highlighting the need for a champion who will carry the reform from idea to action.

PPWSA has shown that through a transparent environment where water utilities have sufficient autonomy, where tariffs can cover costs, where service is equitable to all and where there is the active involvement of staff and civil society, clean water targets can be met.

Enhancing Water Utility Management through Regulation by Incentives in Zambia

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Keywords: regulation, incentives, commercial utility, management, water

Scope of the Paper

Zambia has decentralised and commercialised water supply and sanitation services to address the challenge of bringing clean water to every household – especially the poorer ones. Commercial water utilities (CUs) which are publicly owned but privately operated have been established throughout the country starting in 2000. An independent regulatory agency, the National Water Supply and Sanitation Council (NWASCO), has been set up to regulate these service providers. NWASCO using several tools such as service level agreements, guidelines, benchmarking and comparative competition has fostered performance improvements among the CUs. Since the onset of these reforms significant progress has been achieved in WSS service delivery particularly the service hours, quality of water and customer care. In this paper, we will analyse the impact of regulation by incentives on the improvement of performance of water utilities in Zambia.

The Commercial Water Utilities have been established as private companies by the Local Authorities with Board of Directors appointed from public and private sector as well as civil society. The institutional set-up is conducive for improved management of WSS services. There are, however, still major hurdles to overcome. In the current set-up, two major weaknesses for persisting underperformance of some utilities have been observed:

1. Weak Management largely due to public service mentality; lack of commercial mindset with mainly technical focus
2. Weak Corporate Governance: good structures in principle but poor implementation; weak supervision of management by boards e.g. failure to replace underperforming managers

Regulation in an environment where corporate governance and the commercial mind set of doing business are weak requires innovation beyond traditional regulatory instruments. In such a situation, managers are not necessarily deterred or motivated by the prospect of a fine by the regulator for non-compliance to certain issues. Therefore, additional incentives are needed to ensure compliance and improved management of WSS services. In Zambia, some of these have already been implemented and generated some positive results.

Results and Findings

Attitude and motivation of the top management of any company is the key to performance improvements. Especially former public service workers have to be continuously educated and reoriented to adopt a more commercial and business approach in running of water services. Setting the right incentives by the regulator can be an important external motivation to speed up this process. The following are some of the findings on regulatory incentives in the Zambian case :

- The incentives used in regulation have to be designed in a way that will drive the management of utilities to achieving set targets. Therefore, the regulator first needs to know what will drive the management in their particular environment.

- In Zambia, a very powerful tool has turned out to be the emotional incentives. All managers would want their CU to come out as the best in the highly publicised annual awarding event. It is a major embarrassment for the managers if their Board and their customers hear about a CU being last. On the other hand, a good ranking in a benchmarking exercise published by the regulator will increase amongst others the employability of the top management and increase their market value. Managers of poor performing CUs are under pressure from the customers for better service delivery.

- The application of emotional incentives is a highly cost efficient way of improving the management performance of service providers. A successfully tested scheme in Zambia comprised mainly the procurement of several trophies as well as small monetary awards of USD 5,000 and less.

- Financial Incentives are an effective tool to achieve very specific regulatory targets. Financial incentives help to reach the set targets much faster. Additionally, financial incentives are very useful in getting the CUs to aim at targets which may not necessarily be CU priorities such us extension of WSS service to poor urban areas.

- Financial incentives are most efficient within the framework of incentive regulation when targeted directly at senior management. Managers make greater efforts when they are personnally benefiting from incentives compared to the situation where the CU as a company receives additional funds. The managers set the priorities in the company and will use a wide range of instruments (e.g. an internal incentive scheme) to direct the other personnel to go on the path they have chosen. Given the limited resources that are usual at the disposal of the regulator for an incentive scheme, it is not advisable to include personnel beyond the top management even though this is often considered as unfair in the African context.

Conclusions and Recommendations

- A prerequisite for the introduction of regulation by incentives is the availability of adequate capacities and regulatory instruments to properly assess the achievement of targets. Otherwise, the regulator risks losing its credibility.

- Regulation by incentives is a means to make regulation more effective in an environment where the commercial mindset and weak corporate governance is prevailing.

- The Zambian experience clearly shows that the combination of emotional and financial incentives is most effective in bringing about improved utility management. Emotional incentives are particularily cost effective.

- The introduction of special incentives in regulation can have a major impact on achieving regulatory targets in cases where they deviate from the CU priorities.

- Introducing regulation by incentives in Africa can hasten significantly the improvement of utility management and the attainment of the Millennium Development Goals (MDGs) for water supply and sanitation.

Rural Water Supply System Service Delivery - Experience from Sri Lanka

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Keywords: rural water, decentralization, local authorities, operation and maintenance, sustainability

An estimated 78 percent of Sri Lanka's 20 million population live in rural areas with water supplies that are largely traditional and rudimentary, commonly not meeting accepted basic standards of quantity, quality and convenience. To improve this situation the government has, over the past 15 years, implemented several large-scale Rural Water Supply (RWS) projects. Although legal responsibility for provision of safe rural water supplies lies with Local Authorities (LAs), they are institutionally immature; have weak human capacity and are financially constrained. Consequently they have failed to perform as desired and oversight of RWS has fallen by default to Central Government agencies.

The initial Community Water Supply and Sanitation Project (CWSSP) (1993-1999), supported by the World Bank, piloted a community-based approach to service delivery and management, where Community Based Organizations (CBOs) were involved in RWS system design, construction and management. Implemented through a central Project Management Unit (PMU) and local Project Implementation Units (PIUs) working directly with the CBOs, the project did not appreciably involve LAs in service delivery. A similar community based approach was adopted by the Asian Development Bank assisted RWS Project (1998 – 2006) but did involve LAs as a partner for service delivery, anticipating their active involvement as an Operation and Management (O&M) back-up support agency for CBOs, who would manage the water systems. These two projects provided water services to some 2 million people.

To-date there have been no detailed project evaluations, but monitoring data show service delivery under these projects was generally successful, with quantitative targets being exceeded. Although CBOs are managing most of their RWS systems effectively, nevertheless, the main drawback in this approach is the lack of back-up support by project management or by LAs during the commissioning and O&M stages.

The follow-up World Bank-supported 2nd CWSSP (2003-2009) attempted to address this vital sustainability issue by piloting a highly decentralized project implementation strategy. Project design was based, inter alia, on the notion that testing decentralization on a limited scale would probably fail as entrenched central agency vested interests would resist such reform. It was thus decided to support a more comprehensive and aggressive decentralization model than in the earlier projects. For the first time in Sri Lanka, LAs were given the responsibility of implementing a large community-based RWS project, with the Central Project Unit acting principally in an advisory and monitoring role. Under this project, by end of 2006, approximately 180 sub projects serving some 180,000 people had been completed and were in operation.

However, recent studies show that so far, there is no indication of LAs emerging as effective and mature institutions for RWS service delivery. LAs are still constrained by: (i) lack experience in, and empathy

for, community-based program implementation, and (ii) conflict of priorities having responsibility for all municipal demands such as solid waste management, rural roads and drainage. It seems probable that the potential benefits of RWS decentralization will remain illusory while the overall LA system remains weak. The problems of LAs are one of Sri Lanka's big national issues and therefore need to be addressed holistically from a national perspective. A key lesson learned is the difficulty of sustaining LA interest in RWS activities once project support is withdrawn. This is understandable as LAs are not resourced to provide adequate O&M support to CBOs for activities such as pump repairs, well flushing and water quality testing. Experience has also shown that channeling RWS projects through LA requires much effort, diluting the project's main focus on community-based participatory development. Although devolution of key functions to LAs may be an appropriate long-term solution, LA capacity limitations preclude short-term success. Due to the difficulties experienced working with LAs, many donors prefer other service delivery models. LA capacity development is a slow process which will need substantial resource allocation as well as sustained political will and commitment. But from a rural community perspective the practical issues of scheme timeliness, reliability, affordability and sustainability are probably more important than the issue of "centralized" vs. "decentralized" approach to service delivery.

Experience suggests that scheme sustainability depends largely on project implementers achieving effective service delivery and building CBO capacity sufficient to manage their RWS systems in a transparent and community-responsive manner. Although the LAs oversee the program, the present RWS service delivery approach effectively devolves decision making and implementation / management responsibilities to participating communities. To date this approach has proven to be the most appropriate and successful RWS model for Sri Lanka, with CBOs are not only managing RWS services successfully, but also venturing into other rural infrastructure and socio-economic development activities. On the basis of this experience, the CBO is clearly the key to RWS implementation, management and sustainability. A "strong" CBO, irrespective of the level of decentralization adopted, is better able to find the most appropriate solution for any required O&M back-up support. The conclusion is that stronger community development effort and appropriate technical solutions in service delivery are the keys to successful and sustainable RWS development. So attempts to reform delivery mechanisms, must ensure that "people centered", "demand responsive" and "community plan/construct/own/manage" concepts proven to be successful are repeated and adopted.

The Reform and Modernization Process in the North Governorate Water Administration, Jordan

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Keywords: Water Utility Policy, Milestone Concept , Managing Consultant, Public Commercial Company, Private Sector Participation

In 1997 the Government of Jordan embarked upon a privatization programme, the goal being to orient Jordan's economy towards the private sector and best present Jordan to the international financing community.

The objective of the programme includes increasing the efficiency of enterprises, consolidating public finances, attracting private investment into the economy and deepening the financial markets.

In response to a parliamentary request, the Government developed a strategy for the privatization programme including Concession Agreements and Management Contracts.

It has been noted that the major underlying and significant contributing factor to the privatization success to date has been the emerging and unequivocal support at the highest level for privatization transactions.

As part of the privatization process promoted by the Government of Jordan, the Ministry of Water and Irrigation (MoWI) has produced a number of key policy documents, including Jordan's Water Strategy, Ground Water Policy and Water Utility Policy. These documents amongst others form the framework within which integrated water and wastewater services shall be provided within the country. Key issues within the Water Utility Policy relate to Private Sector Participation, Water Pricing and Cost Recovery and the various components of the institutional setup of the Water Authority of Jordan (WAJ).

In addition, MoWI published in April 2003 a paper on "The Concept of Commercial Companies in the Water Sector" in its drive to improve the provision of water services in Jordan, through which the Ministry of Water and Irrigation (MoWI) declared its adoption of a strategy of corporatization and increased private sector participation. An interim step in this regard - and part of the overall strategy - is the definite intention to establish water companies in the whole of Jordan which can be utilized in conjunction with a private operator, working under different PSP arrangements (e.g. service contracts, management contracts, leases, or concessions), or independently as a direct water services provider.

The Water Authority of Jordan (WAJ) is the Government Agency established to provide water services throughout the Hashemite Kingdom of Jordan in accordance with WAJ Law No (18) of 1988 and amendments thereto. WAJ discharges its water services through locally based units known as Water Administrations. The Northern Governorates Water Administration (NGWA) was formed in 2001 from the amalgamation of the predecessor units of the WAJ serving Ajloun, Jerash, Irbid, and Mafraq Governorates into one unit with financial, technical and administrative separation from WAJ HQ.

In 2002, MoWI decided to assign a private Management Contractor for NGWA to increase the efficiency and to secure the long term sustainability of the water and sewerage systems in the North, which to a substantial extent were financed and supported by German Technical and Financial Cooperation, but the tendering process failed to appoint a Management Contractor and was abandoned in 2004.

As a result, options for the future management orientations in NGWA were discussed and it was agreed to establish a Milestone Concept which serves as a "road map" to reach the final target for NGWA, i.e. the establishment of an independent, commercially operating Public Company working with Private Sector Participation options.

The Milestone Concept included several immediate and intermediate actions to be taken such as granting NGWA management a higher degree of autonomy in the fields of Staff Policy, Maintenance and repair budget, Water Loss Reduction Programs, and the assignment of a Managing Consultant to support NGWA for a period of three years with more than only advisory functions and integrated into NGWA management in line functions. Details of its role and responsibilities as well as his integration into NGWA management were formulated as a result of the review of the organization and business processes of NGWA, and with this NGWA has to reach an operating ratio of 105 % and a balanced cash flow until the end of the contract period of the Managing Consultant to establish in the Northern Governorates a commercially operating Public Company with full autonomy.

This paper will be analyzing the Jordanian experience in its Northern Governorates through the milestone concept elaborated, the concept and roles of the Managing Consultant assigned and the institutional model developed to better serve the population through the achievement of the MDG's.

Uttaranchal: Leading the Way in Implementing WATSAN Reforms on Sector Wide Approach (SWAp) – A Case Study

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Keywords: Sector Wide Approach(SWAp), Uttaranchal Sector Program, Rural Water Supply Sanitation, VISION 2012, MDGs

Swajal Project (Uttaranchal Pradesh Rural Water Supply and Environmental Sanitation Project) was implemented in 857 villages of Uttaranchal from 1996 to 2003, on the principles of community empowerment and demand responsive approach. The Project, implemented with the World Bank's assistance, aptly demonstrated that the rural communities can plan, implement, operate and maintain their water supply and sanitation schemes if they are empowered to take their own decisions. It also proved that Voice and Choice of the community are cardinal principles for the success of community based projects. The Project received satisfactory performance ratings in the Implementation Completion Report (ICR) by the World Bank and was praised by sector specialists across the world.

Scaling up Water and Sanitation (WATSAN) Reforms

The success of Swajal Project triggered the Government of India (GoI) to introduce the principles of community management in its Rural Water Supply and Sanitation (RWSS) policy. Consequently, in the year 1999, the Sector Reforms Project (SRP) was launched as a pilot project in selected 67 districts spread over 27 states across the country. The Government of Uttaranchal (GoUA) took up the entire district of Haridwar under SRP and 103 water supply schemes were implemented by User Water and Sanitation Committees in 89 Gram Panchayats and 2 forest villages.

Buoyed by the success of the pilot Sector Reforms Project, in December 2002, the GoI launched the Swajaldhara Program, on the principles of community management, all over the country. The Government of Uttaranchal (GoUA) already on the path of reform mode has implemented 25 schemes and about 70 schemes are in different phases of implementation. The GoI funded Total Sanitation Campaign (TSC), launched state-wide in 2003 is another community based sanitation project emphasizing on IEC, HRD, and capacity-building activities to increase awareness and generate demand for sanitary facilities. TSC has raised the sanitation coverage from the earlier 20% to 34%.

GoUA's Sector VISION 2012

GoUA has prioritized RWSS as a key area of its development agenda in its Tenth Plan (2003–07). GoUA has envisaged universal coverage of safe and potable water and sanitation by the end of its Eleventh Plan (2008–12), to meet the Millennium Development Goals (MDGs).

The Sector Vision 2012 clearly reflects the commitment of GoUA in replicating reforms and empowering the Panchayati Raj Institutions (PRIs),which are the local government bodies, as envisaged in the 73rd Constitutional Amendment Act of India as: "The rural local government in partnership with rural communities, shall plan, design, construct, operate, and maintain their water supply and sanitation schemes; so that they get potable water and attain health and hygiene benefits; GoUA and its sector institutions shall act as supporter, facilitator, and co-financier and as per need shall provide

technical assistance, training and cater for bigger construction works and sectoral contingencies. The institutional, legal, and financial changes will be brought in by 31st March 2007 and ultimate realization of the VISION will be expected in year 2012."

Continued support of the World Bank

The success of the Swajal Project and the GoUA's commitment to RWSS sector reform demonstrated through the state's sector vision and RWSS sector policy outlining the reform principles evoked the World Bank's interest to assist the GoUA for the follow on Swajal Project. The detailed deliberations of Project Management Unit (PMU),the organization entrusted with project preparation, GoUA and GoI with the World Bank ultimately converged in the shape of Uttaranchal Rural Water Supply and Sanitation Program or Uttaranchal Sector Program.

Uttaranchal Sector Program

The program has adopted a consistent policy for RWSS service delivery statewide and sector-wide in accordance with the GoI's Swajaldhara guidelines and the World Bank's Country Assistance Strategy (CAS) and is being implemented on a Sector Wide Approach (SWAp). Uttaranchal has added another feather in its cap, another first by becoming the first state in India and Asia to implement the SWAp. Uttaranchal, for sure is on the right reforms track.

SWAp essentially represents an approach wherein "most significant public funding for the sector supports a uniform sector policy and expenditure program, under government leadership, adopting common approaches across the sector, and progressing towards relying on government procedures to disburse and account for all public expenditure, however funded." To put it explicitly, SWAp means a state investment program to achieve the vision goals for RWSS for the next 5 years. All funds including the WB loan will be under the same policy framework as well as operational rules for project cycle, procurement and disbursement.

The agreement with the World Bank for the Sector Program has been signed in October 2006 and the first batch of the program is already underway in the planning phase.

The Challenge

In order to meet the Vision 2012 targets of 100% access to safe rural water supply and sanitation, a total of approximately 3 million rural people (50 % of the State's population) will need to be provided with access to improved water supply and about 5 million (80 % of the State's population) to sanitation. The major challenge would be mobilising sufficient resources to provide access to RWSS services. Additional challenges include policy and institutional strengthening to plan, design, construct and operate rural water supply and sanitation systems. This will require human resource development at all levels to enable PRIs and Sector Institutions utilise and manage the increased level of anticipated investments in the sector.

Uttaranchal, as ever before, will come up strongly, to make the Vision come true.

Empowering Water Utilities – Revisiting Capacity-Building

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Across the low-income country world, publicly managed water utilities, still overwhelmingly the majority, have an extremely limited record with regard to services delivered to customers, particularly poor customers. As an example of a public utility when all goes wrong, it is reported that the networked water supplier in one major West African metropolis of 15 million people experiencing 6% per annum population growth was only achieving '30% coverage with 80% unaccounted for water, 4% bill collection efficiency (2001, now 30%) and a $170m World Bank loan had, in effect, vanished' Vidal (2005) goes on to report the comment that 'people wake up angry at being alive in a society like this'. This is the most extreme example of public sector failure this author has come across whilst undertaking field investigations over a number of years in approximately 20 public utilities, but it is not unrepresentative of the challenge.

The global slum population, predicted to grow from the present one billion to two billion within 30 years (UNCHS, 2003), is often a good proxy for the number of people unserved by any utility network. However the benefits of achieving piped water supply can be dramatic. One study reported a 24% reduction in infant mortality in the poorest areas on receipt of new connections (Galiani et al 2002). Another found a reduction of over 80% in expenditure on water which can result in the development of sustainable livelihoods through small businesses (Weitz & Franceys, 2002).

To deliver services to the illegal slums and shanties adds an additional institutional challenge. Organisations and their staff are required to work in difficult (physically, culturally, insecure) areas. They also need to be able and willing to differentiate the service offer to meet very particular community needs. Although such market segmentation and product differentiation are normal practice for customer oriented producers and retailers in other sectors they have not been common in the formal urban water sector. The water sector has to recognise and accept new goals as well as developing capabilities to meet existing needs.

Capacity-building

The initial approach for reform in the water sector to meet such needs was to invest in 'capacity-building' through staff education and training, national and international, nearly always courtesy of some donor, with technical assistance and 'twinning arrangements', all as appeared (randomly?) necessary. Occasional reorganisations, in reality often re-naming exercises, were presumed to deliver the necessary commercial (to the extent to which that was allowed) and service orientation (Franceys and Sansom, 1999).

Delivering real development for many of the individuals involved these investments in evolutionary change failed to deliver any significant early improvement in services delivery. There are notable exceptions with examples of public institutions with a particularly dynamic leadership delivering renewal. But in general these organisations revert to the more normal pattern once that special leader moves on or is transferred.

Considering average utility performance a case can therefore be made for more revolutionary change in order to achieve lasting reform and service extension. In the past, there are clear indications that

significant organisational reform has taken place through a transfer from the private to the public sector (Monks, 1994). However, with the majority of water suppliers presently in the public sector it appears that any major change requires some move in the opposite direction. The privatisation decade, by some viewpoints, began to deliver that necessary revolutionary change. However, being the equivalent of a 'heart transplant', 'the body' (political and civil society interests not to mention consumer concerns) rejected the transplant. With that short-cut being no longer generally available it is argued that capacity-building and empowerment for reform are the only solution.

Empowerment

To build commitment to reform in society as a whole, necessary having failed to achieve much success with a focus purely on the service provider, stakeholder involvement, information, education, empowerment and shared responsibility will have to be broadened significantly. Stakeholders now must include not only all levels of utility staff but also municipal and national politicians and ministry officials as well as customers and civil society. This approach will require more than the previous miscellany of a few international Masters' programmes and in-country training programmes, however valuable those may have been to the individuals. It will take the level of commitment demonstrated by NWSC, Uganda, a reforming public utility which has taken advantage of learning from two major outsourcing contracts whilst encouraging upwards of 65 postgraduate degrees amongst its staff, requiring that all research theses should be linked to the needs of the utility with researched recommendations subsequently implemented (Muhairwe, personal communication). There will be a need to develop the involvement of politicians and society through marketing approaches. Ideas such as the '24/7 water' initiative in India (CMF, 2002), which has subsequently been taken up by multi-laterals and by senior politicians, not unreasonably appears to be a more convincing and motivating slogan for justifying change than the earlier 'you must privatise'.

Throughout all these elements there must be the new thread of empowerment through economic regulation with its supporting customer involvement in the process (Franceys, 2004). If the 'heart transplant' has been rejected perhaps the 'pace-maker' empowerment of economic regulation is required. Governments and society need to perceive, and use, some form of economic regulator as an impartial referee to ensure best value for money, that is adjudicating between the direct water providers and government (representing wider society) with appropriate incentives to outperform through efficiency gains. This is being demonstrated already in the public sector where, for example, the Water Supply Authority of Lao PDR is using comparators between small towns and seeing those towns respond to the challenge to improve (WASA, 2004).

Then economic regulation can go further in helping to make water accessible to the poor by refereeing societies' demands for universal service, with differentiated service standards as appropriate, along with the financing through adequate tariffs required to deliver service – delivering some level of credible transparency into decision-making and monitoring of prices and levels of service. But this whole agenda requires significant international investment in capacity-building - and patience, that is the preparedness to empower utilities to access resources according to their own perceived pace of development.

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Progress and Prospects on Water Sector in Lebanon

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Keywords: Lebanon, Water management, Water sector reform, Legislation, Environmental sustainability

When Lebanon emerged from a prolonged period of civil unrest in the early 1990s, the water sector like other infrastructure sectors in the country was in very poor condition. At the time it was estimated that water availability from the public system was 60% less than in 1975. In order to escape the problems of the existing system and make a rapid recovery, the government prepared a sector reform program centered on the establishment of an institutional structure that would enable commercialization of the delivery of water supply and wastewater services. The previously existing institutional structure of the water sector in Lebanon consists of the Ministry of Energy and Water (MEW), 21 local Water Authorities, the Litani River Authority, plus over 200 local Water Committees. Other Ministries such as Environment, Municipalities and Health play important complementary roles, particularly with respect to wastewater. The strategy was to consolidate the existing Water Authorities into a number of relatively autonomous institutions of sufficient size to enjoy reasonable economies of scale and with the power to generate financial resources, enter into financial agreements, execute projects, and with the power to generate financial resources, enter into financial agreements, execute projects and utilize the private sector for operation and maintenance through management contracts and, ultimately, leasing or concession contracts.

Actually, the water sector in Lebanon is on the verge of a transition that is not well defined. Change is happening, but the reform agenda is incomplete and the official policy appears to be in a state of flux. Although three restructuring laws were passed during 2000 and 2001, their implementation has been delayed. The new laws provide a general framework for sector restructuring, but the implementation regulations will be the key determinant of the actual outcome and timetable of the process. Therefore, although the formal legal structure has been changed and its details are in the process of being elaborated, the new structure has not been implemented yet and the actual institutional and operational reality on the ground is still substantially that of the past.

The actual water sector faces considerable difficulties. The principal issues identified are high physical water losses, an inefficient and inequitable tariff system, and general disarray in the sector stemming from historical circumstances and the scarcity of human and financial resources. The latter issue is being addressed, to some extent, through the sector reforms and private participation initiatives discussed in the next two sections below. The first issue, physical losses, is being addressed by ongoing projects but will continue to require significant financial investment for years to come. Metering is necessary in order to fully asses the extent of the problem. Metering is also a necessary precondition to addressing the second issue, the tariff system.

Since 1992, over half a billion dollars has been spent on rehabilitation of water and wastewater systems, with half that amount again still under execution and another half billion under preparation. By the middle of the present decade, the Government will have invested over $250 for every man, woman and child in Lebanon. Despite the enormous investment taking place, the impact has so far

only been felt in the few places where new systems have become fully operational, and the underlying institutional issues have thus far been addressed largely on paper only. For a majority of consumers, conditions are not greatly changed from the past, but change is coming. For example, there is still not a single operating secondary wastewater treatment plant in the country, but there are about a dozen currently under construction or under preparation for coastal areas, and quite a few more in process for inland communities.

The planned, and desperately needed, sector and institutional restructuring is still in the very earliest stages. The law, which in its present form delivers only half of its original promise, has yet to be implemented. The consensus within the government and among donors and stakeholders that led to the drafting of the law in the first place is not strong. There continue to he significant, if not always clearly stated, differences of opinion over the extent of continued reform, pace of implementation, and form of private sector participation that should he pursued at this stage, particularly between the Prime Minister, the High Council on Privatization, the sector Minister, the leadership of the Water Authorities and their Parliamentary backers.

The paper begins with an explanation of the water sector reforms, leading up to the passage of new laws in 2000 and 2001. It then explains the current situation in the sector and the current status of implementation of the sector reforms, ending with a discussion on current initiatives in private sector participation and recommendations for enhancing sector, project, and environmental sustainability.

Evaluation of Water Supply and Sanitation Delivery Services in Tanzania: Ten Years after Sector Reforms

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Keywords: water supply, sanitation, delivery services, sustainability, evaluation

Tanzania has since its independence in 1961 embarked on provision of basic services to her people. One of these services is Water Supply and Sanitation delivery services. Safe water and sanitation contribute to enhancement of the quality of life through improved general health conditions and well being of the people. Due to lack of safe water and sanitation, many parts of Tanzania has been experiencing the incidences of water and excreta-related sicknesses which are high resulting in periodical outbreaks of cholera and a high rate of diarrhoeal diseases accounting for a hundreds lives every year particularly under 5 year. Existing data on the incidence of water-borne, water-related and water-washed diseases indicate that these are mostly prevalent where people use contaminated water or have little water for daily use and as such these diseases account for over half of the diseases affecting the population and more than 80 percent of Tanzania's population living in rural areas. The principal of institution of a two – pronged intervention in terms of both water and sanitation improvement is a well-known approach for ensuring improvement of the health of the communities. However, the poor, most of who live in rural areas, have limited access to clean water for domestic use and crop production and adequate sanitation. Economic benefits are achievable indirectly through improved health and time saved from the drudgery of carrying water overlong distances.

The year 1995 – 2005 (Third Phase of Tanzanian Government) witnessed the major changes in economic reforms in the country. It was the time that the Water Supply and Sanitation sector in Tanzania underwent reforms. The primary objective of this evaluation is therefore to assess the performance of the Water Supply and Sanitation Program and its contributions to the water and sanitation services delivery system in Tanzania. The aims being to document experiences and "lessons learned" in relation to the preparation and implementation of future activities in the Water Supply and Sanitation (WSS) sector.

The evaluation focused on the qualitative impact of the project in relation to the development objectives of the programme. Three studies, applying qualitative methods, were undertaken (1) a consumer/household (services) study, (2) a human resources development study, and (3) an institutional capacity study. The studies were undertaken in a participatory manner. The idea was to have the end-users assess the impact of the WSS. The evaluation was carried out in two phases: namely a desk study of relevant background papers and reports etc and synthesis of the information obtained.

It has been found out that, with regard to physical installations the achievements are quite impressive. The access to safe and clean water in rural areas nationally is averaged at 53% and 73% in urban areas. However, with regard to the distribution of services to all sections of the population and changes in the

behaviour with regard to water use and sanitary practices the program has failed. Many water installations are located within the premises of rich and influential people. To a lesser extent the program has been successful in promoting the use of sanitary latrines, but it has been unsuccessful in promoting a change in sanitary practices. The majority of the rural population continues to bathe and wash utensils and cloth in ponds, rivers and canals, the banks of which are also used for human defecation and watering of livestock. On the human resources development, the Water Rwegarulira Institute which trains water experts for sustainable management of water resources and provision of rural and urban water supply services had, up to the end of 2004, enrolled 451 students which is equivalent to 84% of its fully capacity contrary to what was in 1995 which had the capacity of accommodating only 300 students equivalent of 55% of its full capacity. On the institutional capacity, the water resources management in Tanzania is now under nine (9) river basins contrary to none before 1995.

The sustainability of consumer benefits is threatened by problems with water quality. However, throughout the implementation too little attention has been given to water quality monitoring. The study is recommending that for sustainable water supply and sanitation delivery systems, the involvement and the participation of all stakeholders is important in order to achieve sustainable access, efficiency, equitable use and adequate protection and conservation of water.

Water Service Reform on the Divide, Experiences with Decentralized Management of Water Services in Small Towns in Nicaragua

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Keywords: water supply and sanitation, small towns, decentralisation, alternative management models, Central America

Water supply and sanitation in Nicaragua is in crisis: hardly any urban systems have full-time water supply and non-accounted for water is as high as 56%. In facing this crisis, large urban centres get top priority, whilst smaller towns have to find their own solutions.

As in many countries, the water and sanitation sector in Nicaragua is divided between a rural and an urban subsector. This division obscures the fact that a quarter of the country's urban population (25%) lives in small towns between 2000 to 20.000 inhabitants, presenting a mixture of rural and urban lifestyles. Of a total of 153 municipalities in Nicaragua, 95 small towns fall into this range. At the moment the management of most of these systems fall under the Nicaraguan Water and Sewerage Company (ENACAL), that also manages the water systems in larger cities. Discussions about reform of this centralized management model started only recently: the new National Sector Strategy for Water and Sanitation, includes different proposals for desconcentration and decentralization of services but does not make a clear analysis of the situation of small towns.

Such reform proposals have sparked strong and emotional debates, relating them to privatization and leading to comparisons with the situation of the national electricity company. For most of the population, discussions about management reform have neither been clear nor transparent regarding the future of water supply services in the country. In spite of this, there are about 26 small towns in the range of 2000-20.000 inhabitants that already have alternative management models for their water supply system. Their local experience and solutions contain many potential lessons for the reform process.

Some cases started off as community-led rural systems, where water companies were subsequently formed, whilst others created a small water company after receiving funds for construction that did not flow through ENACAL. Again others were constructed and initially managed by ENACAL, but later transferred to the municipality. In addition to these 26 cases, some systems remain formally managed by ENACAL, but are de-facto co-managed by local government. In this paper, management models and reform processes in 7 small town systems are described and analysed.

After receiving the systems' management, most operators embarked upon new, sometimes very personalized strategies to deal with their problems, ranging from source protection to neighbourhood discussions and demand management, leading to improved income and control over irregularities. Such strategies are urgently needed so as to avoid future investment costs that cannot be afforded, because even though revenue may improve, this still does not cover depreciation nor major maintenance costs.

For all of these systems,however, the vicious cycle of high non-payment rates, low incomes, poor maintenance and investments, and deficient service delivery is the main issue of concern. Most systems lack micro measurement, which is considered costly in both purchase and maintenance, and leads to resistence from users. Service delivery is deficient in both quality, quantity and opportunity, as water may arrive as seldom as once a month, while sanitation is generally absent..Impacts on the poor population, especially female headed households, are severe.

In spite of advances made with regard to the most urgent issues, most systems that are not directly managed by ENACAL, still lack basic management tools (financial, administrative, technical) and the compliance of necessary legal requirements. Such issues are often not taken into account by municipalities as they tend to focus on the expected social gains of improved service delivery. However, this organizational and legal vulnerability affects the systems' sustainability, as well as possibilities to obtain new investments. In addition, national standards for service delivery are the same for all urban systems, which makes it almost impossible for small operators to comply. Though generally these standards are not applied by the regulatory body, their continual incompliance can lead to revocation of the system to ENACAL.

One of the major topics of discusion regarding management reform in the water sector, is the capacity of the small operators, whatever their legal status. Comparison of different cases, however, shows that it is not so much the existent capacity of the operator which is decisive for good management, but more the institutional capacity of the municipality combined with solid local participation structures that ensure good decision making.

With regard to the technical capacity of the operators, their small scale requires the development of external service providers. An example are systems with electrical pumps, where many small operators do not have the means to employ the necessary specialists. A group of rural systems in Matagalpa, however, is solving this by sharing a technician.

In conclusion, the particular situation of water supply and sanitation services in small towns in Nicaragua requires a strategy tailored to their needs, reality and rationality. It is a segment of the water and sanitation sector that has enormous potential both in achieving the MDG´s as well as enhancing local economic development. The study and comparison of existing experiences with alternative management models provides both a wealth of lessons learned as well as an opportunity to develop management tools, legislation and benchmarking schemes appropriate for this range of systems. It also enables different actors to develop the necessary support capacity for the change process that may be as important or more important in achieving sustainable service provision than the management model itself.

Consumer Attitude and Trust in Accra Water Supply (Ghana)

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Keywords: water supply, consumer survey, private sector participation, Accra, Ghana, customer care

Accra water system is going through fundamental change. A major grant from the World Bank in January 2005 has enabled large investments in the water sector. Management of Ghana Water Company Limited is being reformed toward Private Sector Participation. Contracts were signed with "Vitens International of the Neatherlands" and "Rands Water Services Pty of South Africa" in November 2005.

In the global development debate and ambition to move toward a sustainable development, "consumer participation and involvement" is repeatedly being highlighted as a prerequisite for a sustainable future, which is also reflected in policy documents emerging around the world. The Ghana Water Policy, the Ghana Poverty Reduction Strategy, the European Water Framework Directive and the EU Water Initiative: Water for Life, are examples of policy including issues on water management.

For the water sector to live up to regulation and the underpinning policies in decision-making as well as to consumer preferences, an increased understanding of the consumer perspective is needed. Studies on consumer attitude have traditionally taken place on controversial products such as GMOs (Genetically Modified Organisms) but for consumer studies related to water supply, assessments of Willingness-to-Pay (WTP) are predominant. However, the consumer aspects on water supply are much broader than WTP and consumer costs.

This study captured the consumer perspective of Accra water supply, thus the interface between the user, the technical system and existing water policy/legislation. The survey was limited to Accra and its inhabitants (household consumers) that are supplied with pipe-born water (shared or private tap) or that depend on water tanker service. This division by itself created an even geographical distribution of the study as water supply is segmented in Accra. In the survey 300 consumers, one of each category participated.

The study finds the existence of national policy statements in consonance with regional and global directions seeking to address accessibility and other water supply service issues for the consumer. There is a clear regulatory framework by the Act that established PURC to protect and safeguard consumer interest. The identified consumer criteria for trust include accessibility, reliability, willingness and ability to pay, cost of water (that matches value of service), handling of complaints, and enforcement of consumer-oriented policies. The study shows accessibility as being of little significance to private consumers but of critical interest to shared and tanker water consumers. In descending order private water consumers generally rank trust criteria as reliability, water quality, customer care, affordability and then accessibility whiles for shared consumers, it is reliability, accessibility, affordability, quality, customer care. Tanker water consumers indicated their rank as reliability, accessibility, quality, affordability and then duty of care.

The study confirms the fact that private tap consumers have easiest access to water (although delivery cut offs are common) while shared and tanker water consumers have more difficulty in accessing water. The majority of consumers experience water supply interruptions irrespective of the supply means but consumers of shared water source most likely suffer from supply interruption and consumers are not adequately informed prior to service interruptions. Radio and television media are used by GWCL to communicate interruptions and radio is perceived serving consumers most effectively. However, in spite of the established media of communication with consumers by the utility company, a majority of consumers perceive water supply interruptions as inconvenient.

There is general lack of consumer understanding of the billing or charging system with private consumers having the best understanding of their bills. A considerably high proportion of consumers consider the current amount they pay for water as high. Consumers of tanker water spend the highest proportion of their household income on water for domestic usage. Consumers of tanker water source are less likely to get the quantity of water needed, in addition they have the pay the most for water. At the same time, consumers of tanker water source have the lowest income levels. A slight majority of consumers are willing to pay for water service improvements. Consumers' quest for better services is reflected in their response to willingness and ability to pay. However, the desire for a better service delivery is not mirrored by the proportion of income they are willing to part for the desired improvements.

The study reveals weak consumer knowledge but earnestness for information relevant to water quality. A slight majority of respondents has had water quality problems and may or may not have formally lodged a complaint with the utility provider or regulatory bodies. Water quality problems are mostly dirt contamination, water colouration, odour, bad taste and algae contamination. Respondents resort to boiling, sedimentation and filtration as ways of improving upon their drinking water quality.

The perceived consumer responsibilities include wise use of pipe water, reporting of problems to utility provider, timely payment of water bills and asking for bills if not submitted by utility company.

The study suggest that private water consumers most likely have a positive rating of satisfaction (i.e. good to excellent) with pipe water services whiles shared and tanker-water consumers attach moderate to bad rating of satisfaction to pipe water supply services. In general, most private consumers rate their trust in water supply from moderate to very high while a considerable majority of shared and tanker water consumers rate their trust from moderate to very low.

Management Contracts: Impacts on Services Improvement in Effective Institutional Environment. Lessons from Experience

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Keywords: management contract, emerging countries, water & sanitation, South Africa, Algeria

In many developing countries, urban water and sanitation utilities are poorly managed, invest few or no resources in infrastructure maintenance, give low priority to wastewater collection and treatment and leave aside a large number of families. Inefficient water services are usually correlated with poor local or national sector governance.

Countries or municipalities that have decided to reform their public services in the water sector have at their disposal different tools that can be used according to local characteristics. The "management contract" in which management reform in the form of financial, operational and technical improvements are entrusted to a experienced private operator, while the authority retaining full decision on investment priorities and tariff, has proved to work efficiently when there is a genuine political commitment to reforming public services.

The proposed paper will analyze the impact of two management contracts on service improvements implemented in countries with very different characteristics but similar will of reforming public services: Johannesburg in South Africa and Algiers, in Algeria.

Johannesburg

On 1 November 1995 elections were held for Johannesburg's first democratic local government. By 1997 the City was in a grave financial crisis. Local government in Johannesburg, like that across South Africa, depends largely on its own revenues to finance operating costs. During the days of anti-apartheid resistance boycotts of service charges were a key weapon of struggle. Despite the new democratic process, residents were reluctant to resume paying taxes and utility bills, since services did not improve significantly.

In 1997, the city of Johannesburg was close to bankruptcy. The council launched an ambitious plan called Igoli 2002 that would significantly improve service delivery and development while maintaining strict financial discipline. Three municipal utilities were concerned by this plan: City Power, Johannesburg Water and Pikitup, the solid waste collection and disposal service.

In January 2001, the new City of Johannesburg combined the four water and sanitation departments to form Johannesburg Water, a wholly-owned public company responsible for all water and sanitation services provided in the City. One of the unique features of Johannesburg Water was the signing of a management contract with a specialist water and sanitation management consortium to help the utility finalize, set-up and solve pressing service delivery challenges. The performance driven contract, valued at R 25 million, was awarded to a consortium led by the Ondeo Services (part of the Suez Group). This contractor, known as JOWAM, was responsible for placing a 12-member technical assistance team in the utility. This reduced to two members over the course of the contract as local staff gained expertise.

The main objective of the management contract as envisioned by the City of Johannesburg in 2000 was to build a sustainable water and sanitation Utility in particular through an appropriate transfer of skills. The management contract between Johannesburg Water and JOWAM started 1 April 2001 and ended 30 June 2006. It has been extremely successful in the sense that it allowed Johannesburg Water to become a sustainable utility and has generated solid achievements in terms of customer service, environmental protection, cost effectiveness, financial results and training and development of personnel.

Algiers

In Algeria, water management issues became increasingly critical in the last 20 years. Population growth in cities, repetitive droughts, decay of infrastructure by lack of dedicated financial resources and poor management of resources and services created increased pressure on national authorities for sector reforms. In the capital city of Algiers, the situation has become increasingly critical leading to significant service restriction, financial difficulties and environmental damages.

In 2005, the government of Algeria adopted a new water law aimed at improving water resources management and institutional reforms.

One of the first tangible element of the water law was the creation in Algiers of a single entity in charge of water and sanitation services the "Société des Eaux et d'Assainissement d'Alger" SEEAL, an autonomous utility 100% state-owned with the major mission to modernize water and wastewater infrastructures and systems and guarantee 24 hour water distribution to the residents of the city. At the end of 2005, SEAAL signed a management contract with Suez Environment with the objectives to mobilize and transfer operational expertise, train local staff, modernize utility management, rehabilitate and extend water and sanitation infrastructure. The main commitment is to ensure water distribution to the residents of Algiers 24 hours a day by the end of 2009. The government will finance the rehabilitation and development of infrastructure representing an estimated cost of Euros 200 millions per year.

Suez Environment has mobilized 27 managers and experts that work full time with the national staff of SEAAL to reach this objective. Based on the success of this first public-private partnership, the national authorities have planned to apply the model of management contract to 11 additional major cities of the country. A bidding process is already underway for 3 cities.

Conclusions

These two examples demonstrate that there are two fundamental parameters for water and sanitation services improvement: a strong political commitment to implement sector management reforms and the dedication of water experts and professionals to the modernization of water utilities that work at rehabilitating and expanding water and sewerage systems, improving customer services and strengthening human resources management.The communication will show concrete illustrations of progress achieved based on key performance indicators.

Decision Process on Allocating Water for Ecological Purposes within the San Francisco River, Brazil

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Keywords: basin management, ecological flows, participation, social involvement., decision making

A hydrographic basin of the San Francisco River (SFR) covers six Brazilian states (Goiás, Minas Gerais, Bahia, Pernambuco, Alagoas e Sergipe) and involves 502 municipalities, including the Federal District. Besides regional diversity and variety of institutions involved (federal, state and municipalities), there is a high degree of heterogeneity and complexity in all instances related to water management in this large river basin.

In a year 2001, a SFR Basin Committee (SFRBC) has been officially established, and one of its first actions has been to initiate broad discussions about water allocation along the river course, including determination of required (desired) ecological flow in most downstream part of the basin accordin to the Water Plan that has also been approved recently. Minimum river flows are adopted, hawever, and in a way, arbitrarily, mostly based on the controlled regime of the hydro-electric plant Xingo; that is, without dedicated scientific analysis and justification. Therefore, a necessity for additional studies became obvious, especially with focus on required ecological flows in lower river corridor and its effluents, and this in such a way to determine maximum water flow that can be charged for consumptive uses.

Allocation problems so far has been analyzed in search for best compatible water availability and water demands by primarily respecting quantitative aspects and situations which exists in different regions. By defining allocation per region and per uses within regions an attempt has been made to define limits, criteria and priorities in defining appropriate water rights for the whole river basin. Actually, different actions are underway to preserve participation of relevant entities, directly and/or indirectly, in related WC´s decision making procedures to minimize or avoid possible future conflicts.

Water allocation for environmental purposes in practice appears as the most important issue within the first pass of negotiation process. A knowledge about necessary amount of water for preserving fundamental functions of aquatic ecosystems in most downstream parts of the river, including its confluence with the Atlantic Ocean, has a direct influence on all upstream demands. Therefore, it became obvious that there is a general conflict between water uses for other purposes and of its allocation for environmental (ecological) needs. It was understood that new environment must be created which will optimize, in multi-objective and multicriteria sense, present differences coming from high vulnerability of environment and diversity of socio-economic problems related to extremely different ranges of indicators referring to upstream richness accompanied with high demographic density, downstream poorness with a very low one.

This paper present most recent research results related to implementation of the decision-making process aimed to support negotiable allocation of a environmentally acceptable water flow in most

downstream part of the San Francisco river. Multiple actors and multiple criteria are involved in a methodology that has been developed to motivate and facilitate effective participation of different actors and entities, especially those coming from the social sector. Incorporation of social actors, such as users and organized civil community appeared essential within the decision-making process because they give legitimacy and empower actions of the SFB Water Committee who's competency is to arbitrate water conflicts within the basin.

To come up to the well structured hierarchical decision-making trees and to adopt proper methods and instruments that will support decision-making, a necessary inclusion of specialists from different disciplines is assured, such as from hydrology, biology, geology, economics etc. Diversity of disciplines involved is fundamental for proper definition of all decision elements, from goal, objectives and criteria sets, to valuable and plausible alternatives. Being the core part of this paper, developed methodology serves to ease negotiation process within the WC and to integrate various aspects that influence variable flows and different participants that are involved in both using water or deciding about it on a participative basis; and all this is made by strictly following statements in the National Water Law.

A methodology is based on a leading premise that any water flow regime can be determined based on technical and scientifical criteria, but that a social involvement is of fundamental importance and cannot be avoided in any instance. Having in mind: a) composition of the SFRBC for such a large basin such as the San Francicso river basin, and b) number of 60 official members, and by respecting different socio-economic and political background -- a necessity for participative modeling and conducting the decision process within the Basin Committee has been supported by recognized methods and tools coming from multicriteria decision-making and social choice theory.

Tools to Help Water Service Organisations Serve Their Users Better

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Introduction

27 years after the start of the first world drinking water supply and sanitation decade, we are coming around full circle. It is now recognised that there will need both for increased investment in service provision AND greater attention to the way in which services are managed if we are to achieve the goal of increasing equitable access to sustainable services.

Some lessons have been learned. Key among them is that, where water services are provided in a monopoly situation, users have limited recourse if their provider does not perform adequately. What incentive do suppliers have therefore, to be responsive to users interests and to perform efficiently?

The focus on private sector solutions in the 1990s saw most attention given to the role of regulators in defending the interests of the users – although the regulators' job is just as much to protect the interests of the suppliers.

However, in those 90%+ of cases where service provision remains in public hands, the independent regulator mechanism is not necessarily appropriate and the challenge remains – how to make providers accountable (and therefore responsive) to the needs of their users?

The present study is systematically reviewing the tools that can be used to make both public and private service providers more accountable and therefore, it is hoped, more efficient and responsive to their users.

Approach taken

A variety of mechanisms are used or proposed for use by both public and private water supply and sanitation utilities in order to better account to their users. These range from almost trivial mechanisms, such as the distribution of information leaflets with user's bills to those that are more far-reaching, such as the inclusion of user groups in the ownership structure of the utility. The framework used thus considers

- Depth of involvement: provision of information, consultation, participation in decision making or a mechanism giving users some recourse if they are dissatisfied.
- Channel of participation: through the utility, the regulator, or independently by civil society watchdog groups, outside formal government structures.
- Level of participation: individual consumers, local communities, or participation systems at local government level.

This framework is then used to identify the wide range of mechanisms that are in use or have been tried and to consider their impact. Impact is assessed in terms of:

- Effectiveness: Has the mechanism contributed to (a) improved access to safe drinking water and basic sanitation, (b) better customer service, and/or (c) improved or more informed policy design?
- Inclusiveness: Who does the mechanism involve (a small group or all consumers), do poor and disadvantaged groups have equitable access? Are intermediaries such as NGOs and CSOs effective representatives of the broad consumer base?
- Efficiency: What are the costs of mechanisms (including non-monetary costs such as time inputs from consumers), and how do they compare to benefits?
- Sustainability: How long has the mechanism be in place? Is the approach ad hoc (occurring once or a few times only), is it institutionalized, or does it have potential to be institutionalized?

In analysing the success or otherwise of these measures, it is clear that there are broader contextual issues that need to be recognised. These are also being reviewed. Some of the lessons captured may appear to be obvious – such as ensuring that there is an adequate daily service before engaging with consumers about details of service provision arrangements – but they are ignored sufficiently often to make it worth reporting.

Conclusions and Recommendations

It is widely agreed that one way to improve the long run sustainability of improved services is to ensure that service providers are accountable to their users. The review has already identified many mechanisms through which water supply and sanitation service providers can engage with and account to their users.

There are already examples of cases where such accountability mechanisms have contributed substantially to improving, expanding and sustaining service delivery. Since little attention has been paid to date to analysing the merits of these approaches, their costs, benefits and impacts, the key output of this work will be to give practitioners a systematic overview of the issues and their options.

Assessment of Management Practices in a Public Water Utility: A Case Study of the Namibia Water Corporation

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Keywords: New public management, water utilities, water services, NamWater, market-orientation

More than 90% of urban water supply and sanitation services in developing countries are provided by public utilities. However, public provision of the services has been inherently ineffecient. As a result a number of initiatives have emerged in recent years in many developing countries with a common goal to improve service delivery to the public. With the aim to bring about effeciency in water services, the government of Namibia created the Namibia Water Corporation Limited (NamWater, which is a sole bulk water supplier throughout the country. NamWater provides water to an estimated 1.2 million people out of Namibia's total population of 1.8 million. Since its inception in 1998, however, NamWater has been experiencing poor services and financial performance. This paper presents the findings of a case study that examined the management practices/approaches of NamWater over 5 years (2001-2006)and made comparison to the New Public Management (NPM) paradigm. The focus of the NPM approach is to mirror private sector methods of managing and organizing so that public utilities would accrue the benefits of effectiveness, efficiency and flexibility which are often associated with the private sector. The study covered NPM core-ideas such as corporate culture, market-orientation, customer orientation, delegation of authority to the utility and within the utility, accountability of results within the utility as well as externally. The study was caried out in Namibia in the period January to June 2006. The study tools used were a combination of literature review, interviews and questionaires.

On the degree of autonomy, it was established that NamWater has a high degree of autonomy, although the government approves it tariff adjustments and sourcing of external financing.The utility is subject to strong reporting frameworks including submitting financial audits and annual performance reports to the governement. The utility is embraces a notion of good corporate culture and adheres to sound management practices. NamWater demostrated a strong market orientation and outsourced both core and non-core functions/tasks to the third party to improve effeciency. Benchmarking of services and performance was only done on an adhoc basis over the last five years. The utility's customer orientation was not well developed and lacked customer care centre, customer satisfaction surveys and a customer charter. NamWater was rated poorly by 80% of customers as lacking customer-focus. On delegation of authority within the utility, NamWater's senior management delegated operational authority to lower management to facilitate flexibility and eliminate unncessary bottlenecks. The lower management is held accountable for results by the senior management which in turn account to the management oversight agency (Board of directors). NamWater's performance indicators for the past 5 years fall well within the proposed World Bank yardstick of well-performing developing countries water utilities.

It was concluded that NamWater's management pratices generally adhered to the NPM paradigm but elements of NPM were not fully and consistently implemented. There are no robust methods of ensuring sufficient accountability indicated by the lack of performance contracts between the utility and the government and between the Board of directors and the senior management. Namibia has no drinking water quality statutory instrument that the government (regulator)can use to enforce compliance. There is also no customer customer charter that the utility is bound to when dealing with customer issues.

It is recommended that NamWater should consider developing performance contracts as well as customer charter to ensure accountability. The utility should be more customer focused to enhance customer trust and willingness to pay for services. Benchmarking activities must be consolidated in order to improve service delivery. The government must set-up a regulatory body which shall among other tasks, be developing water quality standards.

Monitoring and Evaluation – A Key Factor in the Reforms in the Water Sector

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Keywords: water, reforms, monitoring, evaluation, millenium

Ghana, like many developing countries, is in the process of reforming its water and sanitation sector. Earlier reforms in the sector started in the 1970s, a few years after the incorporation of the then Department for Water supply under the Ministry of Works and Housing. The reforms focused on restructuring the Water Supply Department into a more viable public institution. This involved mainly management restructuring, training and technical assistance. The restructuring further looked at decentralising authorities from the central office in the capital to the 12 political regions to improve management of the operations of the over 180 systems spread throughout the country. The earlier reforms however failed to meet the objectives of reducing waste and making water more accessible and affordable to the population. This necessitated further reforms in the sector. Current reforms which started in the 1990s after what is considered to be the failure of the reforms of the 1970s, sought to go beyond technical assistance and decentralisation process to unbundling of the water sector to specific institutions, and the introduction of the private sector in the operations of the water supply systems.

The objective for both the earlier and current reforms, like many reforms in the water and sanitation sector, was increased access to affordable services. Of particular concern was the situation of the poor and in the case of Ghana one key success indicator was greater access by the poor to affordable water. While the earlier reforms focused on restructuring the institution for water supply i.e. the Ghana Water Company Ltd. (GWCL), the current reform process looks beyond the institution and looks at the sector as a whole. The current reforms have thus led to the unbundling of the sector to several institutions, with many responsibilities being separated from the GWCL and transferred to newly created institutions. In respect of this, since 1996, operations of small water supply systems have been hived off from the Ghana Water Company Limited for Community management; Public Utilities Regulatory Commission has been established, ending the self regulatory role of GWCL; Water Resources Commission has been established to manage the water resources and the Private sector has been introduced into water supply operations.

Despite all these innovations, it is increasingly becoming clear that the sector is yet to meet the challenges confronting it particularly with regard to providing affordable water supply to the poor. The missing factor appears to be lack of effective monitoring and evaluation. Without effective monitoring and evaluation mechanism, minor flaws in the process go undetected until they escalate into major bottlenecks which finally lead to failures in the reform process. Effective monitoring of Ghana's early reforms would have revealed in the early stages the flaws in the low tariffs and the subsidies. Rather than providing affordable water to the poor, it was discovered almost twenty years later that the subsidy was rather benefiting the rich who were connected to the system and that the low pricing was rather leading to deterioration of the utilities, lack of access to services, and inequity, as a result of low revenue and inadequate subsidies for effective operation and maintenance.. An effective monitoring

and evaluation as a continuing process in the operations of the water will forestall the unending cycle of reforms in the sector and provide more targeted solution to sector problems.

Long-term reviews of management processes, while considered important should complement, and not a substitute continuous monitoring and evaluation which offer greater opportunity for corrective measures at early stages of reform processes.

As part of the current reforms in the sector, the private operator has been mobilised since June 5, 2006 and has started operations. As a result inadequate monitoring and evaluation mechanism within the GWCL, there is fragmented baseline information to assess the performance of the Private Operator. The introduction of the private sector is premised on the fact that a strong utility management is key to achieving the objectives for sector improvement, greater access to potable to water supply at affordable rates especially the low income groups, cost recovery through efficiency gains, better service delivery, and long-term stability, and that the private operator has a demonstrable expertise in this area. However, will these be achieved without proper monitoring and evaluation of their operation?

The MDG targets for on the other hand, does not make it clear what access really means. The access-baseline will thus differ from country to country. Recent study of the coverage of water supply in Ghana by one the UN agencies put access to urban water supply in Ghana as 80% and notes that Ghana is on its way to achieving the MDGs for water, while a study by GWCL places accessibility at 59%. For every country and for Ghana in particular there is need for a strong coordinated monitoring and evaluation process with a well-defined baseline, data management scheme that is able to collate all activities in the sector including contributions made by NGOs, Churches, individuals. Without this, in spite of the spate of reforms in the sector, the achievement the MDGs will be a mirage and will be dependent on who is presenting the report.

Private Sector Participation and Regulatory Reform in Water Supply: The Middle East and North African Experience

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Keywords: Institutional reform, Middle East and North Africa, Private sector participation, Regulatory reform, Water legislation

This research project has been conducted under the scientific direction of the OECD Development Centre and has been funded by the European Commission within the sixth framework programme. It is part of the International Research Consortium "Understanding Privatisation Policy: Political Economy and Welfare Effects - UPP Project" coordinated by Fondazione Eni Enrico Mattei (FEEM, Italy). More information is available at: http://www.privatizationbarometer.net/upp

The Middle East and North African area (MENA) faces one of the most important water crises in the world. The combination of aridity, foreign dependency, climate impacts, misallocation of the resource and escalating human demand make water supply a primary issue for health, economy and poverty reduction in this region. In this context, institutional reform of the water supply sector is of great interest. The aim of this study is to examine the water regulatory framework in MENA countries and the development of private sector participation in the context of urban water crisis.

The research is divided into four parts.
The first part presents the scope of private sector participation in water supply and its different forms around the world. An extensive review of empirical tests and case studies on the effect of private sector participation in water services has been conducted. This survey shows that private sector participation per se in water supply does not systematically have a positive effect on efficiency and that reforming the water supply institutional framework is an essential prerequisite for delegating water services.

Then, the study focuses on the MENA experience. It compares the institutional organization of the water supply sector and recent regulatory reforms in Algeria, Egypt, Jordan, Morocco and Tunisia. This part is based on a detailed examination of laws, decrets and official publications in MENA countries and on the inventory of the majority of private water contracts in the region.

The third part of the research deals with the development of a Water Sector Analysis Scorecard based on 10 indicators (water resource, water use, management of water, water pricing and metering policy, water institutional framework, private sector participation in water supply, desalination, projected investments in water and wastewater services, impact of demography and economic conditions) and 50 sub indicators.

In the fourth part, the scorecard is applied to MENA countries. Based on the experience of the different countries in reforming the organization of the water supply sector, the study proposes major regulatory reforms for Algeria, Egypt, Jordan, Morocco and Tunisia and concludes on the future of private sector participation in water supply in each of these countries.

The Water Sector Analysis Scorecard of this study has revealed great differences of organization among MENA countries.

In Tunisia, water and sanitation operators are very efficient in comparison with other MENA countries. However, some improvements could be made by decentralizing the management of water and by corporatizing local water utilities. Moreover, the tariff setting policy needs to be reformed: prices must reflect the local effective cost of water by being set regionally instead of nationally. Differences of prices among users have also to be reduced; the high level of cross subsidies does not seem sustainable in the long term.

In Algeria, the recent regulatory reform of water services is very ambitious and is expected to be fruitful in the short term. Corporatization of public operators, progressive water tariffs and decentralization are of the many reforms that will improve efficiency in the water sector. The institutional framework has been rationalized and is now well structured.

Egypt started a couple of years ago to restructure the organization of the water sector. The government is currently in the process of decentralizing water policy to the local level. When effective, this reform will reduce inefficiencies due to the very centralized administrative system. The corporatization of local water operators could also facilitate monitoring cost and would ensure a productive competition among water providers. In addition, tariffs are not set at a viable level and need to be increased in order to guarantee the financial sustainability of the water policy in the long term.

In Morocco, the reorganization of the water supply sector started ten years ago. River Basin Organizations, decentralization, corporatization, sustainable progressive tariffs are of the major reforms. The well defined institutional environment permits now true competition between private and public sector. This policy has led to success and will be even more fruitful in the coming years.

In Jordan, the overall situation of water scarcity is concerning. Private sector participation in Amman has led to some improvements, but a broad institutional reform of the water sector is necessary. The organization of water authorities and their respective responsibilities need to be rearranged with a clear separation between political, strategic, regulatory and operational roles. Political interferences in regulatory/monitoring activities must be reduced. Decentralization and corporatization of local water operators would allow efficiency gains. Another problem lies in tariff setting: tariffs are set too low in general and water for agriculture is over subsidized.

The full version of the study is available on the website of the OECD: www.oecd.org/dev/wp

The scorecard developed in this study is a valuable tool to analyze the institutional organization of the water and sanitation sector and to assess the future of private sector participation. The methodology is intended to be replicated for other countries in the future. This scorecard is now being implemented at the OECD for a broad review of private sector participation in water supply and sanitation infrastructure in thirty developing countries.

Irrigation Management Reform in Asia: Lessons from Low Successes & How to Walk the Last Mile for Effective Service Oriented Management

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Keywords: Irrigation, Management, Performance, Services, Re-engineering

Since the mid 1990s, the landscape of the irrigation sector has been rapidly changing. Massive reform of irrigation, through IMT and PIM, and of the whole water sector, has continued and, as a result, tens of thousands of WUAs have been created to take over irrigation management essentially at lower levels.

There are several ways to look at the reform and its achievements. If reductions of state irrigation budgets and numbers of WUA created are the measures of success, the reforms may be considered a success. If irrigation system performance, improvements of service to users and sustainable financing are the litmus test however, achievements are much more modest to say the least.

Promotion of the needed irrigation reforms in contexts where these meet strong opposition certainly induces many reform promoters to insist on positive aspects and ignore the negative ones with the hope that time will bring necessary improvements, but shedding blind eyes on the initial results from the field can be extremely dangerous for the reform. FAO considers that a thorough evaluation of results on the field is necessary and that, in view of initial successes and failures of reform models and processes, reform of the irrigation sector probably needs a second breath, based on a rigorous analysis of what has been achieved, what are the gaps and the remaining challenges. A first step in this reform agenda is to go to the field and evaluate things, and then to initiate a thorough thinking process on how to proceed.

Results of FAO work in Asia show that the reforms generally have not resulted in improved service to farmers, and poor service delivery to WUAs by upper levels of management is a major constraint to their viability, while WUAs and farmers are still not associated to major decisions on system management objectives. The reasons for these disappointing results range from faulty design to a lack of dedication in implementation of the reform process. What is clear though is that the absence of tangible results has progressively grown as one of the main obstacles to support for the reform, especially by farmers, and it is therefore critical to assess results and why these are so disappointing.

Often the process of reform which can be compare to the re-engineering approach carried out in the professional business, from a top-down management through command and control to one more balanced in terms of sharing decisions and costs, has proved much more demanding than many reform promoters had previously thought. This has created gaps in the achievements. Thousands of water users associations (WUAs) have been created but many have been left without adequate professional capacity. Thus, they have been unable to operate effectively the system for which they are responsible and to provide service to their users as they should.

The last mile of the reform should be walked. A full reform or re-engineering process needs to examine not only the institution, the legal system, the social aspects of rural society, but also needs to re-engineer the operation of the irrigation system and ensure appropriate skills at all levels of the command area.

As part of a consistent approach, FAO has been promoting and assisting agencies and managers in Asia in the adoption of modernization concepts for the upgrading and management of large irrigation systems. FAO has been collaborating with many governments, irrigation departments, managers, donors and research institutions and carrying out capacity development programs for hundreds of engineers and decision makers. It also has assisted in designing national strategies for modernization and preparing investment projects.

This paper presents i) the results of the jointly made evaluation of Water Users Association in 22 irrigation systems in 11 different countries in Asia using a Rapid Appraisal Procedure (RAP) to evaluate various dimensions of performance ii) the lessons learnt from these evaluations, and iii) how to address the shortcomings of the reform process through targeted interventions and capacity building of the irrigation managers.

From the review of achievements of irrigation reform in Asia, the paper suggests how to walk the last mile of the reform, and ensure professionalism in the new irrigation business and a real effective promotion of Service Oriented Management. It describes briefly the methodology developed by FAO to partition large command areas into cost-effective practical management units to sustain professional systems operation, and to build consistent modernization plans with WUAs and federations of water users associations (FWUAs). This methodology is called MASSCOTE – an acronym from MApping Systems and Services for Canal Operation Techniques.

Local Meets Bank: Lessons from the Guanajuato State Water Programme

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Keywords: decentralisation, reform, institutions, IWRM, sustainability

Guanajuato State, located at the central part of Mexico, is in the middle of the Lerma-Chapala basin, with a critical scarcity that gives rise to frequent conflicts and jeopardizes the conservation of water bodies as well as the region's development. Since 1996, the State authorities began implementing a reform in the water sector. In 2000, a State Water Program for the long term was proposed, and a mid-term programme began being implemented, in terms of three main objectives linked to the improvement of knowledge, planning and participatory management of water budget balance recovery; to the improvement of coverage and quality in public services; and in setting up proper institutional mechanisms for an adequate financial, technical, legal and cultural support for water management measures. Some relevant outcomes were achieved. In this context, the implementation of the first World Bank's programme for strengthening local capabilities in different sectors, by means of a direct agreement with a sub-national government, took place.

The State Water Plan was partially based in a set of documents which had been produced under the sponsorship of international organisations, so the implementation of the World Bank's project was rather smooth in terms of technical coordination. Nevertheless, through the implementation process, some adaptation shortcomings showed up, dealing with administrative issues such as with the procurement processes or the participation of municipalities in the tender processes and execution of the actions. The substitution, overlapping or adaptation of new external administrative procedures had some negative as well as positive consequences for the State's institutional capacities and the programme's performance. In the other hand, the implementation of the World Bank's programme helped the state water authority to lever some actions within the State Government itself, which were normally subject to difficult negotiations within each years' budgeting process, such as water monitoring, financial and technical support to social participation, capacity building and communication issues.

In terms of the implementation of a program for the reform and strengthening of institutional settings for water resource management, some lessons can be proposed:

a) IWRM implies going beyond isolated capacity building efforts and assessing the improvement in the coordination and exchange of information and resources which occur between the entities dealing with water management within a basin.

b) Conceiving sustainability as the dynamic equilibrium in the use and preservation of natural, infrastructure, financial, human, technological, institutional-legal and cultural resources within a given context, an IWRM program should deal consciously with the evaluation, development and monitoring of these assets through coordinated efforts between all the parts of the system.

c) Investing in institutional strengthening is instrumental to ensure a greater impact, permanence

and stability of infrastructure programs; those investments should be, nevertheless, carefully analyzed in order to ensure they promote the improvement or construction of better processes, institutions and methods which take the sector's capacity to a higher level of performance, measurable in specific parameters

Even though a more formal approach is needed, some initial findings are proposed. The local settings and capacities level seem to have been instrumental to achieve an effective technical coordination. Nevertheless, the rigidity of administrative procedures, within the Bank as well as within the recipient organization, lead to non negligible consequences in the performance of the programme, because of the delays produced during the adaptation phase without considerably increasing the degree of control or accountability of the local administrative procedures. The way in which an intervention program affects the existing rules and practices defines the extent on which this intervention will affect local capabilities, but this influence cannot be globally evaluated as positive or negative, since it can improve the efficiency or stability of some positive processes, but can also contribute to block them or even create or reinforce negative ones. The analysis of the roles and relationships within a water management system, as well as an assessment of the way in which an external intervention will influence their overall performance is an issue which deserves more attention. In a multi-institutional setting, creating stable and distributed capabilities and setting up leverage mechanisms seems to be fundamental. Finally, an ethical consideration should be introduced into the analysis, since initial conditions of stability and accountability shape up the extent of the influence and effectiveness of any institutional reform program, whether it is locally promoted, externally supported or both; at least, a trade-off occurs between the need of optimizing the size of the program and the usual will of amplifying the infrastructure investment components, regardless of the achievement of realistic institutional improvements.

Management Reforms in the Water Supply and Sanitation Sector: The Potential of the New Public Management for Improving Services

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Keywords: Public Sector Reforms, New Public Management, Developing Countries, Water Supply and Sanitation , Utility Management

The vast majority of the world's water utilities are public utilities. Although exact figures on the level of private sector participation in the water supply and sanitation sector do not exist, it is estimated that the number of people served by private utilities is limited to about 200 million (OECD, 2003). This would leave more than five billion people who receive water services from either public water utilities or independent systems. The general consensus is that provision of water services will remain in the public sector for many years to come, especially in low and middle-income countries.

In many low and middle-income countries, however, public water service providers have failed to provide consumers with adequate water supply and sanitation services (Nickson, 2002; Mwanza, 2004). Apart from problems of service coverage of less than 60% (WHO/UNICEF, 2006), other problems that plague water utilities include high unaccounted-for-water (UfW), which often averages between 40%-60% and overstaffing (Mwanza, 2005). Moreover, the service providers are often confronted with financial problems due to a combination of low tariffs, poor consumer records and inefficient billing and collection practices (Foster, 1996; Mwanza, 2004; World Bank, 1994).

In response to the poor performance of many public water utilities, several reform paths have been promoted over the past decade(s). Firstly, management of the water utilities was delegated to the private sector through concession contracts or other contractual arrangements. The second reform strategy kept management of the utility within the public realm, but concentrated on introducing management principles and practices associated with the private sector in the public water utility. This second form of reform appears to be increasingly popular (Franceys and Nickson 2003; Schwartz 2006) and has been referred to as the New Public Management (NPM). The New Public Management originated in New Zealand and the United Kingdom in the early 1980s. Since then, NPM has become something of a generic term to describe a market-oriented and output-based management model for the public sector with an increased emphasis on accountability for results and user-orientation organizations (Peters, 1996; Kettl, 2000; Harrow, 2002; Budding and de Groot, 2003). In general, NPM reforms in the water supply and sanitation sector aim to achieve the following objectives:

1. Increase the level of autonomy of the utility (to let the operate as independent agencies);

2. Separate regulatory tasks from service provision;

3. Create (quasi-)competition in the water sector;

4. Increase tariffs to cost recovering levels and increase customer-orientation of the utility;

5. Increase accountability for the results produced by the utility.

These objectives should not be seen in isolation, as independent objectives, but rather as interdependent reform objectives. In this article we explain the interdependency of these objectives and review specific management reform measures introduced in water utilities in low and middle-income countries to achieve the objectives described above. These reform measures include the use of performance contracts (Uganda), 'agencification' of water utilities (such as in countries like Namibia, Brazil and Zambia through the establishment of government-owned companies operating under private law), the establishment of independent regulatory agencies (in countries such as Zambia, Peru, Colombia and Kenya), implementing customer charters (Uganda), establishing neighborhood customer management offices (Hai Phong, Vietnam) or establishing water watch groups (Zambia), raising tariffs to levels approaching cost-recovery (Zambia, Guanajuato, Mexico), and the increasing use of benchmarking (such as in Vietnam, Zambia).

Although in a number of countries, such as most notably Uganda, instituted reforms have been successful and have been cited as an example for other countries to follow, this paper raises some questions regarding the potential of NPM-style reforms in the water and sanitation sectors of developing countries. First of all, the question is if the performance improvements witnessed in Uganda are fully attributable to NPM-reforms. Reforms often consist of several simultaneous changes (Pollitt, 2003), making it difficult to conclude what the impact of the NPM reforms have been. A second question concerns the pre-requisites which must be in place prior to the implementation of NPM-style reforms. Without these pre-requisites (such as a formal public sector, reliable judicial system, etc.) the potential impact of NPM-style reforms may be limited. A third question relates to the dependency on government and donor support that successful utilities continue to display even after reforms have been implemented. If, in the near future this support is withdrawn or reduced because of political turmoil or other reasons, it will most likely have an immediate impact on the performance of the utilities.

This article concludes that elements of the NPM can lead to providing better services, as is illustrated by success stories such as the NWSC in Uganda. However, implementation of NPM reforms must not be seen in isolation but may complement other reform measures. Secondly, NPM-style reforms are most successful if they take place in an environment which is conducive to these reforms. This means an environment in which pre-requisites for such reforms are in place (such as, for example a well-developed system of contract law) and in which continued government and donor support is guaranteed. In short, NPM can only be successful if these reforms are complemented by other reforms, can build on the required pre-requisites and only if they receive pro-longed supported by other relevant stakeholders.

Public Water Utility Reform: From Best Practice to Best Fit

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Keywords: public sector reform, utilities, water and sanitation, corporatization, urban services

In the past decades, many governments have tried to make state-owned water utilities more efficient but few have succeeded in turning them around into effective and viable organizations. The most recent wave of reforms had a strong focus on private sector participation. In the past few years, there has been an increasing realization that private sector participation can help, but it will not suffice to get sustainable services to all.

The major transition of most utilities in the 1990s has not been from central public provision to local public provision. Another important 1990s trend was the drop in public, private, and donor sources of investment funding significantly reduced opportunities for network expansion or performance improvement. Despite these changes, the problems that utilities face are similar to the ones in the past.

The emphasis on private sector participation in the 1990s led to a shortage of rigorous analytical work on public service delivery. This paper is one of several studies to fill this knowledge gap. It looks at public utilities that have been successful in turning around their performance and becoming more efficient service providers.

The objective of this paper is to summarize new approaches to public utility reform. The paper is based on a dozen case studies, consultation with sector professionals and a literature review.

Attributes

There is no perfect model for public utilities that guarantees good performance. A review of 15 case studies in 11 countries using a standard analytical framework validated a series of common attributes of well-functioning utilities. These attributes are customer orientation, autonomy and accountability. The attributes apply to the relationship between the utility and the environment in which it operates as well as to the internal functioning of the utility. The paper introduces two tools to map public utility reform processes.

Tools

The tools to achieve these attributes vary, but certain patterns of high potential practices are emerging. These include corporatization, the use of public-public performance agreements, enhancement of consumer accountability, and capacity building.

Corporatization is the process of transforming a utility that is embedded within a municipality or ministry into a public organization with its own corporate identity. Performance of corporatized utilities varies widely. Well functioning corporatized utilities have a number of factors in common, including board composition and mandate, asset ownership, and the discretion of utility management

in key areas. In addition the state exercises its ownership function clearly. Multiple ownership can improve autonomy of corporatized utilities.

Performance agreements can clarify the objectives for a public utility – and their relative weight - between the government and the utility, its corporate oversight board or its managing directors. They thus can make it easier to hold managers and boards accountable for performance. Most inherent limitations of contracts plans cited in the 1990s are still valid. However, in the past decades the potential of performance agreements has been enhanced by the emergence of financial bonuses for individual staff and increased competition between decentralized utilities for central government funds.

Consumer accountability can help depoliticize balance the accountability framework of utilities and can help prevent political capture. Traditionally, utilities lack of consumer accountability reflects the fact that they are dependent on governments, financially and in other ways. The belief that citizens were effectively represented by politicians, who in turn connected with utilities, was challenged in the 1990s. This led to an increased interest in direct accountability from utilities to consumers. Consumer accountability is achieved through a combination of consumer accountability mechanisms, such as information channels, complaint mechanisms, advisory groups, board membership.

Capacity building can be defined as the process to provide individuals and institutions with the capacities that allow them to perform in such a way that the sector as an aggregate can perform optimally. Capacity building is a long term process which requires a mix of approaches that focus on learning new skills through applying them. Providing individuals and institutions with the motivation to implement their newly acquired skills is critical. There is a growing realization that capacity building should be demand driven and more responsive to real world needs. As a result the landscape of trainers now increasingly includes local training institutions, consultants, and operators.

Conclusion

As a conclusion, the paper provides a short discussion of opportunities and challenges of public sector reform going forward. Successful reforms combine measures to improve the institutional environment with utility-focused steps. There is a substantial difference between reforms that are desirable and reforms that are feasible. Reform – in reality – is often an incremental process, and reformers will (temporarily) have to put up with less-than-ideal solutions. The selection of reform measures will have to be based on the best-fit rather than the best-practice.

In the past years, changing governance regimes have created windows of opportunity in some countries. The emergence of a stronger civil society has put pressure to deliver better services. Technology has increased the ease of information exchange. New practices have been introduced within public organizations such as performance-based pay for management and staff. The threat of private sector participation has moved some public utilities into action.

Public sector reform is difficult and intrinsically political. It is not a quick fix or an easy alternative to private sector participation. Public reform requires financial, human and knowledge resources.

Better Water Services Operation Through Local Franchising

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Keywords: Water services, Operation, Franchising, South Africa, SMME

In South Africa, the rapid rate of construction and commissioning of new water services infrastructure is severely challenging the municipal institutions to which have been given the responsibility for operating and managing this infrastructure. Current institutional approaches, together with lack of capacity and skills, are in some instances inadequate to support the main aim of the new infrastructure programmes, viz to improve the access of the poor to basic services.

Even in the well-resourced municipalities, although the service may be reliable, efficiencies are sometimes unacceptably low -- water losses, for example, are significant, due largely to a legacy of underfunded maintenance budgets and inadequate maintenance practices, a generic problem in many developed countries, and more so in many developing countries.

Given the changes in the customer base of municipalities, and changes in technology and new service levels, innovative thinking and approaches to water service delivery are required. But even if all the existing institutions were coping with the water services delivery responsibility, there would be good reason to investigate alternative institutional models, on the grounds that it needs to be found out if alternatives:

- could be more cost-effective, and/or
- could allow existing roleplayers to focus on their other responsibilities, and/or
- could offer a range of other advantages (including greater community participation).

Internationally, it has been recognised that there is a need for partnerships between public, private and civil institutions to achieve water services delivery objectives. The variety of partnerships that has been implemented, viz. private sector concessions, Build-Operate-Transfer (BOT), Build-Operate-Train-Transfer (BOTT), etc., has enjoyed mixed success overseas and in South Africa. These have generally been "big business" partnerships for large scale contracts, and generally investment (public or private) in new infrastructure plays a prominent role.

There is an alternative service delivery institutional model that is suited more for the ongoing operation and maintenance of water services systems, rather than for investment in new infrastructure -- and that is friendly to small business and local economic development. This alternative is the franchising of water services. However there is little experience of this approach anywhere in the world, and no experience in South Africa -- although some partnerships have some of the characteristics of the franchise approach.

To address this, the South African Water Research Commission (WRC) initiated a study to explore the concept of franchising, its relevance to the water services sector, and its prospects as an institutional option for water services operations and management. The study found that the franchising concept, if applied to water services delivery, could in favourable circumstances both alleviate problems encountered in and raise the efficiency of water services delivery. At the same time, franchising would have the added advantage of stimulating small business activities.

A key is the incentive, to franchisor and franchisee alike, to improve efficiency.

The study, completed in 2005, described at a conceptual level how a water services franchise model could be made available to emerging entrepreneurs, and concluded that this could be the basis of a viable business. The franchise would be in respect of a component of the value chain that is suitable for small business because it can be readily systematised. The study indicated opportunities in the water services delivery chain, and recommended that these be further explored.

The study found that the great need for alternative water services provider systems, and for local economic development, is indisputable, and that there is through water services franchising potential to simultaneously:

- more consistently deliver water services to specification;
- improve water services efficiency; and
- promote local economic development, SMME development and (a major objective of the South African government) the empowerment of Black people who were disadvantaged by previous government policies.

A major follow-up study is currently under way, to further explore and establish the concept of franchising of water services. The key objectives are:

1. To further explore the concepts of franchising and its relevance to the water services delivery chain.
2. To identify and determine those elements in the water services delivery chain which offer the greatest scope for franchising.
3. To develop franchising models for the areas identified by the research, taking inter alia the legal, regulatory, financial and technological aspects into account.

The World Water Week presentation will summarise the findings of the follow up study, which, by the time of the conference, will be nearly complete.

Workshop 4: Progress on Financing Water Services

Community Financing of Small Scale Urban Water Extension Projects in Nigeria

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Keywords: water financing, deman driven, innovative schemes, community financing, water infrastructure

The Bread of Life Development Foundation and WaterAid Nigeria submit this abstract jointly. This report is an outcome of an evaluation study on the Plateau State (Nigeria) Water Board Citizens action project. The study was commisioned by WaterAid Nigeria and conducted by The Bread of Life Development Foundation in January 2007.

The Bread of Life Development Foundation is a Water policy advocacy NGO and monitors the implementation of the urban water sector reform projects in Nigerian to mainstream pro poor concerns. WaterAid Nigeria Urban work seeks to support urban utilities in their reform process while facilitating the setting up of community involvement in governance, which will ensure sustainability and protect the interest of the poor.

Jos metropolis is the capital of Plateau State in Northern Central Nigeria. Like most other urban centres in Nigeria, the residents perennially experience acute water shortages and near absence of sanitation services.

The Plateau state water board, over the years has not been able to meet the demands from the various urban poor communities in Jos for proper access to water supply and basic sanitation. Most of the inhabitants of these communities suffer from diseases such as diarrhoea, cholera, typhoid, Hepatitis and other water borne diseases, which are direct result of the poor water supply and sanitation situation in the areas.

The Plateau Water Board a public water utility had been wholly reliant on government subsidy sine it was created in 1991. Historically, and traditionally, water supply is seen as a government supply to be provided to the people free.

In September 2002, the state Government granted autonomy to the Plateau State Water Board which implies that it was expected to generate revenue from its operations to cover its operating costs, personnel and overheads. The Government however is to continue to take responsibility for capital projects expenditure and associated debt servicing.

Subsequent to its commercialization, the management of the Plateau state water board faced the challenge of collecting tariffs from its water consumers to finance its operating costs. Hitherto, the billing system and tariffs collection was very in efficient and the returns very poor. The management of the Water Board devises two programmes to tackle this challenge.

First, it organized "Community Consultation Forums" in most of its 19 Business districts in Jos metropolis between 2003 and 2005. The fora was an opportunity to inform the citizens of the water sector reform programme of the Plateau state water board, and the need for them to pay water tariffs to enable the water utility sustain and improve its operations.

Second, in 2005, the Plateau state water board set up a "Committee for the Actualization of community participation in Revenue collection" which started Pilot schemes in Laranto, Jos Central and Agwan Rogo business districts all aimed using community leaders to encourage water users pay their water bills.

The primary result of these two programmes is an increase in the revenue collected by the Plateau State from water users within the community. But this is not the focus of this abstract.

A fallout of the two programmes were the willingness of some communities within the Jos metropolis to partly finance extension of water supply to their communities. During the implementation of the two programmes, the members of the communities in Jos hand close interaction with the management of the Plateau State Water Board, and were informed of the inadequacy of funds to financed extension of water services to the communities. Several communities however offered to contribute towards the cost of extending water services to their domains, an arrangement which was accepted by the Plateau State Water Board.

Under this arrangement, the Water Board will itemized the materials needed to extend water supply top the community (in most cases pipes); members of the affected communities Board will tax themselves, purchase the materials directly and hand then over to the Water Board, who will in turn use the pipes in extending water to the community. An additional contribution by the affected communities is excavation of soil on the path in which the pipes were to be laid. Thus at the end of the day, the community provided human and material support while the Water Board provided technical know how to extend water services.

The communities that offered this voluntary service/support and by so doing had water services extended to their domains are:

1. Agwan Jumaa: they purchase pipes and materials for the Plateau State Water Board.
2. Agwansoya: In January 2004 contributed about $300 to purchase pipes that were used by the plateau Stare Water Board in extending water supply over a bridge to the community.
3. Agwanzumuruchi: they excavated the ground through which the Water Board laid pipes to the community. They also purchased pipes worth about $1000 for this purpose.
4. Furak community: the community excavated the soil and the water Board purchases pipes and laid them.
5. Tae Filling Station in Bukuru express: They taxed themselves< purchased pipes< excavated the ground and the Water Board laid the pipes extending water supply t the community>

Recommendations

Members of poor communities are ready to contribute to the task of water delivery if they are consulted and informed by key Government officials.

1. Demand driven mechanism should be explore for sustainable development of the water sector.
2. It may not be reasonable to posit that the poor communities cannot contribute to financing water projects even minimally in developing countries.
3. Sustainable Development of the water sector will involve harnessing the energies and resources of the citizens.
4. Community participation in financing urban sector water supply is a new development that needs to be further studied.

WFA-FTI: Reaching the Global Access to Water, by 2015, with Effectiveness and Harmonization in the ODA

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Keywords: WFA-FTI(Water For All-FTI), Effectiveness, Harmonization, Tackle Goal10 by 2015, Financial Alignment

The goal 10 approved in the Millennium Summit is clear: "Halve, by 2015, the proportion of people without sustainable access to safe drinking water". According to the report of 2001 on the fulfillment of the MDGs, 1.000 million people were lacking access to drinkable water (18 % of the population). Of continuing the current tendency of water consumption, in 2050 the shortage will affect almost 2.500 million persons, according to the second report of United Nations on the water resources in the world (ONU, 2006).

The reports of the III and IV Water World Forum, celebrated in 2003 in Kyoto and in 2006 in Mexico, respectively, coincide that countries face political, institutional, economic and technological limitations to reach development in access to water. Paradoxically, the international aid in this sector suffers, in many cases, from the same problems: lack of political commitment, lack of institutionality to macro level, and insufficient funding for the achievement of the MDGs.

This study applies the advantages and the achievements obtained in the initiative EFA-FTI (Education For All-Fast Track Initiative), in its struggle for reaching the ODM2, to the water sector. In the last years, the model created by this initiative has been consolidated and its efficiency has been proved moving quicker towards the universal elementary education, in the framework of the Paris Declaration on Aid Effectiveness. In this respect, this study analyses the viability of the elements in the model Fast-track Initiative (FTI) for a "Water For All". The idea would be to construct a global partnership between donor and developing countries to accelerate progress towards the MDGs to halve the proportion of people without sustainable access to water, by 2015.

The development countries that want to form part of this initiative need to approve by consensus a strategy of improvement the access to water between the stakeholders of the country involved in water, with indicators, concrete actions and budget until 2015. The process for the construction of this strategy would be similar to the "National Dialogues" that the EUWI has stimulated in different countries, and that has worked in an unequal way (Assessment report for the Steering Group, 2007)

It is advise, for time and economic efficiency that, for the design of the above mentioned strategy as well as for the phase of diagnosis, were used the numerous studies already realized by development agencies of different countries, as well as for international institutions (UNESCO/IHP, GTZ, AECI, GWP, CCAD, CAN …). In a global way, the different donors part of the WFA-FTI, would evaluate and assign the funds depending on the above mentioned strategies. A monitoring phase of results will be basic to set new strategies or different kind of funds for next years. Development countries thank not to have several assessments per year and donors clarify results and save money in consultants just with one report.

Also there would be useful, the application of the tool of a Catalytic Fund to provide transitional financial assistance to low income countries which have completed Poverty Reduction Strategy (PRS) and whose strategy of water has been accepted by the donors members of this WFA-FTI. Especially some countries of Africa and Asia would need years of transition receiving funding "extra" from this Catalytic Fund up to improving in this sector quicker.

The model of WFA-FTI exposed in this work learns on the lessons of the EFA-FTI, using funds for the water sector. For donors, the great change of this model Fast Track Initiative for the development cooperation in access to water, is the creation of a process with emphasis on alignment, coordination and harmonization, since recommends the Paris Declaration. When the strategy of a FTI process has worked for a sector in a country (for instance, in education) it turns out easier that it could be similar success for another sector in the same country, with the same donors. Only the European Commission and its members states have spent around 2.000 million Euros per year in development projects of water resources, without being able to establish categorically the degree of efficiency that has had this aid. Almost all the members of the European Union take part in the EFA-FTI. The fast track initiative for water (WFA-FTI) proposed in this study might increase in twenty per cent the efficiency of the European Union Aid in the water sector, obtaining in addition more political commitment, an institutional strengthening (elements that, as it has said before, are in the base of difficulties in the access to water) and more appropriation, alignment and harmonization between donors.

Cost Estimates, Budgets, Aid and the Water Sector: What's going on? An Analysis Illustrated with Data from 12 Sub-Saharan African Countries

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Keywords: Cost estimates, Financing, Aid, Budget allocations, Sub-Saharan Africa

Increasing access to water and sanitation services is a financially daunting task. Recently, a large number of studies have been conducted to estimate the costs to achieve the Millennium Development Goals MDGs. The range of estimates is broad, covers all regions and ranges between US$6.5 billion per year by the UN MDG Task Force on Water and Sanitation (2004) to US$75 billion per year by the World Water Vision (2000).

There is disagreement on how expensive access can be, but there are also an increasing number of sources of funds ranging from the more traditional Overseas Development Assistance, to national government sector expenditures, to and increasing number of international and national private financing mechanisms.

The analysis to be presented draws from the global financing picture for water and sanitation, focusing on 12 countries in Sub-Saharan Africa that are least likely to achieve the MDGs: Angola, Burkina Faso, Chad, DR Congo, Ethiopia, Kenya, Madagascar, Mozambique, Niger, Nigeria, Tanzania, and Uganda.

The analysis of a few variables shows firstly that on a per-capita basis, cost estimates to achieve the MDGs that are used to drive policy decisions both by donors and governments, tend to be underestimates. Secondly, amounts of funding to WASH, whether through public budgets or ODA, still (for the most part) are insufficient to meet even those under-estimated cost estimates.

We argue in this paper that:

i) Existing cost estimates per capita are grossly underestimated;
ii) Public budgeting processes do not provide sufficient resources to WASH;
iii) ODA is insufficient to bridge the financing gap;

The conclusion is clear: the financing situation in the water sector is depressing. In this analysis, we started by considering cost estimates to achieve the MDGs, and found that these are largely underestimated. Further, we found that the missing components of the cost estimate are those most strongly linked to sustainability, because of the difficulty in deriving a standard estimate. Then, we looked at the public budgeting process in 12 countries least likely to achieve the MDGs, and found that current budgets do not match even the low-balled estimates in terms of WASH. Further, given

per-capita GDP estimates, and GDP growth trends, it is unlikely that these countries will be able to leverage additional finance from domestic resources, whether through taxes, user fees, or the like, particularly for the poorest. Then, we considered the role of ODA, and noted that even while ODA commitments have increased recently, per capita ODA to the poorest countries are still insufficient to meet per capita costs. Additionally, the challenges of disbursements, and the increased volatility of aid flows, suggest that the systems surrounding ODA need to change in order to be more effective, to achieve development targets.

Recommendations on financing WASH include:

- Per capita cost estimates should reflect capital maintenance expenditures, on-going support costs and indirect support costs of WASH. Updated costs should be discussed and adopted at a country level by donors and other sector actors, to feed into budget projections, investment planning, large and small projects. It is a very simplistic recommendation but in fact cost underestimation has been one of the single most direct causes of programme, project and utility failures and inability to move from "pilot projects" to scale.

- Donor agencies should focus on streamlining their processes to make aid more predictable and consistent. While the MDGs are focused on results in developing countries, a considerable cause for concern rests with the budgeting and administrative processes within aid agencies. Donors should work harder to ensure that their recent commitments to the WASH sector are disbursed as quickly as possible, to maximize impact in the next few years.

- NGOs operating at both a country and international level should publish their annual commitments and expenditures, to help fill this information gap. While the OECD captures ODA commitments and disbursements for governments, no similar source of information exists for NGOs, which provide considerable sums in many countries, particularly the poorest. Because NGOs often work outside the scope of government, whether for political or other reasons, NGO contributions are also not captured in a government budget. For the purposes of coordination and aid targeting, it would be extremely helpful for NGOs to provide information on their commitments, expenditures, and outputs/outcomes in a standardized fashion, to allow for greater understanding of the impact of this sector.

- Likewise, new financial sources and agencies entering the WASH market should be encouraged to report their commitments and expenditures, with funding details, to allow for more comprehensive analysis. Ideally, the DAC database would be able to capture the efforts of non-state actors, such as NGOs and private foundations or companies; however there may be other agencies, for example as part of the UN Global Compact, or UN Water, which may be able to serve a similar function.

Financing Urban Water Supply in India: Trends and Lessons for Emerging Economies

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Keywords: Camdessus Panel , municipal bond, private sector participation, water policy, legal and regulatory climate

Indian economy registered a growth rate of 8.9% in the first quarter of 2006-07, which is the highest growth rate of this decade. Interestingly, urban areas, which houses only about one third of the country's population, contributes about 60% of the national income. But the urban population in the country is steadily increasing from 23% in 1981 to 29% in 2001, and is likely to be twice its present level in the next two decades. It will exert acute pressure on civic amenities including water supply, .At the same time it is well recognised that there is a need for much more and much better infrastructure to sustain the phenomenal growth, which the country is witnessing today.

It is estimated that the 3682 municipal bodies of India, mandated by law for provisioning of basic services, including water supply in urban areas would require an additional investment of about Rs. 740 Billion in order to provide all sections of urban population, access to basic urban services by 2020.

Clearly , the infrastructure investment needs of India are huge and India's faces a challenging task of financing these huge needs over the next couple of years. Traditionally this has been financed by Public sector or governmental sources include budgetary support and various internal and external budgetary resources (such as internal generation of public sector undertakings, allocation of cess on petrol / diesel etc.) and market borrowings of PSUs engaged in the creation of infrastructure.. But since India opened its infrastructure sector to private investment as a part of country's 1991 reform program, there has been a slight but discernable shift in the sources of finance for urban water supply and sewerage services. This paper attempts to capture new financing options which have recently become popular and impediments to their wider uptake .Specifically it will map the current status on the recommendations of the Camdessus Panel Report 2003 in the country on aspects of

- Water Policies
- Promoting local capital markets
- Cost recovery
- Legal and regulatory environment
- Private investment and operation

New Financing options

Municipal Bond issue : The debt market in India for municipal securities has grown considerably since the issuance by the city of Ahmedabad in 1997 without state government guarentee. Since 1997, Several urban local bodies and utility organizations have issued bonds and have so far mobilized over Rs. 900 crore through taxable bonds, tax-free bonds and pooled financing. It is significant to note

that most of the municipal bonds issued so far have been without a government guarantee. The success of these issues demonstrated that local governments can access the capital market for resources for efficient delivery of civic services. To boost the municipal bond market, the Government of India decided to provide tax-free status to municipal bonds.

Pooled financing : Pooling concept has helped small and medium towns to access the capital markets which were hitherto out of their reach. It has provided economies of scale by spreading fixed costs of borrowing (for example, credit analysis expenses, legal fees and document printing) across several borrowers. The State of Tamil Nadu, with FIRE (D) support, developed a Rs. 30.41 crore (US$6.4 million) pooled bond issue with USAID Development Credit Authority (DCA) guarantee whose proceeds would fund water and sewerage projects in 14 small and medium-sized towns in the Chennai Metro Area.

Borrowing from commercial banks/financial institutions :In Recent times local bodies have accessed loans from private commercial banks for financing urban infrastructure projects . For instance, Vadodara Municipal Corporations (VMC), Surat Municipal Corporation (SMC) and Thane Municipal Corporation(TMC) obtained several commercial bank loans to finance its urban development. In most cases the loan is secured by opening an escrow account into which designated collections are transferred . These efforts demonstrate that bank loans can and will play a very important role in financing urban infrastructure projects.

Private sector participation (PSP) : Options, albeit limited have also emerged in private sector participation (PSP) in the financing and management of urban services in India. These range from service contracts (Chennai), performance-based service contract (Navi Mumbai), joint sector company to implement and finance the projects (Tiruppur and Vishakhapatnam) to name a few.

Creating an enabling environment to access alternate finance

Over last one and a half-decade, 172 PPP projects accounted for total investment of US$ 51,448 million in India. Of these only 1% was invested in water supply and sewerage projects. However, some progress , as a part of the larger reform agendas has been made in developing the policy and legal framework which enables for local governments to access resources. Undoubtedly a robust municipal revenue base is a critical factor for obtaining market finance. The paper will analyse the various reform initiatives taken in the country , including the recently launched Central government flagship programme –Jawaharlal Nehru National Urban Renewal Mission(JNNURM) aimed to improve urban services delivery . It will also assess the lacunae in policy and regulatory environment in the sector, which impedes financial flows into the sector.

Revolving Water Community Funds as a Means for Micro-Financing Water Services

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Keywords: Community ownership, pro-poor governance, revolving water fund (RWF), CWASC, micro financing

With rapid urban development, the gap between water demand and supply in urban areas in India is widening, imposing stress on the basic infrastructure facilities of the local bodies, which often fails to address the growing demand. In the process, the urban poor suffer the most. While additional financial resources will help to meet these challenges, infrastructure investment alone does not ensure sustainability. Though there are immediate prospects for a rapid increase in the external investment flow into the water sector it is more likely to address the requirements of main trunk infrastructures in the cities. Thus there is a possibility of poor people living in slum and squatter settlements not deriving benefits from such improvements in the city water supply system.

There is a need for more intensified funds for ensuring that poor people living in the periphery of the cities obtain improved services. Various types of loans / subsidies have helped to fill gaps in the more conventional financing available for development works. Therefore, there is a need to devise means that focus on filling this critical financing gap by providing loans to Community Based Organizations (CBOs) to initiate development of water supply facilities. A revolving fund for financing such community initiatives is one such solution.

Such a fund has been created under Water for Asian Cities Programme for Community Managed Water Supply Scheme (CMWSS) and is being implemented as a pilot demonstration project in Gwalior, Jabalpur and Indore. The revolving fund is being managed by the Municipal Corporations in Gwalior and Jabalpur and by the District Urban Development Agency (DUDA) in Indore. There are existing poverty pockets in the cities which, amongst other basic services, do not have sustainable water supply, but urban civic bodies have no plans to connect these poverty pockets with the normal water supply system of the city in the near future. Given this back drop, the CMWSS seeks to demonstrate that it is possible to quickly improve the lives of the urban poor and the disadvantaged by connecting them to safe drinking water which would result in users not having to travel long distances or waste time queuing for water. CMWSS has a pro-poor governance approach in which, the cost of construction and the water connection charges are met upfront from the revolving fund set up for this purpose. The consumers are assured of continuous service or, at least on a regular basis (same time every day) and provided with enough water to cover their needs for daily house chores, which would facilitate proper housekeeping.

The enabling framework for CMWSS initiative is as follows:
Adoption of a demand-responsive approach along with community participation based on empowerment of the community to ensure their full participation in the project through a decision making role in the choice of the drinking water scheme, planning, design, implementation, control of finances and management arrangements;

Full ownership of the assets by the community through a Community Water and Sanitation Committees (CWASCs);

100% responsibility of operation and maintenance (O & M) and loan recovery with the community;

In these cities, homogeneous communities have organized themselves to constitute a Community Water and Sanitation Committee (CWASC), a CBO, to improve their financial and managerial capacity to execute and manage the scheme for the community as a whole thus demonstrating a pro poor governance approach. After verifying the extent of mobilization of the community and obtaining their concurrence for payment of connection and monthly user charges, capital cost and taking up the future O&M responsibility, the RWF manager and the CWASC entered into a Memorandum of Understanding (MoU) resulting in a loan being extended to the CWASC to meet the capital cost of the scheme upfront and their capacity is enhanced for the execution, operation and maintenance and financial management of the scheme. The schemes are owned and have been executed by the CWASCs with technical support from the local bodies. The CWASC now have the responsibility of operation and maintenance of the scheme as well as repaying the loan to the RWF as per the MoU through collection of connection as well as monthly water charges from each household in the community. The individual households do not pay the connection charges at one go to the CWASC. Rather installments are fixed which can be monthly or fortnightly as per the paying capacity of the individual thus ensuring pro-poor water charges. The monthly user charges are as per the prevailing rates in the city.

The Revolving Water Fund (RWF) is a special micro-financing measure, which makes finances available in the form of interest free loans to the CWASCs for meeting the capital cost of the water supply scheme upfront and then uses the repayments from the CWASCs to take up additional schemes, thus "revolving" or reusing the capital to increase the access of urban poor to drinking water. The whole process is expected to generate a sense of ownership and ensure the financial viability and sustainability of the schemes. The local bodies are the managers of the fund and are responsible for the disbursements and repayments to and from the fund. It is expected that with the recouping of the RWF, the local bodies would be able to replicate and upscale the scheme in other slums of the city, making potable water available to the community at large.

The paper elaborates on the institutional mechanism and operational methodology of revolving fund and presents the learning of the CMWSS.

Financing Water Supply through Public-Private Partnerships: Lessons from an Indian Case Study

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Keywords: Public-Private Partnership, Sustainable, Water Supply , Financing, Private Market

In many parts of the world water quantity is decreasing and quality is worsening leading to social and political conflicts. Sustainable water resources management is crucial for improving human well-being and in particular for achieving most of the Millennium Development Goals. In rapidly growing cities, provision of adequate water is a big task. Since the urban demand for water is primarily for 'non-consumptive' purpose wastewater management also important. Since water is a 'fluctuating resource' ensuring its availability in time and in space is a challenge and required large investment. The WHO estimates that for every US dollar invested in water and sanitation generates an economic benefit of US $ 3-34, depending on the type of water system installed and the region where the investment is made. The funding requirement for providing enhanced water and sanitation services over the next decade is estimated to be around US $ 800 billion. Generally private firms are not interested in constructing water supply systems because of the long gestation periods and the comparatively low returns on investments. In most cities, the industrial water requirement may not be substantial compared to the domestic. The Public-Private Partnership (PPP) water supply project of Tiruppur, a major textile city in South India, is an interesting example.

The textile industry in Tiruppur not only has a dominant position in the economy providing employment opportunities for 300,000 and generating foreign exchange of US $ 2,278 million/year, but is also a large water user (90 million litres per day - mld). The industrial water requirement for the city has increased from 4.4 mld (1980), to 40.8 mld (1990) and 86.4 mld (2000), roughly three times the domestic requirement. In earlier years industries extracted their required water from their own wells. But from the early 1990's due to textile pollution industries transport water from the periphery by tankers paying about US $ 22 million/year. It was thus logical for the industry to enter into a PPP with the Government to implement the water supply scheme. However the financial sustainability (which depends on the relatively high tariff that industries have to pay) and the environmental sustainability (the overall water resources management in the region) of the PPP are critical issues for consideration.

The Tiruppur Area Development Project (TADP) was implemented through the New Tiruppur Area Development Corporation Limited (NTADCL), a group of public and private entities. NTADCL act as a Special Purpose Vehicle operating on a Build-Own-Operate-Transfer base with a 30-year time stipulation and is the first PPP in the water and sanitation sector in South Asia. The project includes: (a) bringing 185 mld of water from the Cauvery river (55 km. away) to Tiruppur for industries and households and (b) treating 15 mld sewage of the Tiruppur city. The TADP was developed by the Government of Tamil Nadu, Infrastructure Leasing & Financial Services Limited, and Tiruppur Exporters Association with the assistance of United States Agency for International Development. On February 2006, the water supply scheme was inaugurated, while the sewage system is under progress. The total cost of the project is US $ 230 million and consists of US $ 73 million as equity, US $ 20

million as subordinate debt and US $ 137 million as debt. Out of the 185 mld water, 115 mld has been allotted for industries and 70 mld for households. Apart from industry, 629 rural habitations and the wayside villages covering a population of 0.32 million, and urban population of Tiruppur of 0.42 million including 60,000 slum dwellers, are the beneficiaries of this project. The pricing of water to industry (US $ 1/m3) has been determined on the opportunity cost basis, which is the amount paid by the industry to the tankers. However for the domestic sectors US $ 0.12/m3 by urban and US $ 0.08/m3 by rural people is based on the current pricing policies in the state.

It was assumed that after the project commenced the private water market through tankers would disappear and industry would prefer TADP water. The Tiruppur Municipality also had announced that 'no private/informal water supply would be allowed to operate'. However, some of the industries do not prefer the TADP water because of its high price (US $ 1/m3) compared to the tankers. Generally significant variation existed on the tanker price based on seasons (US $ 0.73/m3 to US $ 1.12/m3) and the average amount (US $ 0.92/m3) was less than TADP price. After the scheme the lorry tankers started to significantly reduce their prices. Now the stiff competition from private tankers has become a great challenge to the TADP, which was forced to cut the water tariff to US $ 0.5/m3, 50% less than the original rate. In this situation, the financial sustainability of the project is jeopardy.

Another serious problem that the TADP faces is the new regulatory requirement on "Zero-discharge" imposed by the Pollution Control Board. Industries in Tiruppur will have to treat their effluents and recycle the water. If recycling is enforced, the industrial water requirements will be substantially reduced resulting in a much lower demand for TADP water. The main rationale for the PPP of supplying 115 mld will no longer exist, if industries require only make-up water.

The water supply project has succeeded in providing protected drinking water to 0.75 million people in water scarce and highly polluted Tiruppur region but at a very high cost. It is unfortunate that TADP did not include the industrial wastewater management in project design. The Tiruppur experiences demonstrates that planning the project in terms of the full water cycle project is essential for achieving sustainable water resources management for both economic and environmental perspectives.

Financing Water Services in Armenia - Major Challenges and Ways Out - A Case Study

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Keywords: Financing, Water services, Affordability, Willingness to pay , EECCA

Presentation of the project/topic and analysis of the issue(s)

What are the major challenges in financing water services in a country in transition such as Armenia? And what are the ways out? These are the two major questions to be dealt with in this paper.

In doing so we will focus on lessons learned in Armenia with the preparation and implementation of an environmental financing strategy for the water sector. This strategy has been prepared by COWI A/S under the supervision of the OECD/EAP Task Force. It builds upon the model FEASIBLE.

The paper will consist of three chapters - in addition to the introduction. Chapter 2 defines the water services and available financing mechanisms in the EECCA region, highlights the major challenges and presents the concept of an environmental financing strategy and FEASIBLE. Chapter 3 provides a case study assessing the results of the use of FEASIBLE for the preparation of an environmental financing strategy within the urban water sector in Armenia. Various issues, such as affordability, willingness to pay and priority setting, are dealt with in this context. Finally, Chapter 4 provides conclusions and recommendations regarding financing water services - valid to other EECCA countries.

Presentation of the results/findings

Definitions

Key terms such as water services and available financing mechanisms are defined with a view to the EECCA region taking into consideration recent developments (e.g. the newly approved Water Codes).

Major challenges

The major challenges regarding financing water services in the EECCA region are listed and explained with a view to, among others, the water-related Millennium Development Goals, targets of the World Summit on Sustainable Development held in Johannesburg in 2002 and existing national strategies. The need of decision makers to make tough investment (or rather dis-investment) decisions in the short term is emphasised.

Environmental Financing Strategy and FEASIBLE

An environmental financing strategy is a methodological framework for medium- to long-term strategic balancing of environmental and infrastructure service targets with available financing. Thus, the basic idea behind the environmental financing strategy concept is quite simple. There should always be a balance between the money needed to meet the target and the money available to do so.

Environmental financing strategies can be used by transition and developing countries as well as western market economies, including EU Member States and EU Accession Countries:

- To assess total investment needs of alternative policy targets.

- To bring about practical implementation programmes taking into considerations what the economy and households can afford.
- To identify investment projects and build short- to medium-term project pipelines.
- To identify the policies and measures which are necessary to ensure effective financing of the project pipelines.
- To support claims of environment and other ministries responsible for municipal services on the public budget.
- To support transition country requests for donor and IFI financing.
- To measure and report on the progress in the implementation of programmes and policies.

A computerised decision support tool has been developed to support the practical implementation of the methodological framework. The tool, called FEASIBLE, facilitates an iterative process of matching the expenditures required to meet given targets with available finance.

Case Study: Armenia
In 2005, an environmental financing strategy was prepared for the water sector in Armenia. It is presently under implementation. Two scenarios were developed:

- Baseline scenario. It anticipates the implementation of the ongoing programme on WSS rehabilitation in Yerevan, and maintaining the service level and condition of infrastructure at the base year level in the other urban areas.
- Development scenario. It includes more ambitious targets for the rehabilitation and development of the urban sanitation infrastructure.

FEASIBLE model simulations have shown that, in principle, it is feasible to reach the development scenario targets by 2015. The following policy package could fully cover the operation and capital expenditures, amounting to some AMD 689.4 billion (equivalent of USD 1.2 billion) over the 2002-2015 period:

- To improve user charges collection rate up to 94% by 2006 (from some 70% in 2003).
- To increase the water bill for households to the affordability threshold (4% of the average household income) by 2006 and to increase the tariffs for other consumers by 150% by 2007.
- To undertake energy and cost saving measures.
- To allocate public funds and international loans to WSS amounting to 2.2% of public expenditure budget for the 2005-2011 period, then gradually decreasing to 1% by 2016.

This package entails, however, some pitfalls. In particular, maintaining the water bill at the level of 4% of average household income over 2006-2015, and allocating public funds and international loans amounting to 2.2% of the public expenditure budget in 2005-2011 are challenging targets. Presently, these pitfalls are being addressed in Armenia. Much attention is paid to a meter-based tariff system.

Conclusions and recommendations

Problems within the water sector in the EECCA countries are plenty. Environmental catastrophes may occur unless decisive action is taken. There is not one way out. It's important to apply different tools, including the proper preparation, approval and implementation of environmental financing strategies. Most important is that environmental financing strategies force decision makers to set SMART (Specific, Measurable, Attainable, Realistic and Time-bound) targets, even though it necessitates some difficult choices. In this way they constitute a framework for discussions - and also conflicts.

Paths and Detours of Integrating Water Resources and Financing

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Keywords: water financing, municipal water supply, water policy, water sector reform, Indonesia

Introduction

Indonesia's drinking water utilities have struggled in the past, despite significant assistance from the donor communities, to increase access and improve corporate governance in water services. Currently, the water utilities outside Indonesia's capital, Jakarta, are at a major turning point. Very few utilities out of existing 319; operate at full cost recovery. The vast majority manage with water tariffs that barely cover their operation and maintenance costs. Quality of management, a "politicized" tariff-setting process and availability of alternative water sources are posing cost recuperation problems. Access to credit, alternative mechanisms of financing and political will prevent utilities from expanding their services. However, emerging legislation, along with a number of innovative pilots implemented on the ground, suggests that significant reform is on the way. The challenge will remain in integrating an enlightened policy with proper management framework and financing to achieve rapid service coverage to support the Millennium Development Goals (MDGs), Target 7. This abstract reviews the historical development of the legal and institutional structures underlying Indonesia's water sector. It particularly highlights current policies and pilot interventions, with the objective of assessing gaps and showcasing emerging best practices that may succeed in creating a better national environment for the delivery of piped water.

Detours and Paths to Modernity

Achieving water and sanitation targets pledged under MDGs is a professed priority of the Government of Indonesia (GOI). The fundamental objective of government is to improve access to safe, reliable and affordable water, and expand the piped network to include marginalized urban and peri-urban communities. The National Action Plan on Water Supply 2004 projects that 18 million new connections will be needed, along with a collateral investment of about US$5 billion in piped water network expansion, to achieve 2015 targets. The difference between actual and required investments to achieve this target amounts to around US$400 million annually.

About 47 percent of Indonesia's population of 220 million lives in urban centers, with over 110 million people living on less than US$2 per day. There is increased pressure on local governments and water utilities to improve and extend network coverage. Given the current coverage, water use pattern and a growing urban population, Indonesia's water sector faces critical challenges in expanding access to the urban communities. This abstract focuses on the salient laws and institutional structures underlying Indonesia's water sector. Furthermore, it examines various detours and paths that have led to the current framework by examining key legislations related to water and the integrated approach to combining resources and institutions in the mobilization of financing. Two important pieces of legislation among others, in this respect are the Law 7 (2004) on Water Resources and the Presidential

Regulation 67 (2005) that attempt to integrate water not only within rural, urban and basin-wide context but also in promoting a cross-sectoral infrastructure development.

Since 2001, the policy framework on water utilities has been in transition due to macro-economic recovery process, decentralization of governance and devolution of finance from central government to regional agencies. Over the past two years, several important pieces of legislation have thrown open the possibility of financing the water sector, the most important of which is the transfer of responsibility of public services from the centre to local governments. The Water Resources Law 7 (2004) recognizes several disparate components in water resources management. Expansion of piped services cannot take place without additional investments to conserve and protect water sources and to ensure quality, quantity and year-round flow of water. Innovative financing is needed to expand production and distribution of water utility network particularly among poor households. Pilot models on the ground illustrate that an integrated framework to water financing that combines conservation finance; corporate and municipal finance, micro finance and public private partnerships may improve the linkages between rural, urban and basin-wide service delivery. In addition, Presidential Regulation 67 (2005) attempts to integrate urban infrastructure, including water supply, sanitation and wastewater within a larger framework intending to improve the mobilization of private sector participation in all infrastructure. The effectiveness of this law will be carefully watched to determine its impact on scaling up access to piped water supply of low-income households.

Conclusion: Face-to-Face with Reality

Reforms are underway to create a favorable policy and legal framework for mobilizing finance in the water sector. Progress is evident in the provisions that govern the issuance of municipal bonds by local government and other forms of debt by local government-owned enterprises. New rules governing the selection of private proponents to implement concessions are rapidly being clarified. Reforms in the policy structure, however, have not been successful in translating the umbrella regulations into action-oriented management of water utilities. Inter-jurisdictional and inter-local cooperation will largely determine success in improving quality, quantity and flow of water resources. Defining the integration of 'rights to water: human, contractual and property' in national legislations related to water will also impact effective implementation of these cross-cutting initiatives.

The ability of water utilities to access "financing" to manage water resources and expand the number of households served by piped water will remain a key challenge. However, an integrated approach to water financing provides scope at a meso scale to maximize on technology, institutions and resources. At a macro-scale, the ongoing reforms appear inadequate without parallel efforts to ensure the achievement of the MDG targets. The expansion of financing options through an enlightened policy framework can be successfully implemented to obtain rapid service coverage only if reforms in public sector finance can attract sufficient interest among local commercial lenders and investors to finance projects. Parallel reforms will be needed to ensure participation of investors, financiers, consumers and users of water in the management of water resource management. Equally important are the issues of good corporate governance, accountability, creation of autonomous institutions and promotion of internal utility reform.

Allocating Water Related Financial Budgets by Synergistic Use of LP and AHP

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Keywords: financial budget , allocation, synergy, LP, AHP

Although there are many Ministries/Agencies in Serbia that 'handle' water, ranging from planning for its utilization, distribution for various uses throughout the country, monitoring its quality, and managing water reuse, the main responsibility for water management in Serbia lies with the Ministry of Agriculture, Forestry and Water Management and public water management companies Serbia Waters and Waters of Vojvodina Province. In recent years it has been widely accepted an integrated approach to water management requires a clear understanding of the existing policies and strategies for water resources and acquiring their coherence with the European funding models. In other words, national water sector is now founded upon the principle of self-sustainable development of water sectors, where this branch of the economy earns a major share of its revenues by levying charges for 'water services'. This concept includes the entire field of water activity, ranging from water source protection and building of water infrastructure to water distribution by municipal systems. It should be noted that levies for water use also include environmental protection costs.

Self-funding of the water sector is based on strict adherence to two basic principles: 'user pays' and 'polluter pays'. The use of this method secure funds required for the maintenance of current and building of new water infrastructures. A self-funding and sustainable development of water management in Serbia is under serious consideration with principal focus on the issue that water will become an economic category rather than a 'social resource' as perceived at the present time.

In view of the current economic situation in Serbia and the low standard of living, it is unrealistic to expect applicability of the European funding model for the water sector in the short-term. The actual price of water and water services can be charged to residents only after a period of economic revitalization and increase in the standard of living. Until then the state budget will continue to play important role in water sector funding together with international assistance (specifically: grants, loans and concessions).

This paper presents possible model for aggregating two different optimization techniques in search for positive synergy between multiple participants in water related decision-making business, i.e. in allocating the financial budgets. The first is standard Linear Programming (LP) which belongs to single criteria optimization tools. The other one is Analytic Hierarchy Process (AHP), widely used supporting tool to the decision-making process for hierarchically structured problems. The later method can be considered as an optimization one only in wide multicriteria sense.

The AHP is used for generating weights in a criteria functions of the LP models created for each individual participant involved in a allocating the efforts (qualitative resource) and associated financial budgets (quantitative resource). Both efforts and budgets are optimized for each participant taking into

consideration their a priori preference in allocating financial budgets for technical human resources and managerial human resources.

By scalarisation of criteria functions and re-composition of constraints in initial individual LP models, the final relative linear programming model is created and solved in search for a positive synergy regarding (optimal) allocation of both joint efforts and financial budgets. The regional hydro system Nadela in Vojvodina Province is used as a case study example to demonstrate possible scenario and approach in motivating key players in vital issues related to operation and long life of this system. Identified partners in the decision-making process were Public Water Management Company Waters of Vojvodina Province, Association of Water Users, and Provincial Secretariat for Agriculture, Forestry and Water Resources. Allocation segments considered in this particular example were: (1) increase of system's attractiveness for national and international investments; (2) establishment of stable development and operation of the system, and (3) cost reduction by merging technical and managerial human resources. By assessing different influence (and power) of the partners, it has been shown that significant differences in achieving positive synergy may occur. It was found that improvements can be obtained by (limited) increase of the number of participants, by splitting financial budgets into more categories, and by introducing additional and problem specific qualitative criteria into the decision process.

Doubling Asia's Water Investments: ADB's Imperative

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Keywords: water financing program, water financing partnership facility, doubling investments in water, millennium development goals,

Finding Funds to Ease Water Woes

ADB's report "Asia Water Watch 2015" estimates that a minimum investment of $8 billion annually would assure that every country in the region reaches Target 10 (halving the proportion of people without access to water supply and improved sanitation). Once Target 10 is reached, the $8 billion annual investment will yield a $54 billion annual return—that is almost 7 times the annual investment made. The report argues, "It is the height of economic irrationality to not invest in these vital services".

The impact of water is so diffused that every dollar invested in people gaining access to water and sanitation returns $6 in health, livelihood and education benefits. It is never just water for water's sake, but water for poverty's sake. Clean water and improved sanitation can save the poor time, improve their health and provide them income opportunities.

We're just talking here of water supply and sanitation. How about irrigation and water resources where the investment need is just as much if not more? Obviously, the overall investment requirement for the sector is beyond $8 billion annually.

Despite such clear justifications for investing in water, governments have not stepped up investments in their water sector. ADB has identified 3 barriers:

- There is a lack of understanding about the importance of water sector investments as a necessary first step in achieving ambitious overall development and poverty reduction objectives.
- Governments have not been aggressive enough in pursuing policy reforms, which create the enabling environment for ensuring investor confidence.
- Financing modalities have not been attractive options for governments, particularly in countries undergoing decentralization.

Putting Money Where the Mouth Is

ADB recognizes the magnitude of Asia's water woes and is committed to increasing financing to the water sector and achieving the MDGs. In March 2006, ADB Management decided to make water operations a core business area for ADB through the Water Financing Program 2006-2010 (WFP).

WFP is about providing water and sanitation services, reducing people's exposure to flood damage, improving irrigation and drainage, and introducing sustainable water resource management practices. It is also about taking bold, new steps to implement water projects, institutional reforms and improvements to water governance in three key areas:

- rural water services to improve health and livelihoods,
- urban water services to support sustained economic growth, and

- basin water management to promote integrated water resource management and healthy rivers.

In implementing WFP, ADB strives to break the three identified barriers to increasing country water investments. In particular, it pursues the following approaches:

- Promoting understanding on the link between water investments, development and poverty reduction

To raise awareness levels of government and the general public, ADB conducts campaigns that reinforce the importance of water and its links to poverty reduction and economic development. Through a whole range of knowledge products and services, ADB helps governments pursue their water policy reform and strengthen the agencies that manage water resources and operate water services.

- Promoting national water reforms

ADB supports national governments in pursuing reforms designed to improve the management of their water services and resources. These include the formulation of national policies or regulatory frameworks, improvement of tariff structures, introduction of integrated water resources management, and more.

- Promoting financing modalities responsive to national and local government needs

In 2006, ADB introduced a range of competitive financing products such as local currency bonds, lending to subsovereign (municipal) governments, multi-tranche financing facility (MFF), flexibility in commitment charges and refinancing facility. At the WFP Conference held in September 2006, delegates from India, Indonesia, and the Philippines have already expressed interest in MFF.

WFP: One Year Later

WFP had its birth pains but is now taking significant steps towards achieving its goals. Dialogues with five initial client countries during the September 2006 WFP Conference resulted in a list of opportunities to develop further business and bring more water investments in these countries.

Continuous discussions with developing member countries have yielded a 3 year pipeline of $6.8 billion: $1.9 billion for 2007, $2.1 billion for 2008, and $2.8 billion for 2009. Several of the pipelined projects utilize ADB's multitranche financing facility.

A host of other initiatives are underway to support the WFP, including the:

- Establishment of the Water Financing Partnership Facility, which intends to mobilize some $100 million cofinancing and investments from development partners
- Development of a score card system for ADB-wide monitoring of WFP progress
- Establishment of new partnerships that develop capacity and improve service delivery, e.g. knowledge hubs, regional water utility networks, etc
- Performance benchmarking of critical water organizations, e.g. river basin organizations, water utilities, national water sector apex bodies
- Establishment of the Asia-Pacific Water Forum which focuses on three key themes: water financing, disaster management, and water for development and ecosystems

Microfinance for Piped Water Supply – Emerging Experience from Kenya

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Keywords: microfinance, water supply, community management, business development services, output based aid

A number of commentators have highlighted the need for increased finances in the water supply sector, particularly in the context of reaching the Millennium Development Goals. Less frequently, it has also been noted that increased sector finance alone will not necessarily result in increased sustainable water access. For this to happen, efficiency of sector finances needs also to increase.

In Kenya, there has been limited government financing of rural water supply projects. Rural piped water projects in the past two decades have relied heavily on inputs from their users, a phenomenon which has led to a very vibrant self-help movement in the sector. These community-owned and managed, piped water systems are run on a commercial, cost-recovery basis and are constantly looking for new demand responsive sources of finance.

Donor funds in Kenya have focused on the construction of new systems. This has meant that for systems interested in expanding their operations or rehabilitating and replacing infrastructure funds are not generally available. The run down of assets is essentially promoted through this sector finance arrangement.

The Kenyan financial sector is quickly deepening and significant levels of liquidity have forced banks to look for innovative lending routes. One area that is increasingly being investigated is the infrastructure sector which has tremendous financial needs.

Given these environmental factors, the Water and Sanitation Program – Africa and K-Rep Bank saw an opportunity to develop innovative credit mechanisms for small scale piped water supply. A pilot project was launched in December 2006 to explore possibilities for microfinance in facilitating increased water access and this paper shares lessons which are emerging from that pilot.

The pilot project utilizes a number of innovative structures in delivering loan finance to community owned and managed water systems.

Microfinance skills within K-Rep Bank have been adapted to infrastructure lending needs. This has required that staff familiar with group based lending be trained in the details of the water supply business. As well, project finance analysis has been introduced together with streamlined credit assessment tools, the development of which was supported by the Water and Sanitation Program – Africa.

The success of such lending activities will fundamentally be determined by the affordability of locally available finance. If affordability is a constraint, adjusting interest rates will affect the market conditions and possibly the long term sustainability of the project. This pilot project uses an output based

subsidy to create a blended financial product addressing the affordability constraints associated with relatively short loan tenors and high interest rates in Kenya. The output based aid (OBA) subsidy is released upon the delivery of pre-agreed performance outputs and is used to refinance the loan. The community project ultimately pays for sixty percent of the total investment cost. A blended loan-grant product is less distorting to the incentives of financial institutions and therefore makes their engagement in the sector more likely to persist.

In addition to affordability constraints, such small piped systems often have capacity constraints and given their small size, engagement of full time staff to address such constraints is too expensive and inefficient. The pilot project is driving the piloting of business development services (BDS) in Kenya by offering each participating community water project a fixed subsidy to procure the construction management and post-implementation support services. These service providers are selected by the community from a pre-qualified shortlist to ensure quality. The service package offered is tailored to the specific demands of each project. BDS if mainstreamed would result in critical consultancy services become available for small piped water providers. These services include technical and financial audit services, engineering design, strategic business planning and tariff review assistance and other related services.

Considerable demand for this project has been expressed by communities eligible to participate with over forty communities expressing their interest initially. The competitive selection of 21 of these community projects has resulted in a relatively strong portfolio. Selection was based on a mixture of criteria including both demand for increased water and likely ability to afford to repay a loan for infrastructure development. As such, this mechanism targets those projects which are not eligible for funds targeted at the poorest and acts to empower the poor by giving access to demand responsive finance. As the loan component to the project is based on commercial terms and conditions and is financed by the microfinance bank's own money, the product line is both sustainable and scalable. Further, as the market for such projects expands it is likely that other financial institutions will become engaged and expand the extent of such transactions. Competition between finance institutions will lead to lower prices and more responsive products. Competition will also serve to reduce the time taken to process and assess applications for loan funds.

Scaling this approach up to a national level requires that the grant component be made easily accessible and linked to the commercial credit appraisal by domestic financial institutions. A fast-track grant fund placed within the existing Water Services Trust Fund – a water 'social fund' – could be one possible route to scaling up. Increased oversight by financial institutions in project monitoring has positive sustainability impacts. This directly addresses one critical shortfall in historical rural water project design and implementation. By involving financial institutions in developing rural water infrastructure, increased sustainable access to reach the Millennium Development Goals becomes more possible.

Workshop 5: Sustainable Water Technologies in Industry

Mudialy Model, a Sustainable Natural Way to Treat Industrial Waste Water and its Pollution Evaluation by Bio-Mapping

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Keywords: Mudialy Model, Industrial waste water, Bio-monitoring, SWQC, Macro benthos

Industrial waste water treatment is a major environmental concern now-a-days. Usually conventional primary physico-chemical treatment processes are applied in waste water treatment. But in the developing countries like India these conventional treatment plants have various problems in their management. Furthermore it is a costly affair. Natural wastewater treatment using stabilization pond may be a very innovative and cost-effective solution of this problem. In European countries like France, Germany, in Bangladesh already this technology has been adopted. In Kolkata, East Calcutta Wetlands have been recycling city sewage using pisciculture very efficiently.

'Mudialy Model' is a small version of East Calcutta Wetlands. It is basically a nature park comprising of a network of 8 sewage fed waterbodies (locally called 'jheels') and a long macrophyte canal, located near Brace Bridge in the heart of South-West Kolkata in West Bengal, India. Here both industrial (70%) as well as domestic (30%) wastewaters are treated naturally. Nature Park is situated in an industrial belt. Total 37 industries (among which 11 are now closed), generate both solid and liquid wastes in this area. Among them 72.9% are dry industries while rests are of wet category. The industries usually generate domestic wastes, general wastes like rag and plastic, oil and grease, metal contaminants, hot water from cooling tower plants and toxic chemicals. Applying pisciculture and phytoremediation, Mudialy Fishermen's Co-operative Society Limited (MFCS) very effectively manage and treat the waste water. The wastewater is first generated in the primary settling tank where the water is kept for about 2 days and is treated. Then it is passed to the secondary settling tank whose depth is quite higher than that of the primary one. The wastewater is then passed through a long macrophyte canal that acts as a facultative stabilization pond. Here the bacteria decompose waste compounds into oxides of elements and respire CO2 and end products that are used by the algae to carry out photosynthesis. The planktons take up the algae and flourish on which the air- breeding fishes depend. The air- breeding fishes (like Tilapia, Silver Carp, Singhi, Nylontica) are introduced along with some grass (like Leptopla chinensis and Fragmytis carka, to absorb oil) and aquatic weeds (like Ichornea crassipis, to absorb heavy metals) only to test and improve the quality of wastewater in the canal. From the canal, the water is passed through a series of wetlands. Both IMC (Labeo rohita, Labeo kalbasu, Catla catla etc) and exotic (Cyprinus carpio, Gtenopharyngodon idelea etc.) kinds of fishes are cultured in the sewage-fed jheels. In this way the pollution level decreases gradually and finally the treated water enters into the Monicanal that meets AdiGanga. It takes about 12-14 days to purify the whole wastewater coming through the canal upto the end at Monicanal at a time. During the summer about 25-35 million liters wastes is generated per day in this area while during monsoon the amount increases up to 35-40 million liters. On an average, about 30 million liters waste is generated each day. Physico- chemical analysis of the water quality shows, the BOD value generally lies between 40-80 mg./l in the influent water and between 3-15 mg/l in the effluent water. The COD varies between 120-470 mg/l in the influent water and 15-65 mg./l in then effluent water. pH ranges

6.0-8.5 in the inlet water and varies 6.5-8.5 in the outlet water. Chloride value generally lies between 100-125 mg./l in the influent water and 15-20 mg./l in the effluent water. Microbiological study shows, MPN value ranges 50 X 106-60 X 106/ 100ml. in the influent water and varies between 20 X 106- 35 X 106/ 100 ml.in the effluent water.

The health of a water body is usually analysed by the conventional physico-chemical processes. But as these traditional techniques are costly and also do not provide any information regarding the aquatic biodiversity, Bio-monitoring is given emphasis. Worldwide there are a number of biomonitoring methodologies. In India, Central Pollution Control Board (CPCB) has developed a novel Secondary Water Quality Classification (SWQC) on the basis of Primary Water Quality Classification (PWQC) using macro-invertebrate benthic fauna as bio-indicators. Using BMWP site score (pollution index) and Sequential Comparison Index (SCI) (population index) they introduced a new concept of Biomapping by which the water quality information can be represented in a color map. They categorized surface water quality in 5 different classes biologically, namely A (clean), B (slight pollution), C (moderate pollution), D (heavy pollution) and E (severe pollution) respectively.

In the present study, the water quality of the head of the canal where the waste water first comes in was found as class E, while in the next settling chamber it was class D. The rest other water bodies fell under C category. The study shows a significant correlation between PWQC and SWQC. Linear regression model showed very little correlation between individual families and the physico-chemical parameters but fairly high correlation coefficient was found when the total number of individuals was taken into account. The study also supports the efficiency of the existing system of the Mudialy Model by showing increasing trend of the benthic population in the treated water bodies with respect to the untreated initial chamber. In the first settling chamber except Chironomidae no other family was found viable. In the canal no bivalve was seen as they are very much sensitive to toxicity but found in abundance in the jheels where the pollution level is relatively low. Similarly much more pollutant-resistant Lymnaedae and Physidae were found in higher abundance in the macrophyte canal rather than the other less polluted water bodies.

Pioneering Sustainable Solutions to the "Water Crisis" with Stakeholders using Plastics

Author: **Mr. Robin Bresser** (Invited Speaker)
Borealis Polymers NV, Belgium

Who are we?

Borealis and Borouge have more than 40 years of experience in producing and marketing polyolefin materials. We focus mainly on products for the infrastructure, automotive and advanced packaging markets. We have production facilities, innovation centers and service centers across Europe, the Middle East and Asia Pacific regions and work with industrial partners in more than 170 countries around the world to provide innovative and sustainable solutions.

Different areas, different water challenges

It is well recognized that the availability of fresh drinking water is one of the major global challenges of today. In the developing world currently 1.5 billion people lack access to fresh drinking water and some 2.2 million children per year die from water-related diseases. Less severe but none the less serious problems also arise in many well developed countries due to the poor state of their old water and sewage systems.

As an active member of the World Business Council for Sustainable Development (WBCSD) Water Project Borealis contributed to the development of "Business in the world of water" which was launched at Water Week in 2006. This main objective of this set of scenarios was to raise the awareness of businesses around the world to the importance of water and the critical situation they face in many countries.

"There are alternative sources for energy. There are no alternatives to water" Source: Sustainable Development International, 2005.

One of the WBCSD scenarios "Hydro" focuses on innovation and efficiency in water – "more value per drop". Set in China where urbanization and development raise a multitude of water challenges it describes how innovative and flexible solutions solve these problems and provide business opportunities.

Water awareness in Polyolefin production

As responsible producers, Borealis & Borouge are committed to monitoring and continuously reducing our own water consumption in the production of polyolefin materials. In addition polyethylene (PE) and polypropylene (PP) pipe systems make an important contribution in addressing the water and sanitation problems around the world due to their durability, leak-tightness and ease of installation. These benefits apply equally to the installation of new sewage and water systems in developing countries or the renovation of old leaking networks in major cities thus saving water and reducing contamination of ground water.

At Water Week this year the WBCSD will launch a tool to help industrial companies to better understand their water needs in relation to local externalities, such as water availability, water stress and access to sanitation. The tool will be easy to use and freely available and enable companies to assess their "water footprint" and take steps to reduce their impact on the local environment.

Polyolefin solutions around the world

In London much of the central water distribution system was over 100 years old and leakage rates were above 30%. A major rehabilitation program was started by Thames Water 2005 and after careful whole-life cost analysis, carried out with PE pipe systems. Digging up all the major streets to replace the old iron

pipes was not a practical proposition and therefore Thames Water used a number of innovative "no dig" techniques employing PE pipes. In many cases the new PE pipes were simply inserted into the old iron mains from a small number of open pits to minimize the disruption. Where flow capacity was critical swagelining or pipe bursting was used to reline the old system. These modern techniques have been successfully transferred to other countries around the world, for example in Shanghai, where swagelining was used to minimise traffic disruption and additionally save 400 trees growing along the road.

In India PE piping was used to transport treated drinking water from the Godavari river to half a million people living in 450 villages in the East and West Godavari district of Andhra Pradesh. This project was supported by the Sri Sathya Sai Trust which is a charitable trust founded in 1972 to undertake a number of welfare activities, including the provision of drinking water supply. The project involved installing over 1175 km of water pipe of which the majority was PE due to its flexibility, corrosion resistance and durability.

Working together to share knowledge and to bring new solutions

"Each and every stakeholder can and should play a constructive role in striving towards sustainability in a changing world." Source: Editorial – World Water Week, 2007.

To successfully address the challenges that face us it is necessary to share knowledge and work together to bring new solutions. Borealis and Borouge have been facilitating such discussions and actions in a number of countries.

In Italy the lack of investment in the infrastructure by successive governments has lead to average water leakage rates of 42% and much higher levels in the water stressed areas of the south. Faced with this situation Borealis organized a number of workshops throughout Italy for industry experts (infrastructure owners, installation companies, pipe producers, financial bodies and consumers representatives) to discuss the problem and develop new proposals to improve the situation. The workshops have lead to a number of industry initiatives which if successfully implemented will contribute to an improvement to the quality of the network and to the structure of the future Utility business in Italy.

"In Italy, the overall leakage of water from the system is 42% and this figure is even greater in other parts of the country. As rainfall becomes more unreliable, we must repair our ageing pipe system" Source: Mauro D'Ascenzi, Dept. President of the Italian Federutility & President of EUREAU

In the Middle East Borouge have launched an initiative to form a Plastics Pipes Academy to bring stakeholders together to share knowledge and raise skills in the manufacture and installation of plastics pipes systems. This will be achieved through developing education and training programs, promoting product standards and certification and by encouraging best practice in health, safety and environmental matters. This Gulf Plastics Pipe Academy (GPPA) will be an independent, non-profit organization run by its members who will be elected representatives of the polymer producers, pipe and fittings producers, pipe system designers and contractors, pipe installers and utility providers.

Conclusions

The "Water Challenges" around the world are manifold and will require close co-operation of both local and international partners and the development of many different innovative solutions. Borealis and Borouge are committed to help facilitate this process of discussion and development. We will continue to innovate and improve our product solutions, making them more durable, cost and environmentally efficient. Our ambition is to foster local knowledge and partnerships throughout the value chain to provide sustainable solutions for the availability of safe drinking water and sanitation around the world.

Sustainable Water Management and Pollution Abatement through Common Effluent Treatment Plants in Industrial Areas

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Keywords: sustainable water management, pollution abatement, common effluent treatment plan, small scale industry, total dissolved solids

Recent studies in various countries showed that the surface water and groundwater resources have been severely assaulted with many sources of contamination. The main sources of pollution include sewage systems, industries and trade, agriculture, traffic and waste deposits. For example in India, the magnitude of damage caused to water resources can be estimated from the fact that about 70% of rivers and streams in India contain polluted water (Ministry of Water Resources, 2007). The incidence of water pollution is highest in urban areas where large volumes of waste are concentrated and discharged into relatively small areas. As far as pollution from industries are concerned, effluent in most of the cases are discharged into rivers, streams, pits, open ground, or open unlined drains near the factories without any treatment, thus allowing it to move to low lying depressions resulting severe surface and ground water pollution.

For Small Scale Industries (SSI), due to small operation, lack of technical skills, capital, space and other constraints, individual Effluent Treatment Plant (ETP) is not techno-economically feasible. In order to tackle with pollution from SSIs, one of the significant measures which can be adopted is Common Effluent Treatment Plant (CETP). The performance of the CETP depends on several factors such as pre-treatment at individual member unit, segregation of toxic/ hazardous effluents, collection and conveyance system, plant design, trained man power etc. CETP has to adapt to changes in the waste water characteristics from various industries such as mixing of sewages. However, the efficacy of CETP has been identified by various Governments and now CETP has been promoted by various States and Central Governments in India.

In this paper, the role of Common Effluent Treatment Plants for the treatment of industrial wastes and sustainable water management in urban industrial areas in India are discussed with the help of a case study. The study area covers about 160 sq km in Patancheru, Medak District, Andhrapradesh, India. In 1977, an Industrial Development Area (IDA) has been established in Patancheru and consequently about 400 small and large pharmaceutical and chemical industries have been started in the area. Some industries in the area produce bulk drugs and pesticides and hence use large quantities of organic and inorganic chemicals as raw materials. Thus the effluents discharged contain appreciable amount of these chemicals and their bye-products. Very few of the industries in the beginning have any waste treatment facilities and the effluent produced in the process were discharged, untreated or partially treated, directly into various unlined channels and stream in the nearby areas. In this process, the surface water in the streams and groundwater in the surrounding aquifers got polluted severely. The tests carried out showed that the treated effluent has a Total Dissolved Solids (TDS) concentration of 4000 – 5000 mg/L. Due to the effluent discharge, the streams have become perennial. While carrying the effluents, the streams act as diffuse sources for the underlying aquifers all along its course.

After understanding the severe pollution problems from the Industries, the Central Effluent Treatment Plant (CETP) was commissioned in 1994 for treating the industrial wastewater with a capacity of 7000 m3/day. Even though the CETP was not equipped to treat the different types of effluents completely produced by various chemical and pharmaceutical companies, it has reduced the pollutant levels in the waste water drastically. After the treatment from CETP, the treated effluents are directly discharged in to the nearby streams.

The paper presents the details of the field investigations and related computer simulations at various times in the study area. A large number of surface water and groundwater samples were collected and analyzed for TDS, colour, pH, electrical conductivity, turbidity, fluoride, chloride, total hardness, nitrate, alkalinity, sodium, potassium, sulphate etc. It was seen that after the CETP was established, the pollutant levels in surface and groundwater reduced drastically, even though still pollution problems are there. The paper further discusses various aspects of the water pollution problems and role of CETP for sustainable water management in the area with data analysis, computer modelling and interpretations.

Grass as Energy Source for Biological Sulphate Removal from Mine Waters and other Industrial Effluents

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Keywords: Cellulose, Grass, Mine water treatment, Sulphate removal, VFA

Introduction

Due to mineral mining operations in South Africa, polluted (often acidic) mine waters are produced. From a water management perspective, the treatment of mine effluents is a necessity since water is a scarce commodity in South Africa, due to low rainfall and increasing demands on water resources. The treated mine effluents can be re-used or be discharged to receiving water bodies. Several technologies exist for the treatment of mine waters, e.g. 1)chemically with barium carbonate, 2) applying the biological sulphate removal and 3) with reverse osmosis. The advantage of the biological treatment is that sulphate can be removed to less than 500 mg/ℓ (as required in South Africa), that the pH of the acid mine water can be increased to neutral, due to alkalinity production and that metals precipitate as metal-sulphide, since sulphide is the reduction product of sulphate. The disadvantage is that often an external carbon and energy source has to be added as an electron donor, resulting in additional costs to the technology. Degradation products of cellulose, e.g volatile fatty acids (VFA) can possibly provide a cheap source of energy for the biological sulphate reduction.

Cellulose is the major constituent of plant biomass, forming an important component in the carbon cycle, which is closed as a result of the cellulose utilizing microorganisms, present in soil and guts of animals. Plant biomass is a sustainable source of energy when cellulose is fermented during anaerobic degradation, resulting in the production of VFA and other intermediates. This process involves many species of bacteria, such as the microorganisms in rumen fluid. Cellulose, during the fermentation process, is converted into microbial cells, in acetic, propionic and butyric acids and CO_2, H_2, CH_4. A close syntrophy exists between the VFA and H_2 producing and utilising microorganisms.

The study presented here showed that the degradation products of grass-cellulose can function as the carbon and energy source for the biological sulphate removal in mine water.

Materials

Pre-treated mine effluent (1 part effluent from the sulphate removal reactor feeding synthetic feed water with 1 part of acid mine water) was used as reactor influent at feed rate of 15 ℓ/d, to increase the acidic pH of the mine water to neutral. A one stage 20 ℓ anaerobic reactor system was used. The bottom part contained anaerobic sulphate-removing biomass and the top part (fermentation section) received grass cuttings, which were mixed with rumen fluid, containing cellulose fermenting microbes. The pH of the reactor was controlled between 6.6 and 6.9. The reactor temperature was initially maintained at 39 °C and was later decreased from 39 to 33 °C (in steps of one °C) to investigate whether rumen microbes can adapt to function at lower temperatures. The feed water entered the reactor at the top, a recycle stream was installed for mixing purposes and the effluent was discharged at the bottom.

Results

When the reactor was operated at 39 °C, the average sulphate removal was 78%, the effluent COD

concentration was 757 mg/ℓ, while the butyric and propionic acid concentrations in the effluent were <10 mg/ℓ. The acetic acid concentration decreased from 649 to 27 mg/ℓ during the experimental period. Acetate is the degradation product of propionic and butyric acids when sulphate is reduced to sulphide [1 and 2] and can also function as carbon source [3]. The obtained results indicated that the sulphate removal was dependent on the reactor COD/VFA concentration. An increase in COD/VFA concentration was achieved by adding fresh grass to the reactor more regularly.

$$CH_3\,CH_2COO^- + \tfrac{3}{4}\,SO_4^{2-} \rightarrow CH_3COO^- + HCO_3^- + \tfrac{3}{4}\,HS^- + \tfrac{1}{4}\,H^+ \qquad [1]$$

$$CH_3\,CH_2\,CH_2COO^- + \tfrac{1}{2}\,SO_4^{2-} \rightarrow 2\,CH_3COO^- + \tfrac{1}{2}\,HS^- + \tfrac{1}{2}\,H^+ \qquad [2]$$

$$CH_3COO^- + SO_4^{2-} \rightarrow HS^- + 2\,HCO_3^- \qquad [3]$$

When the operating temperature of the reactor was decreased step wise from 39 to 33 °C, the percentage sulphate removal reduced from 95 to 57%, while the remainder COD concentration varied from 2684 to 463 mg/ℓ. At a reactor temperature of 35 °C, the percentage removal was measured at 83%. A real decline in sulphate removal was observed at 34 °C and 33 °C, when the percentage SO_4 removal decreased from 70 to 57%, respectively. This result indicated that the rumen fluid microorganisms functioned less efficient at temperatures < 35 °C.

Conclusions

Based on the results of this study the following conclusions were made:

- The fermentation products of grass cuttings (COD/VFA) can serve as the carbon and energy source for continuous biological sulphate removal treating mine water.
- The sulphate reduction was dependant on a continuous COD/VFA production, which was achieved by adding fresh grass to the reactor on a regular basis.
- The highest sulphate removal was obtained when the reactor temperature was 39 °C (95%), while the poorest sulphate removal was obtained when the reactor temperature was 33 °C (57%). When the temperature was 35 °C, the sulphate removal was 83%. These results indicated that rumen fluid microorganisms function optimal between 35 to 39 °C.
- The combined cellulose fermentation and sulphate reduction in a one stage reactor is a promising technology for a cost effective mine water treatment.

Recommendations

Additional studies will be conducted at room temperature, with the aim to adapt specific rumen fluid microorganisms to ambient temperature to make the technology more cost effective.

ICTs: A Tool for Water Resource Management (WARM) in Industry for Sustainable Development

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Keywords: Information and Communication Technologies (ICTs), Water Resource Management (WARM), Scientific Knowledge Communications, Socio-Economic Development, Changing Global Environment/Climate

Improved water technologies in industry are crucial for human and social development and to safeguard vital life support functions in the landscape. The prominent role of industry in development circles drastically contrasts with the poor performance and lack of application of the technologies that often characterise industry in developing economics. From the resource and environmental perspectives, there is a need to reduce pollution and improve water use efficiency. Typically, the relation between infrastructure systems and impact in terms of environmental disturbances are not properly taken into account in policies and choices of technological solutions. In view of this, the Information and Communication Technologies (ICTs) play a vital role in Information and Documentation Centers (IDCs) and as a tool for water related supporting scientific e- knowledge information access and dissemination and information products and services to the Water Resource Management(WARM) Industry in order to achieve its goals on sustainable development. The effective scientific knowledge communications are essential for cost benefit analysis and decision making support in water management policies according to the concept identity on "Every Drop Counts Business Program" in industry. This paper identifies the importance of information products and services in water management industry related concepts for sustainable development. Highlights the water management related organisations and association's role and responsibilities in pollution free water production for food security. Outlines the information scientist's effective role in water related knowledge dissemination for industrial development. Discusses the issues evolved in water management from the developing countries perspectives. The issues such as lack of awareness on environmental information systems and services related to water management, ill- developed information institutions, reluctant manpower, insufficient funds, increasing population growth, political strategy, lack of significant leaders/water management subject experts and other similar factor that come in the way of proper knowledge access with water resource management that serve as an indicator of socio-economic development which in turn moves to the Regional, National and International Development. In the light of constraints towards water resource management, certain value added solutions/ planning strategies are provided for effective water resource management for sustainable development in view of pollution free/cleaner water production for drinking, livelihoods, poverty reduction and water use consumption in the minimum costs in the Changing Global Environment/Climate.

Advanced Wastewater Treatment from Toxic Pollutants with Biosensor Feed Back Control

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Keywords: Organic pollutants, water treatment, biosensor, feed back control., oxidation and biosorption

Presentation/topic

The creation of cheap and effective technology for the removal of toxic pollutants from water is an urgent need in modern environmental protection. The first and the most important problem is technologies modifying and changing, their aiming at towards energy savings and reaching the minimal emission levels in hydrosphere. This problem can be resolved by optimal combination of chemical-technological methods with biological ones. Treatment expenses depend on needed purification degree. There exists certain purification limit, determined by economy, under which the enterprise becomes non-profitable. The role of combination of natural biodegradation processes with chemical-technological methods in this context is mostly important. Toxicity of pollutants penetrating into the environment and their transformation as a result of wastewater treatment are to be taken account during technology creation without fail. Recent experiences indicate that the efficiency for the purification of wastewater from toxic xenobiotics can be improved by combining adsorption and oxidation methods with biological methods. However effective automatic control of water treatment is needed for the optimization of clean-up process.

Biosensors offer unique possibilities of obtaining cheap, fast and sensitive control units that can be incorporated as sensors for water toxicity control and regulation at different stages of the treatment process.

The complete water treatment process based on a joint action of photoozonation, biosorption and biosensor detection with computer-controlled feed back loops (with surface active matters as examples) to optimize and adjust the purification efficiency has been worked out.

Presentation of results

This technology is realized by successive a pre-photooxidation step (O3 and UVirradiation) followed by adsorption with simultaneous biological degradation in a biosorber with activated carbon (AC) with immobilized degrading bacteria. At first time it was proposed and realized the use of the Daphnia chemiluminescent test for the express determination of total toxicity during process of water purification.

It was established that this biotest is very sensitive to the presence of toxic pollutants, such as nonylphenolethoxylates for example. Quantitative their control is possible at the concentration about

20 mg•L-1 and less. It was demonstrated: a) optimal regime of photoozonation may be achieved if concentration of initial substances decreased on 50% from initial; b) use of active carbon after photoozonation allowed to sharply decreasing general toxicity of treated water due to adsorption of some organic radicals and semi-decay of pollutants.

The optimum modes are recommended to minimize the doze O3 and to get products which are acceptable for their following biosorption. It decreases the price of process in 1,5-3 times. The new construction of the biosorber with AC is created. The resource of sorbent operation in the new type of biosorber is twice higher than that in the ordinary type.

The stability of the biosorber work with AC is provided by simultaneous bioregeneration of the AC during solution filtration trough AC layer. The special methods were developed to increase the efficiency of AC bioregeneration to 95-98% from initial capacity. To provide the stability of biosorber work the special requirements were developed on the sorbents first, as regards there operating conditions, and second, as regards their porosity.

For the determination of chemiluminescent signal it was developed special device. This device is designed on basis of PC. This process signal registration and its processing is full automated.

A pilot scale system aimed at the complete treatment process based on a joint action of the physic-chemical and biochemical processes has been developed and assembled. The full clean-up process is incorporating in a closed loop system using biosensors for the control and optimization of the entire process. During treatment there has been investigated varying the integral parameters of water quality grade: chemical oxygen demand (COD), permanganate oxidizability (PO), biological oxygen demand (BOD5), total organic carbon (TOC), residual concentration of ozone and peroxides dissolved and total toxicity.

The technology developed is successful for the textile industry (band textile, silken, knitted, artificial technical fabric and cotton factories as well as wool-spinning mill), the degreasing process of galvanic productions and oil-extraction processes.

Conclusion/recommendations

- The new advanced technology is developed to reach minimal emission levels in hydrosphere.
- Optimal mode of wastewater treatment is specified by the biosensor that is regulating water quality at different stages of water treatment to provide effectiveness of the treatment process and decrease of the cost.
- Principally new method for environmental objects total toxicity evaluation was developed.
- A pilot-scale system aimed at the complete treatment process based on a joint action of photoozonation, biosorption and biosensor detection with computer controlled feed back loops to optimize and adjust purification efficiency was created. A list enterprises where employment of the technology is successful is determined.
- The using of this technology leads to recycling of the process water within an industry.
- The results might be used for wastewater purification from toxic pollutants (surfactants, phenols, pesticides, oil products) and production of drinking water from polluted sources of water supply.

Application Titanic Coagulant for Elimination Intestinal Viruses from Natural Water and Sewage is Sustainable Water Technologies in Industry

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Keywords: Titanic Coagulant, Intestinal Viruses, Natural and Sewage Water, Sustainable Water Technologies in Industry, Environmental

According to experts the WHO, in the world annually falls ill with sharp intestinal infections about one billion person. From these diseases about 4 million people annually die. Last decades the biological environmental contamination connected to insufficient quality of sewage treatment and descent in reservoirs of industrial sewage constantly increases.

The water factor of transfer pathogenic is one of conducting ways of distribution of bacterial and especially virus intestinal infections. The special place in a cycle of water-preparation occupies process of coagulation for removal of bacteria and viruses from water.

The purpose of work has consisted in carrying out of laboratory researches on different virus models, switching Noraviruses and an estimation removal of intestinal viruses of water with the help Titanic Coagulant.

Material for research served a virus of a hepatitis A (genotype 1a), a virus of a hepatitis B and Rotaviruses person HRV/SPb/884/10/05, 4 years allocated from the child with symptoms sharp enteritis. The virus has been allocated on culture MA104 and has passed (N5). Noraviruses (nora-SPb/2005) aerations (Saint-Petersburg) have been received from sewage of Northern station and used for the laboratory purposes as virus model.

During carrying out of some experiments the maximal cultivations virus material which was brought in water with different concentration Titanic Coagulant were done. In quality virus material used the liquid of cellular culture MA104 collected in 36 hours after infection of Rotaviruses. The infectious credit of a virus determined in a series of cultivations, has made 1,3x104 BFU (4 logarithms). To avoid toxic influence of means Titanic Coagulant on cells, made washing a virus buffer solution STE (pH 6,7). After an exposition with a solution Titanic Coagulant virus a mix besieged on ultracentrifuge Beckman L8 in a mode 120000g, 90 mines, then supernatant accurately deleted by means of a micropipette, layered of 1 ml on a bottom of the buffer, in 1 minute a buffer solution deleted and resuspensdition a deposit in 0,2 a fresh buffer solution. Infection of culture MA104 made the received material.

After 10 mines of influence Titanic Coagulant there is a sharp decrease in concentration Rotaviruses - on one order, further, practically for two hours of contact with Titanic Coagulant, infectious activity Rotaviruses has been completely suppressed. At electron microscopic research virus preparations before contact Titanic Coagulant, it was revealed, that under its influence of a particle Rotaviruses lost an external albuminous environment.

Thus, Titanic Coagulant allows completely elimination and suppresses infectious activity Rotaviruses, contained in cultural to environment in concentration 1,0x106 BFU, within 40 minutes. It is established, that contamination (hepatitis A and hepatitis B) tests of water at presence Titanic Coagulant are cleared by viruses better at pH 5,0 - 6,5.

Proceeding from the received data, estimating elimination intestinal viruses of property Titanic Coagulant it is possible to recommend last for reception of high quality potable water, and also for coagulation and clearing of sewage. Titanic Coagulant for reception of potable water in field conditions application is possible water of open reservoirs, at extreme situations, accidents, etc. in local clearing devices in interests of local population.

The data about elimination of Noraviruses from water solutions are received at the presence of Titanic Coagulant (within the limits of 120 minutes), that allows to recommend wider geography of application Titanic Coagulant, not only during water-preparation at water-purifying stations, but also a production cycle at preparation waters in bottles.

Fluoride Removal and Recovery from Industrial Effluents

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Keywords: Fluoride removal, alumina, calcium fluoride recovery, thermal regeneration, fluidised-bed reactor

Background

Fluorine, a fairly common element in the earth's crust occurs in the form of fluorides in a number of minerals and rocks. It is also used in many industrial processes. In aluminium smelters, hydrogen fluoride gas is recycled in the processing of alumina (Al_2O_3) into aluminium metal. Hydrogen fluoride gas losses during recycling may enter storm water which is often discharged into water courses, or seeps into ground water, and ultimately may end up in drinking water. Excess fluoride in drinking water causes harmful effects such as dental and skeletal fluorosis. The permissible limit of fluoride in drinking water is generally 1 mg/l.

Aluminium smelter effluents typically contain ca. 35 mg/l fluoride. Various processes are used for removal. Fluoride can be precipitated as CaF_2 using lime or $CaCl_2.2H_2O$. Due to the relatively high solubility of CaF_2, fluoride concentration can only be lowered to 10 mg/l. Reverse osmosis is often used for fluoride removal but the water requires extensive pre-treatment. Fluoride concentration needs to be lowered to less than 5 mg/l during pre-treatment to avoid scaling of the membranes with CaF_2. Besides, low water recoveries are achieved with reverse osmosis. Activated alumina is the most common medium employed for fluoride removal. Water is passed through a bed of activated alumina until it becomes saturated with fluoride and break-through occurs. It has a high absorption capacity of about 6 mg fluoride/g activated alumina and may be reactivated with caustic soda and sulphuric acid. A disadvantage of the use of activated alumina is the large brine stream resulting from the process.

Description of novel fluoride removal process

A novel process has been developed for fluoride removal from effluents of aluminium smelters and other industries. Alumina, the raw material of aluminium smelters, is used for removal of fluoride from effluent water. Fluoride containing water is passed through a fluidised-bed of alumina until the alumina is saturated with fluoride. The saturated alumina is then flushed out of the reactor and replaced with fresh alumina. The used alumina is next dewatered and dried and can either be passed on to the next stage of the smelter where fluoride-rich alumina is required, or recycled to the fluidized-bed reactor for further fluoride removal. When the alumina has been completely regenerated, at high temperature, it can be re-used for fluoride removal. HF gas is produced during the regeneration step which can be contacted with either fresh alumina, to absorb HF gas, or alternatively, the HF gas can be absorbed in a caustic soda solution. Fluoride can be removed from the NaOH solution by dosing $Ca(OH)_2$ to precipitate CaF_2 which can be separated from the slurry as a by-product or discarded as a solid waste.

Objective

The objective of the investigation was to develop the process configuration required for treatment of fluoride-rich water with alumina.

Material and Methods

Fluoride-rich water and alumina were provided by Mozal Aluminium Smelter, Mozambique. Batch and continuous studies were carried out.

Results and Conclusions

Laboratory studies showed that fluoride concentrations could be lowered from 35 mg/l to less than 1 mg/l. The absorption capacity of alumina is 5.5 g F/kg alumina. Fluoride-rich alumina was regenerated at 250°C and re-used for fluoride removal. Regenerated alumina regained the same absorption capacity as that of fresh alumina, but did not remove fluoride to the same low concentration. Therefore, it is recommended that, in the case of aluminium smelters, alumina be used only once for fluoride removal and then be passed on to the next processing stage in the smelter.

Benefits

The CSIR fluoride removal process offers several benefits:

- Fluoride can be removed to below the required level of 1 mg/l,
- No brine is produced,
- Fluoride can be recovered as a valuable by-product, CaF_2, a raw material in the manufacture of tooth paste.

Project status

Currently a 2 m^3/h containerized pilot plant is under construction and will be evaluated on-site at various aluminium smelters during 2007. A provisional patent has been registered on this innovation.

Rainwater Harvesting in the Industrial Sector

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Keywords: rainwater, harvesting, reservoir, price, recharge

Rainwater is a public good accessible to everyone. It is a resource which can provide sustainable access to water in numerous regions in the world. Its intelligent management can contribute to the improvement of hygiene and sanitation conditions as well to better water provision for the agriculture.

Rainwater Harvesting has already begun to be common practice in the design and construction of public and private buildings in some regions of the world. Timidly, it makes its way also into the sector of services. Why use clean potable water for toilet flushes, to water gardens or to clean cars? Ecological thinking coupled with simple economic studies leads towards simple solutions which have already proved their efficacy all over the world.

Industry, a biggest water consumer, should also benefit from good practices in rainwater management. These practices are respectful towards the environment and are a part of the Integrated Water Resource Management. It is of great importance to introduce them in the industrial sector, as there water consumption is very substantial. It is well known that water is an essential element in almost very industrial activity. It is used in processes such as the cooling of machines for which no high quality requirements are demanded. In other cases very high quality water is needed (breweries, food processing units, mineral water plants etc) and clever resource management of the region would provide by means of artificial ground water recharge to limit the exhaustion of the water table and ensure better water quality.

A number of criteria define the conditions of rainwater harvesting action in an industrial plant. A preliminary study of the local rainwater pattern should be made. The catchment areas, normally the large roofs of factories, offer perfect conditions to collect substantial quantities even in relatively dry areas. A careful analysis the water consumption should define what is the quantity of water which can be satisfied by rainwater. Only afterwards can we dimension the required volume of the most important element of each rainwater harvesting system, the reservoir.

Today there are a large number of possibilities for the choice of the type of the water reservoir. There are cisterns made in :

- metal,
- stone, bricks or concrete,
- plastic materials with a flexible or a fixed shape.

These can be underground or open area ubits. They can be a part of a building or built as separate constructions. They can be new elements added to the plant or adapted existing structures. On many industrial sites there are cisterns, parts of old technology, which can be easily transformed, covered with a tailored lining and put to use in the rainwater harvesting system. Here the ingenuity of designers can reduce the price considerably keeping as a priority the functionality of the system.

In an industrial site the utilisation of the collected rainwater could be diversified, covering a big part of the needs linked to production, the maintenance of the premises, the hygiene of the staff, sanitation and the watering of the gardens etc. The new organisation of water supply in the plant will lead to a reduction in operating costs and to environmental preservation.

In all the cases, the team designing a rainwater harvesting system in a plant should conduct a serious economic study to justify the efficiency of the action. Actually, the investment for it is minimal when the architects and engineers integrate it at the time of conception of a technology or of the design of new buildings. Where different plants are involved different solutions might become judicious: using existing reservoirs, open area basins, providing a closed cycle of rainwater use, etc.

In most of the cases, water used in plants does not require drinking water qualities. Therefore, there is no need for the application of expensive purification methods. Simple decantation or basic filtration are sufficient.

Another important argument will push the private sector to undertake serious action in the proposed direction. Soon the world will face a serious water crisis and the price of water, surely, will be considerably and repeatedly raised.

Today it is obvious that we need sustainable management of natural resources to preserve the water table and the biodiversity and stability of ecosystems, this way guaranteeing acceptable conditions of life for future generations. Industry, the backbone of our economies, should respond to this appeal.

Many concrete cases will make part of the expose during the workshop.

Mapping Rainwater Harvesting Potential for Artificial Ground Water Recharge Using GIS and Remote Sensing (The Case of Upper Kabete Campus)

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Keywords: Rainwater harvesting, gorundwater recharge, geographic information system, remote sensing, groundwater table

Due to rapid urbanization, the demand for water in institutions, industries and residential places has increased, leading to overexploitation of the ground water resource to meet the current high demands. Ground water has therefore become the main source of water for various purposes ranging from domestic to industrial. This overexploitation of the groundwater is leading to depletion estimated at 2.94 meters per year.

University of Nairobi's Upper Kabete campus is a typical example of an institution that largely depends on groundwater to augment the water supply from Nairobi City Water and Sewerage Company. Upper Kabete campus lies between latitudes 36o 76' East & 36o 72' East and longitudes 1o 26' South & 1o 24' South and altitudes of between 1700 meters to 1900 meters above sea level. The campus covers an area of approximately 600 acres (290 hectares) with about 5% of this being occupied by buildings. The institution receives rainfall ranging from 800 millimeters to 1075 millimeter per year. The water demand in the institution is approximately 200 liters per head per day for approximately 1200 students plus staff and subordinate staff. Over 80% of this water demand is met by the water from the two boreholes within the institution with the rest being met by water from Nairobi City Water and Sewerage Company. Currently the water table for the two boreholes within the campus has since fallen by 10 meters leading to increased costs of pumping and reducing the supply and if no mitigation measure is taken soon it may result in vanishing of groundwater in the area. Rainwater harvesting for artificial ground water recharge technology is proposed as a possible mitigation measure to stall this trend.

A GIS and remote sensing protocol in the study was therefore used to assess the potential of rainwater harvesting technology for artificial ground water recharge in the institution by identifying suitable rainwater catchment surfaces and estimating the expected runoffs from these surfaces. This was possible using a quick bird satellite image because of its very resolution of 61 centimeters by 61 centimeters therefore enabling the capture all the buildings in the study area, the paved areas and the non-built up areas. The institution was found to have a potential of harvesting total of approximately 796,626 cubic meters of rainwater per year from these individual catchment surfaces which had different runoff coefficients and surface areas. These results show the very high potential of the institution to carry out rainwater harvesting for artificial groundwater recharge. This harvestable rainwater was found to be able to establish a perfect balance between withdrawals from underground water and recharge water through both natural and artificial means if it's utilized for groundwater recharge. With the installation of the recharge systems, it is estimated that the ground water levels will rise due to favorable geologic formations found in the area until it gets back to its original level and even go above it.

Using the necessary datasets for the study area such as soil data, rainfall, slope, geology and land use, GIS techniques were then used to identify the suitable artificial groundwater recharge sites. The results of this exercise therefore showed the capability and suitability of these GIS and remote sensing tools by providing a map output showing suitable sites for artificial groundwater recharge and the possible flash floods to harness in the study area. Finally the appropriate designs for the different artificial groundwater recharge sites were designed considering a number of factors such as distance from specific facilities and amount of water for recharge in the site. The efficiency and effectiveness of the system will be detailed at the end of the study. The poster presentation is an illustration of the groundwater table scenarios with and without the artificial ground water recharge systems showing that the technology is an appropriate tool for sustainable water resource and environmental development.

Advanced Water Reuse Methods in Industry – Prospects and Driving Forces

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Keywords: water reuse, membrane science, reverse osmosis, nanofiltration, advanced oxidation technologies, ultraviolet light

The industrial sector uses water to almost the same extent as the urban sector. The potential for water reuse in industry is generally higher than in urban sector, since most water is present instantly at site and can be treated after use to a quality appropriate for reuse. Methods that can enhance reuse of water are legio and no general technical limit exists anymore for turning used water, wasted water, to reused water. The water treatment methods are namely not only emerging technologies anymore, but well established processes used in full-scale with years of accumulated experiences of the possibilities, limitations and costs.

Water reuse is intellectually easy to grasp. Water reuse if properly managed reduces the water related environmental problems such as pollution of recipients, increases the security of supply and reduces the cost of production. Barriers against water reuse are lack of knowledge, know-how, information, education, strict legislation, adequate pricing and possibly financial incentives.

In this paper, technologies applied for water reuse are reviewed and three case studies presented were water reuse has been applied in full scale for industries with fine results. The driving forces necessary for stimulating water reuse are discussed and some policies and measures to improve the water reuse status presented.

Rainwater Harvesting and Groundwater Recharge in Low Income Urban Communities in India

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Keywords: Rainwater Harvesting, Groundwater recharge, Low income communities, Peri urban settlements, Water and sustainability

Water is a precious resource which sustains life on our planet and sustains all its ecological functions. In a purely natural eco system, water flows are so executed so as to provide nourishment and life to all incumbent living things. But within urban and peri-urban ecosystems in India, which are a dense conglomeration of human habitat, these flows are altered, blocked and polluted. These need to be safeguarded, managed and made sustainable, so as to maintain both the quantity and quality of water availability for all segments of the incumbent urban communities.

Low income and low serviced peri-urban settlements are high density, tightly built conglomerations with both sanitation and space problems, where a combination of over densification, overdraft from underground aquifers and wasteful practices have resulted in a precarious water situation. These settlements are excluded from the planning programmes of the municipal services and are "nobody's babies". Peri urban areas are usually a mix of both affluent and low income colonies. Though both these areas lie within a common ecological setup, the low income colonies end up bearing the brunt of under servicing in physical infrastructure for water, sewage disposal, roads and electricity. This exists due to municipal inefficiencies and simple the lack of social and economic clout.

This papers studies the water flows prevalent in such a low income and low serviced area in the periphery of New Delhi, India's Capital, in the district of Ghaziabad, and proposes an improved usage of the rain resource in a "use it where it falls paradigm". It studies the feasibility of creating a rainwater harvesting and groundwater recharge system, keeping in view the area's specific physical, social and economic challenges. This has been carried using a detailed physical site survey to understand qualitatively and quantitatively the open space, house and street configurations, many of which are informal in nature. This has been used to determine various water balance parameters to model a variety of cumulative groundwater recharge scenarios. The system has been evaluated in context of the water demand studies and their consequent effect on groundwater levels. The paper studies multiple scenarios for the system's implementation within the community to derive planning and policy directives for the same. These scenarios reflect the changing situation, evolution and further development of these settlements as follows:

- The relative applicability of Groundwater recharge and Domestic Rainwater harvesting programs separately on in combination along with other community based water conservation measures.
- In low income, low serviced urban settlements, various segments of the rain catchment area are unsuitable for deriving rainfall runoff for recharge. How these areas are to be excluded and how a stepwise programme for residential waste and effluent control factors in with the stepwise implementation of the community rainwater harvesting programme.
- A stepwise increase of built up areas due to over-densification and its impact on harvesting and

recharge scenarios on the water table is also examined for the sake of studying replicability of the study in similar other settlements.

The various scenarios are analyzed from not only a data perspective, but using stakeholder's inputs and an understanding of financial constraints.

The study goes on to show that high income colonies, where rainwater harvesting programs have often been piloted, usually anyway possess developed open space for natural water percolation, have limited population densities and possess water access alternatives like a good municipal supply and well developed groundwater situations.

The study shows the viability of an integrated domestic rooftop rainwater harvesting program along with usage of open space runoffs and rooftop overflows for groundwater recharge for this peri-urban situation. It shows that even in this tightly built neighbourhood, where rainwater runoff from many areas might not be useful due to pollution, the segregated groundwater resourse use potential itself can significantly arrest groundwater decline. It study uses time –step analysis to examine feasibility of overcoming dry spots and other variations to create a sustainable water supply.

The study compares the existing strengths and weaknesses of existing low income urban settlements vis a vis high income settlements and shows that small local initiatives like rainwater harvesting have a much better possibility for local ownership and effort. Small local initiatives like rainwater harvesting tank development and small scale conduiting are the only requirements which can be done using local resources and help from civil society agencies and the private sector. As maintenance in rainwater harvesting is also a local and personal householder's issue, municipal inefficiencies in the same are avoided. Local rainwater harvesting initiatives can be tied up with recharge of various borewells which have gone dry due to the falling groundwater levels. This has the potential to avoid enforcement problems to prevent people using groundwater. It can instead be encouraged along with promotion of recharge. In addition to this, misplaced replacement of low cost pavings like brick with are permeable with solid concrete impermeable pavings in the name of "development" is avoidable.

Within a scenario of increasing density and construction, in such settlements, it shows that while expensive conventional water supply systems would falter in keeping up, the above-mentioned decentralized, cost efficient and people based program has a much higher potential in ensuring a sustainable water supply.

Hydrological Substantiation of Water-Economic Actions in the Upper Don River Basin

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Keywords: water recourses, water-economic actions, water-management design, sanitary-allowable river flow, Upper Don River Basin

Presentation of topic and analysis of issue

The heavy use of water resources in Russia results in change of their condition. Thus quite often there is an increase of deficiency of water resources and deterioration of their quality. Economic recession is observed last decades in Russia. It has caused as decreasing of human impact on water resources (almost in all regions water use has decreased), and deterioration of water-protection activity. Water resources management in up-to-date Russia demands the decision of the complex of problems (economic, social, political and ecological character). Strategy of water management is determined, on the one hand, by features of region natural-economic conditions, and with another - sustainable water technologies in industry. It is necessary to develop such water technologies in industry that simultaneously with increase of production efficiency would be provided also decrease of negative human impact on the environment. In this connection it is necessary to estimate possible changes of the water resources at various levels of economic development.

Presentation of the results

The object of research is Upper Don river basin. It is located in the Central part of Russia. The drainage area of the Upper Don is about 69500 km2. The Upper Don basin is characterised by limited water resources and high population density, which cause intense hydroecological situation. River runoff is non-uniformly distributed in time. Don concerns to rivers of flat type with sharply expressed spring high water and small low-water runoff. Spring runoff (March - May) makes about 70 % of annual. Spring flood has sharp water level rise. It varies both in height, and in time depending on meteorological conditions. High non-uniformity of runoff distribution is extremely undesirable because it limits water consumption of the population and various branches of economy during low-water periods.

The diversified water-economic complex is now functioning in the Upper Don River basin. Its main participants are: water supply (industrial, including thermal and nuclear stations, agricultural, household); irrigated agriculture; water-power engineering; water transport, fish industry. Total water consumption in the region makes up 1831.6 million m3. 60.7 % of it use surface water as a source. Water supply is the priority component of the whole Don water-economic complex (83 % of total water consumption). The major volume of household and industrial water supply belongs to large industrial centers of Upper Don - to the cities of Lipetsk and Voronezh. New-Lipetsk Metallurgical Combine and New-Voronezh Nuclear Power Station are the largest water consumers among industrial and power users.

Household water supply makes up 22 % of total water consumption in the Upper Don basin and uses mainly ground waters. Industrial water supply is the largest water consumer. Its part reaches 34 % of total water consumption in the basin. Basically it uses surface river waters. Water supply for power

system needs makes up about 19 % of total water consumption and also mainly uses surface waters. Water consumption for the purposes of agricultural production in Upper Don basin makes up about 143.4 million m3/year (8 % of total water consumption).

From the beginning of 1990-th gradual reduction of water intake from the surface and underground sources, deal with production decrease. Water use is reduced to a smaller degree and differs in trade. As a result economic efficiency of production goes down and specific water consumption is increased.

The following tendencies reveals in changes of water use in the Upper Don basin last decade. Total water intake and water removal significantly decreased (correspondingly in 2.4 and 2.9 times). Total dump of sewage into water objects has decreased almost in 3 times. But dump of polluted and not enough cleared waters has considerably increased. Some decrease of irrevocable water consumption is observed (in 1.5 time).

Reliable estimates of availability water and needs of all region water-users are necessary for water resources management. Now uncertainty of water-management design does not decrease, despite of techniques development and a computerization of water technologies in industry. It is connected by that hydrological supervision were sharply reduced in up-to-date Russia, results of them are frequently inaccessible and the data of statistical reports on the water use are not always authentic.

Hydrological substantiation of water-economic actions requires development of management rules and water technologies in industry. Thus needs for water of the higher priority users first of all are taken into account during the water deficit periods. In particular, water use concerns to such priority for drinking needs. The following on importance can be sanitary-allowable river runoff. Water use can concern to the following priority for industrial needs, an agricultural production, etc.

Conclusions and recommendations

For a hydrological substantiation of water-economic actions we had been made up-to-date and perspective water-economic balances in the Upper Don river basin. Water needs for all productive industry were compared to total water resources of the region. The main tasks are: calculation of water consumption for various water-users and an estimation of hydro-economic system safety. Useful decrease of water consumption in Russia during the up-to-date period has reduced “intensity” of water-economic balance. The account of perspective values of water resources and water consumption is necessary for an estimation of sufficiency of the water resources. Complexity of the decision of these problems is connected to various hypotheses about development of economy, possible climatic changes and the river runoff, etc. The listed factors are characterized by the great uncertainty.

Moringa Oleifera for Water Purification - a Traditional Boon for Rural peoples

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Keywords: Turbidity, Clarification, Flocculation, Natural, Water purification

Presentation of topic and analysis of issue

Water born disease are one of the main problem in developing countries; about 1.6 million people are compelled to use contaminated water, however in many communities of these countries water clarification methods like flocculation, coagulation and sedimentation are often inappropriate because of the high cost and low availability of chemical coagulants. The use of natural materials of plant origin to clarrity turbid water is not a new idea.

Among all the plants materials that have been tested over the years, the seeds from Moringa Olifera found through out India have been shown to be one of the most effective as a primary coagulant for water treatment and can be compared to those of alum (Conventional chemical coagulant). Common names: Morinaga, Horseradish tree, Drumstick tree, Sahijan etc. Parts used Roots, Seeds Leaves. USES: The roots are acrid igestive, anathematic constipating, anodyne, bitter, alexipharmic, stimulating and vesicant. They are useful in Paralysis, inflammation, fever, cough, cold, bronchitis pectorial, diseases, epilepsy, hysteria its leaves are useful in survey, vitiated conditions of Kapha and Vata. Product Offered: Seeds, roots, leaf, leaf powder, oil. Coagulation: Generally, coagulant is used for (Physical and Chemical) purification of turbid raw water. At very high turbidity the water using water can no longer adequately treat filters. Coagulants have to be applied to transform water constituents into forms that can be separated out physically. In large scale treatment plants aluminium sulphate is used as a conventional chemical coagulant. Seed solutions many be prepared from either seed kernels or the solid residue (Press cake) with the prescribed procedure. Press cake should be ground to a fine powder and sieved. Solution preparation is the same a seed kernel's.

Discussion of Results / Findings

As an alternative to conventional coagulants, Moringa Oleifera seeds can be used as a natural coagulants (Primary coagulant) in house hold water treatment as well as in the community water treatment systems. The seed kernels of Moringa Oleifera contain significant quantity of low molecular weight (Water soluble proteins), which carry possitive charge. When the crushed are added to raw water, the proteins produce positive charges acting like magnets and attracting the predominantly negatively charge particles such as clay, silk, bacteria's and other toxic particles in water. Flocculation: The flocculation process occurs when the proteins bind the negative charges forming flocs through the aggregation of particles which are present in water. These flocs are easy to remove by setting or filtration. The material can classify not only highly turbid muddy water but also water of medium and low turbidity. The level of turbidity influences the required time for the flocculation. As with all coagulants, the effectiveness of the seed may vary from one raw water to another. The practical application of dosing solutions is exactly is same as for all other coagulants.It is a cheap and easy method at house hold as well at community level for developing countries.The efficiently is independent of raw water pH. The processing does not modify the pH of the water. It does not alter the water taste unless a very high dose is added. The low volume

of sludge precipitated found biodegradable and hence environmentally not harmful.

Conclusion

Application of plant flocculants is such as Moringa Oleifera is highly recommended for domestic water purification in developing countries, where people are use to drink contaminated turbid water. M. Oleifera does not guarantee that the raw water becomes completely (100%) free of pathogenic germs. Water is cleaned and drinkable but not completely purified since it reduces the number of suspended particles drastically (flocculates) means it also reduces the quantity of microorganisms in raw water.

Water Stress in the Przemsza (Poland) and Iskar (Bulgaria) River Catchments – Water Stress Mitigation in the Industrial Sector

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Keywords: water stress, water saving in industry, water reuse, wastewater from metal industry, water use reduction

Introduction

Water stress occurs when the functions of water in the system do not reach the standards (of policies) and or perceptions (of the population) on an appropriate quantity and quality, at an appropriate scale and the adaptability for reaching those is not given (D2.1-1).

Many countries and regions all over the world, including Europe, suffer either from water quantity or water quality problems. That is why, number of investigations deal with responses to water stress using single or integrated approaches. In this respect the European Commission has set legislation like the Water Framework Directive (2000/60/EC) and the Integrated Pollution Prevention and Control Directive (96/61/EC) to ensure water protection through effective water utilization and reduction of the pollution from different users.

Within the EU funded project Aquastress two catchments (Przemsza in Poland and Iskar in Bulgaria) have been chosen to investigate options for mitigation of water stress caused by industrial drivers (www.aquastress.net). The selection of these two sites have been done after thorough analyses using DPSIR approach in eight test sites in Europe and North Africa. The focal water problems have been identified to be high water abstraction rates and generation of heavily polluted wastewaters (D1.1-1, D1.2-1, D2.2-2d, D2.2-2e).

Industrial water stress characterisation

Upper Iskar catchment suffers from water scarcity. The European Environment Agency (EEA) uses the Water Exploitation Index (WEI) defined as the ratio of annual water consumption and the annual available renewable water resources to measure the water stress (EEA, 2003). For Upper Iskar region it has been determined to be 0.58 indicating severe water stress and high competition for resources between water users. During the last drought periods (1991, 1994, 1995) some water stress mitigation options have been implemented to reduce water demand in all sectors however water management remains a priority (D1.1-1, D1.4-1). While the industrial sector contributes with about 90 % to the total water used, the added value per m^3 of abstracted water for industrial purposes amounts only to 106.9 € (PPP)/m^3 which is low compared to other European regions (D2.2-2e).

The Przemsza river catchment is located in Upper Silesia, Southern Poland and is a highly industrialised region with a high population density, the highest in Poland (584 inh/km^2, the average in Poland: 122 ihn/km^2) and a long history of mining activities which certainly had a large impact on the water regime. The industrial water abstraction has an average contribution of about 76 % to the total

water abstraction of the region. The main industrial activities are related to heavy industry (chemical, pharmaceutical and metal industry). The water quality aspects concern mainly the discharge of saline mine waters and waters from metal industry (D1.1-1, D1.2-1). The added value per m³ water abstracted for industrial purposes is very low (90.6 € (PPP)/m³; D2.2-2d).

In the two regions, the water stress was characterised and the results were concluded in a spider diagram where sectoral indicators like water availability per capita, industrial water abstraction per capita, domestic water use, irrigation per area, added value and water losses have been presented (D2.2-2d, D2.2-2e). The preliminary identification of industrial water stress with its two components – high water demand and highly polluted effluents was confirmed.

Responses and conclusions

In both sites, in order to increase the water availability for the domestic sector which is considered as priority during droughts the high water demand for industry has to be decreased and the quality of the industrial effluent needs improvement.

A common general approach for water saving was applied in the two sites. First stage includes water balances of the industrial water use as a tool to assess the water use efficiency, to determine the bottlenecks in the water management and to show the potential for water re-use. In the second stage a comparison with Best Reference documents generated by the IPPC Bureau is performed to show the potential for water stress mitigation by implementing the IPPC Directive.

The application of this approach differs slightly in the two sites considering their specificity. In Iskar region only one industry was selected – the metallurgical plant Kremikovtzi as the major water user (90 % of the total industrial water consumption in the region) while in Przemsza a water quantity and quality balance was prepared for the whole Biała Przemsza subcatchment and the significant industrial users have been identified.

The results, achieved so far show that in the metallurgical plant Kremikovtzi two of the most promising mitigation options would be the advanced wastewater treatment and the optimisation of the cooling system performance. The enhancement of the treatment will lead to the increase of water recycling and the saving of freshwater resources and improved effluent quality (Dimova et al, 2007; Tarnacki et al, 2007). The studies in Poland have revealed that major industrial users in terms of water intake and wastewater discharge (including quality aspects) are from the metal processing field and further work will concentrate on recommendations for water management and improved wastewater treatment in those industries.

Acknowledgement

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D1.1-1 - Methodology and outcomes of the stakeholder selection and of the stakeholder bodies' structure and function, July 2005
D1.2-1- Data on pressures and water availability, January 2006
D2.1-1 – Common framework for the characterisation of water stress, October 2005
D2.1-2 – Report on current state of the art and major knowledge gaps to characterise water stress in different sectors, January 2006
D2.2-2d - Report on the state of water stress in different sectors in the case study areas and current strategies to cope with water stress – Przemsza test site report, April 2007
D.2.2-2e - Report on the state of water stress in different sectors in the case study areas and current strategies to cope with water stress- Iskar test site report, April 2007

Restoration of Petroleum Contaminated Groundwater Aquifer

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Keywords: groundwater, water quality, organic contaminants, in-situ remediation, oxidation

Presentation of Project/topic and analysis of issues

According to the serious situation of groundwater contamination in Zibo City, a program was set for the in-situ remediation of a typical karst aquifer contaminated by organic compounds produced by a large Chem-industrial Enterprise. The groundwater quality was contaminated in the study area due to the following pathways:

(a) Leakage of oil tanks and wastewater drainage pipelines, ditches which spread through all the area;
(b) Infiltration of streamflow polluted by industrial wastewater in the groundwater recharge area; and
(c) Farm land irrigation with domestic and industrial wastewater for the past decade, which causes non-point pollution for air, soil and groundwater.

The field investigation and observation processes were based on two hundred and thirteen pumping and monitoring wells installed in the study area of 10 km2. The observed data showed that petroleum pollutants included more than 80 organic compounds containing 14 mutagens, and the total concentrations in groundwater often reached 1.0 mg/l, but they varied with rainfall. The observation verified that the leaching velocity of oil in top soil was about 1 meter a day. The vertical distribution of pollutants in the aquifer showed that the concentration reduced with depth, and pollution was not detectable under 40 meters in depth below the water table. It was evident that the aquifer deteriorated on a large scale, and the plume was gradually expanding to the low reaches where the major production wells for the water supply system are located. The water supply area was threatened, and would be damaged if measures of protection and remediation were not taken in time. The recovery practices in the program used either isolation or removal approaches.

Presentation of the results/findings

There were four in situ remediation technologies available for managing contaminated aquifers in the study area - capture zone, air stripping, biodegradation and chemical oxidation which have proved to be practical based on the results of a series of experiments both in the laboratory and in the field. However, only oxidation technique is introduced in this presentation because it has seldom been reported to use chlorine dioxide as an oxidant in the field remediation.

A comparison was made of the remedial effect on organic contaminants using ozone, chlorine dioxide, potassium permanganate and hydrogen peroxide in laboratory tests. Chlorine dioxide was chosen for use in situ remediation of a petroleum contaminated aquifer. The laboratory experiments indicated that oxidation capacity of chlorine dioxide was affected by reaction time, gas injection method, and pH of groundwater. A pilot-scale field experiment was conducted through the oxidation treatment involving the injection of chlorine dioxide solution into the aquifer The in situ oxidation treatment proved that most of the organic contaminants including 5 mutagenic compounds were decomposed

or removed and 19 new by-products were found without mutagenic carcinogens. The results shows that the unsaturated hydrocarbons were easily removed excluding that some of saturated alkane and alkene and polycyclic aromatic hydrocarbons and heterocyclic compounds were not oxidizable. The oil concentration in groundwater reduced by 50-60%.

Conclusions and recommendations

The pilot-scale field experiments have shown that the remediation of the aquifer contaminated with organic hydrocarbon involves very complex reaction mechanisms and is a formidable challenge. In situ remediation of groundwater must be combined with aquifer media cleanup. However, complete restoration of contaminated groundwater has generally not been possible.

The chemical clean up method should only be considered in cases involving specific contaminants, and where the extent of the contaminant plume and the contaminant concentration levels in the aquifer were remarkably reduced. In response to the concrete contaminated aquifer, the chemical agents are specific for the class of main contaminant. Chlorine dioxide can been chosen instead of ozone because chlorine dioxide and its mixing gases including chlorine, ozone and hydrogen peroxide can be produced and injected at low cost and in simple operation. The use of mixing gases has been found to efficiently oxidize and remove oil and benzene homologous compounds in water treatment processes meanwhile the formation of mutagenic and toxic substances is limited. The degradation rate was proportional to input amount of oxidants and increase of operating time. The optimal molar ratio for the organic compounds and mixing gases was found to be 1 : 1.5, i.e. concentration ratio of some 1 : 2 for this chemical treatment. The effective pH at which reactions occur is slightly acid range of 5 to 7 at which formation of chlorite and chlorate is minimized. In the aquifer, oil, the benzene group of organic compounds and other unsaturated hydrocarbons significantly decomposed or degradated by the mixing gases. However, a large proportion of the 80 organic pollutants detected in the groundwater decomposed by the in-situ treatment including some more toxic and mutagenic chemicals. Some new by-products were produced in the reaction process, but no mutagenic carcinogens were found. It was evident that desorption of organic contaminants from aquifer media significantly affected the groundwater quality during remediation process. Therefore, groundwater remediation must include aquifer media cleaning.

Workshop 6: Building Capacity for Future Challenges

Workshop 6: Building Capacity for Future Challenges

Can "Integrated River Basin Management" Be Taught at Schools? Yes and the DANUBE BOX Shows How!

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Keywords: water education, river basin management, Danube River Basin , schools, future generation

The Danube is the most international river of the world, and together with its tributaries it connects over 81 million people. Despite the fact that the Danube basin links 19 countries, the focus of the citizens is on the respective national stretch of the Danube or its tributaries. Rarely the Danube is understood as the water ribbon linking peoples and landscapes throughout Europe. Reason enough to think about common interests and ties and to develop teaching material that gets young people to appreciate the Danube river basin in all its aspects and with all its challenges – in short "to bring the concept of integrated river basin management to schools".

"Integrated river basin management" is a very complex concept and not really in everyone's mind. But understanding the link between ecology and economy, and understanding the requirements of a natural balance which secures economic well-being is crucial for current and future water management.

The International Commission for the Protection of the Danube River (ICPDR) facilitates the cooperation between all Danube countries, such as Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Moldova, Montenegro, Romania, Serbia, Slovakia, Slovenia, and Ukraine, based on the principles of the EU Water Framework Directive and the Danube River Protection Convention. The ambition of the ICPDR goes beyond water-management questions in high-level technical meetings: We want to enthuse ordinary people about the Danube river basin and to bring each and every individual closer to it.

So the DANUBE BOX idea was born! The DANUBE BOX does not only focus on ecology, but links all different aspects of the river, its importance in history, its economic value and its main problems. And the DANUBE BOX does not stop there: It explains in simple terms what each and everyone can do to help the Danube river basin or to support the concept of integrated river basin management!

The DANUBE BOX is a comprehensive education kit for teachers and others working with children of the age between 9 and 12. It can be used in and outdoors and fully reflects the methods of modern environmental education and education for sustainable development and includes several media: handbook for teachers, Danube poster, playing cards, worksheets, and a CD-ROM with pictures from all over the Danube river basin, info maps, background material and a large quiz.

Each of the chapters (The Water Cycle, The Danube River Basin, Function and Values of Undisturbed Water Bodies, Water Use in the Danube River Basin, The Danube Basin - Formed by Water, Cooperation and Sustainable Use) comprises one to three teaching units - ready to be used. And the DANUBE BOX cannot only be used in biology lessons, but also in physics, history, art and many more.

The main goals of the DANUBE BOX are:

- increasing the understanding of the Danube - as a ecologic, historic, economic, and cultural link between people

- raising awareness on the Danube river basin – its ecological treasures, its economic values, its environmental problems

- explaining the integrity of a river basin - the complexity of integrated river basin management

- strengthening the virtual link between the people in the Danube Basin – building up "Danube Solidarity"

The DANUBE BOX has been developed in English (available also on the internet www.danubebox.org as by the end of February), but is being translated into national languages of the Danube Countries. The Danube Box is already in use in Austria, where the Ministry of Water Management and the Ministry of Education support it; the translation and the implementation of the national versions for Romania, Hungary and Serbia are currently under way. The national implementation is led by national project teams, being composed of representatives of the Ministry of Water Management and the Ministry of Education, as well as relevant NGOs and pedagogical institutions..

Despite the fact that water education material exists in nearly all countries, education tools focusing on the Danube based on the concept of integrated river basin management is missing. But to get public acceptance, people need to get a better understanding about the complexity of water it and to understand the concept of "basin solidarity: It is high time to include these principles in schools.

The DANUBE BOX is an outcome of the "Green Danube Partnership" between The Coca-Cola Company, Coca-Cola HBC and the ICPDR, which was established in June 2005. The "Green Danube Partnership" is a private/public initiative to demonstrate business responsibility for the future of the Danube. The Coca-Cola system is committed to fully fund the implementation of the DANUBE BOX in as many Danube Countries as possible. Following the code of conduct of Coca-Cola, no marketing of the Coca-Cola, nor any of their products is linked to the DANUBE BOX.

Capacity Building within the Ministry of Water and Irrigation in Amman, Jordan: Successes, Failures and Lessons Learned

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Keywords: Professional Training, International Partnerships, Workforce Development, Collaboration Successes, Continuing Education

As one of the ten least water endowed countries in the world, Jordan faces significant challenges in providing the necessary quantity and quality of water to meet current and future demands. Effective management of scarce water resources is critical to Jordan's economic development, the health and wellbeing of its citizens, and to peace and stability in the region. Essential for creative management are well trained human resources in all areas related to water allocation activities including institutional, public, private, and third sector capacities to develop, access, adapt, and implement water related knowledge and technologies. As a result, there are significant needs and benefits associated with water skills enhancement and provision of information necessary for decision-makers to make the best possible choices related to the water resources sector.

The Jordanian Ministry of Water and Irrigation (MWI) has long identified qualified human resources as key needs to achieve and sustain its critical objectives. These needs include technical skills specific to the water sector and management skills to increase program effectiveness and operational efficiency. To address these needs, a US-Jordan team consisting of representative from Washington State University, the University of Jordan, the Jordan University of Science and Technology, Hashemite University, and Purdue University was formed to implement the Jordan Water Skills Enhancement and Information to Decision-makers (JWSE) project. The JWSE project was a four year project aimed at increasing capabilities within the Ministry of Water and Irrigation (MWI), the Jordan Valley Authority (JVA), and the Water Authority of Jordan (WAJ). A secondary goad was to carry out one or more targeted analytical studies to fill information gaps identified by the MWI with USAID, in order to provide practical information needed by decision-makers in the water sector.

In support of the objectives presented above, numerous training activities were conducted. Lecturers from all participating institutes assisted in the preparation and delivery of these courses. In total, 38 individual training courses related to water resources were presented to 669 participants. Of these, 595 (83%) were male and 74 (17%) were female. On average, 9.5 courses per year were presented with an average participation of 17.6 individuals. This average includes the 4 courses taught in the US which averaged 6.0 trainees per course due to the expenses related to bringing students to the US. Excluding these courses, the average attendance was 19.0 individuals per offering. The course topics were selected in cooperation with USAID Jordan and the MWI at the beginning of each year and were designed to meet specific objectives and needs identified by the agencies. Course evaluations were used to determine both the quality of the materials presented and to identify deficiencies that could be addressed in subsequent courses.

Two "action training" activities were conducted as part of the JWSE project. These faculty strengthening activities were conducted by multi-disciplinary teams of researchers from the three Jordanian

Universities with discussions and reviews by US partners. The two action training activities were: 1) Water Allocation, which aimed at the development of a water allocation model that determines the optimum allocation of the available water resources in the northern Jordan valley, and 2) Reservoir Management, which aimed at the development of a basin protection plan for the three dams in the southern Jordan valley, namely, Tannur Dam, Mujeb Dam and Walla Dam which will ensure the protection and optimum utilization of these reservoirs based upon the principles of sustainable development which pays due attention to the characteristics of the reservoirs and their watersheds. Technical reports which took into consideration MWI comments were submitted as part of the project report. Two softwares were developed specifically for the two case studies in the two action trainings which are the Water Allocation Model (WAM) and the Decision Support System (DSS).

Two of the thirty-eight training courses were directed towards training MWI, WAJ and JVA personnel on the application of the Watershed Management Systems (WMS) and Agricultural Non-point Source Pollution (AGNPS) models to the Amman Zarqa basin and the southern Ghor area. Trainees were also instructed on the use of two other models developed as part of the two action training activities which were Water Allocation Model (WAM) and Decision Support System (DSS). Twenty one professionals, mostly engineers were trained on these models. Trainees were given course materials in hard and soft format. Trainees were awarded certificates that signify their achievements.

The development of a business plan aimed at marketing the training courses that were held during the four year project, for the purpose of generating revenue for the participating institutes, was completed. A booklet containing information about the training courses, participating institutes, and instructors, was developed and distributed to potential clients. The booklet was also posted at the internet sites of all participating institutes.

The presentation summarizes the successes, failures and lessons learned from the project.

Building Local Capacity to Deliver Regional, National and International Strategies

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Keywords: local circumstances, strategies, innovative techniques, partnership, capacity building

Introduction

The Mersey Basin Campaign is a regional initiative with a successful track record of delivering projects that respond suitably to local circumstances. The Campaign recognises that, if the targets advanced in international, national and region-wide strategies are to be achieved, appropriate action must be supported and sustained at the local level.

Inevitably the needs of communities vary substantially across a territory of 1750 square km containing more than 6 million people. Within this extensive area, the Campaign recognises that local communities must be supported in different ways in order for projects to be delivered. Over a period of more than twenty years the Campaign has sought ways of increasing the capacity of communities to contribute to its programme of:

- Improving water quality
- Facilitating sustainable waterside regeneration
- Awareness raising and engagement

The Mersey Basin Campaign approach

The Campaign has developed a number of innovative techniques and approaches that have enabled it to deliver waterside regeneration projects across England's North West, often working in some of the most deprived and disadvantaged communities in the region and indeed the country.

1. Stakeholder mapping

As a multi-sector partnership organisation the Campaign seeks to understand the needs and views of its many stakeholders on major strategies and projects. To help manage this complexity a novel technique of stakeholder mapping has been used to identify stakeholders and to capture their views and aspirations. This approach was used in the development of the Water Framework Directive public participation pilot on the River Ribble. This project involved:

- identification of all relevant stakeholders
- categorisation of stakeholders according to set criteria such as location and willingness to be involved
- selection of appropriate individuals in events such as "visioning workshops"

The success of this experiment has meant that the same approach is now being used to build capacity in other parts of the country, as the production of River Basin Management Plans goes nationwide.

2. Partnership development and management

The Mersey Basin Campaign works at the local community level through a network of Action Partnerships. These are multi-stakeholder partnerships drawn from the public, private and voluntary sectors responding to local needs and circumstances within a defined catchment area.

The Campaign is responsible for co-ordinating activity across this network of Action Partnerships. Generally each Partnership appoints a project co-ordinator who is responsible for building links with the local community and fostering the capacity of local people to improve their watercourse or waterside.

The co-ordinators work to facilitate links between "grassroots" action and the programmes of the public bodies and private companies involved in the Action Partnership. In this way the Campaign has built up a wealth of experience in ensuring its objectives are translated into action at a local level.

Good examples of this approach include:

- The Rivers of Middleton programme
- "Dirtbusting" in Skelmersdale

3. People's panels

The Campaign is a key partner in a major regeneration project in the Liverpool City Region: Mersey Waterfront, a £60m programme to rejuvenate 120 km of the Merseyside coast over 10-15 years. To engage with communities across this area an innovative participatory technique has been developed: People's Panels.

Area- and project-based panels have been established to ensure that local people are "placed at the heart" of the development of Mersey Waterfront. They are, in effect, "sounding boards of public opinion" comprising 14-16 people aged 16-65. The programme for each panel includes an introductory event, a site visit and a series of "deliberative" activities designed to capture how local people would like to see Mersey Waterfront develop.

Panels have enabled the Campaign to be more socially inclusive. For example, a young persons' panel has been established for the regeneration of the Speke & Garston Coastal Reserve. Sixteen young people that were excluded from school were asked how they thought the site should be developed. They were asked to adopt the position of other stakeholders and evaluate the site from different perspectives.

4. Participatory appraisal

As part of the regeneration of the Mersey Vale Nature Park in Greater Manchester, the Campaign and its partners developed a technique for community engagement: Participatory Appraisal.

A team went out into the area surrounding the Nature Park to engage the community in non-directive decision-making and action planning. The team visited schools, libraries, shops and sports clubs, and encouraged people to share their thoughts on the current state of the park and what they would like to see in the future. Over 500 local people and 15 local interest groups took part. The results of the consultation were fed into the design and creation of the new park.

As a result of participation in this project, the local community has now set up a 'friends' group that meets regularly to discuss how the Nature Park can grow in the future.

These techniques have been used as part of the Campaign's contributions to transnational programmes funded by the EU. They have helped the Campaign to translate European-wide legislation (in the form of the Water Framework Directive) into effective action on the ground at the local level.

Conclusion

Twenty years of operation has shown that, for regional initiatives such as the Mersey Basin Campaign to be really effective, capacity must be fostered and built at the local level, often in poorer communities. Because there is no 'one size fits all', the Campaign has responded by developing a range of techniques to match the differing circumstances, aspirations and abilities across communities.

"Disappearing Lands: Supporting Communities Affected by River Erosion"

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Keywords: Dissappearing lands, River erosion, Community extentionist, Pit cultivation, Sand bar

A large part of Bangladesh is delta in formation. The 230 small and big rivers intersecting the country are considered to be most unstable in the world, and are frequently changing their course, thus eroding the lands situated along the river banks, inhabited by millions of people all over the country. Statistics reveal that nearly 7 million people have been displaced by river erosion over the past two decades, and current trends shows that more than a million are affected and nearly 100 thousand are displaced every year. In the process people loose not only their farming land and homestead, but find them completely uprooted from their community, social networks and livelihoods. In a way, the impact of erosion is far more devastating than other natural disasters, as it permanently washes away the land on which their livelihood and structures depended. This affected community having no other means of shelter and living, and are forced to take refuge in unauthorised and marginal lands, living under most deprived and in-human conditions. Those who have no other alternative migrate to cities in search of jobs. They are among the poorest of the poor in

The society

Practical Action Bangladesh (former ITDG Bangladesh) has been implementing the project since April 2004 to address the development needs of the communities, who have been displaced by river erosion and those who are living under the threat of being eroded in the near future. The five year £1.3 million pound project is being implementing in Gaibandha district (north-east of Bangladesh), a badly affected area and highly prone to river erosion, annual flooding and cold wave. The project is working in close partnership with 5 local NGO's to achieve the following four major outcomes:

- Poor women, men and children living on vulnerable river bank lands are better prepared to withstand the impact of recurrent (annual) natural disasters.
- People displaced by river erosion have access to basic services. (Food, shelter, water, health and education: through cluster village development and multipurpose shelters, beneficiaries will have access to basic services i.e. schools, community dispensaries, vocational training centres and awareness building campaigns)
- People displaced, or at risk of being displaced by river erosion have alternative livelihood options both on and off farm sectors (i.e. in fisheries, agriculture, livestock resource management, small enterprise development, light engineering skill training and agro-processing for alternative earning opportunities)
- To articulate social, civil and political rights of disadvantaged men, women and children affected by river erosion and regular flooding with particular emphasis on land rights and rights of women and children.

The project activities specifically will provide extensive livelihood skills training and technology support to over 12000 direct beneficiaries, about 800 community extensionists skilled in various trades

will be developed and self deployed, 4 model cluster villages equipped with housing, water sanitation, livestock shed and other health and education services are on board, several multipurpose refuge shelters construction are in progress. In total, the project will reach directly 20,000 households (indirectly over 100 thousands men, women and children). Practical Action is playing a key role in technology innovation and dissemination, skills training, enterprise development, and other activities related to disaster mitigation, rapid evacuation system, early warning system and volunteer group development, market access and infrastructure services. Partner organisation is directly playing implementing role in collaboration with the Practical Action expert panel based in the field. The project has attempted to take a holistic approach to tackle the poverty situation, mobilising a broad range of interventions to support a sustainable livelihood system among the community and its replication to the similar areas in Bangladesh and other parts of the world by the Practical Action group.

Results and Findings

To date the project has successfully built the capacity of 10228(70% women)direct beneficiaries on alternative livelihood skills through its diversified and innovative approaches. The systematic monitoring and evaluation and impact assessment studies showed that the livelihood pattern, access to basic service facilities, food consumption, and average income for the beneficiaries has changing very rapidly. The average income has risen from 300 USD to 450 USD over the period since 2004. Additionally access has been secured to the common property resources particularly on water bodies and sand bar islands by the resource poor and vulnerable communities. Additionally a number of new technological options have been identified and explored i.e. floating vegetable gardening; crop production in barren and unfertile sandbar through pit cultivation technique; community based cold protection mechanism and integrated model housing through cluster village development all over the project command areas (over 1600 sq.km)

Conclusion and Recommendation

The last three years experience of the project was very impressive and has able to bring positive impacts at the community and stakeholders level. The project has presented both at home and aboard to influence policy makers for greater human interest. The technical options and lessons could benefit millions of households who are currently living on the edge of five mighty rivers in Bangladesh. Additionally some technical options (i.e. floating garden and sand bar cropping) have been already identified by a number of overseas visitors as common technology for other some countries as well. Some of the overseas visitors commented that it could replicate other developing countries in the world to address food security and poverty issues.

Changing Household Structures and Composition: Challenge to Capacity Building For Water and Sanitation

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Keywords: Availability of water, Capacity Building, Household Composition, Household Structure, Sanitation

In more recent years many parts of the world have been experiencing changing household structure and composition. A vast majority of literature exist to provide evidence of changing household structure and composition (Borgaarts, 2001; Dungumaro et al., 2006; Noumbissi and Zuberi, 2001; Zulu and Sibanda, 2005). Challenges and impacts attributed to changing household structure and composition have made it a topic of active research. More importantly is how do such changes translate into availability of domestic water and sanitation. Furthermore, poor households of different structures are unable to educate their children, this perhaps is, the most important challenge brought by changing household structures and composition.

This article utilizes General Household Survey (GHS) for South Africa to assess the implications of changing household structure and composition on water and sanitation. It further assesses living and socioeconomic conditions of the people and relate to availability of water and sanitation. On the issue of capacity building, it will be assessed whether children from different household structures are able to go to school. Socioeconomic status of households will be related to ability of a household to send a child to school. Variables such as gender of head, education level and age will be used as proxy determinants for child schooling.

It is realized that in order to adequately increase the number of people with access to safe water and sanitation, there is a need to build capacity of the people in various areas. These include needs assessment, selection of technologies and designing practical interventions that can be sustained by communities. The present paper argues that any efforts to build capacity will be highly hampered if in the first place people are not able to read and write. It is emphasized that school going children need to be targeted especially those in poor households. Poverty is known to have different impacts across population segments. Children are in most cases disproportionately impacted by poverty in households that they live. Children raised in poor households are in most cases poor and do not have an opportunity to go to school. This is realized as a significant challenge to capacity building.

In the given premise, it becomes difficult for such children to break through intergenerational poverty. This is no way means that intergenerational poverty must be passed from one generation to another. However, there should be a mechanism to make it possible for children raised in poverty to break though intergenerational poverty. Such mechanism includes providing education. Unfortunately this does not seem to be the case for children living in poor households. On this ground, it appears that any capacity building initiative such as providing vocational training or micro-credit to support and improve livelihood is likely to be unsuccessful.

Analysis and Preliminary results

Data analysis is mostly descriptive. However, multivariate logistic analysis is also employed. Principal

component analysis is used to estimate wealth for households. Preliminary results indicate that there exist differences in household structures and composition by age and gender of head of household. The study found as expected, strong relationship between socioeconomic conditions and availability of water and sanitation. Principal component analysis indicated that female headed households are generally poorer than male headed households. Results suggest that female headed households are more likely than male headed households to be large and extended. Logistic regression analysis indicated that children are more likely to live in female headed households than in male headed households. This paper argues that this phenomenon can be detrimental to children's welfare and schooling given the poverty levels in female headed households as was found in principal component analysis. Furthermore, this can highly impact on capacity building initiatives in that it is not so easy to adequately build capacity of an illiterate population.

Conclusion and Policy implications

The importance of the present study is based on the use of secondary data to inform prevailing changes in household structure and composition and relate to availability of water and sanitation and also estimating for wealth in the absence of income and expenditure information. The paper can fairly conclude that changing household structure and composition pose a challenge to availability of water and sanitation and also capacity building. It is therefore recommended that as we develop initiatives for capacity building for water and sanitation, we must not forget to take into account different living conditions of the people, their socioeconomic status and also household structure and composition.

Based on preliminary results presented above, it is recommended that various policies need to be in place in order to assist poor households, especially those headed by female. Such initiatives will greatly help in assisting poor households in general and those headed by female in particular to improve their living conditions and welfare of children. Improving welfare and children schooling is critical for capacity building. Assisting such poor households will also help them improve their livelihood and economic status and subsequent afford safe water and proper sanitation.

Guardianes del Riachuelo: River Keepers for Buenos Aires

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Keywords: Community, Network, Action, Prevention, Commitment

Guardianes del Riachuelo is a community based program in Buenos Aires, Argentina. Its main objective is to improve the quality of urban streams and rivers along the Matanza - Riachuelo river, a long postponed, and highly polluted water course.

Background

The Matanza Riachuelo River basin, located in the Buenos Aires Metropolitan Area, is a vast area that encompasses the south section of the capital city of the country and areas of 13 municipalities. With an approximate total of 4 million people, this region has a variety of land uses and activities and has suffered decades of environmental and social decay and abandonment. Large scale approaches to the problem and solutions have in most cases, failed.

In order to involve citizens and community organizations in the future plans for the basin, Fundación Ciudad organized a series of deliberative public forums on the sustainable development and management of this basin. A great number of consensus and proposals came up, among them, "Guardianes de los Arroyos" (Guardians of the Streams). It is an initiative that focusses on the ability and possibility of local communities on the margins of streams and rivers, to take action, design activities and direct actions to improve their habitat and quality of life. Many of these riverbanks are used today for slum settlement and illegal garbage dumps, among others. The initiative submitted by participants of the forums, makes emphasis on the fact that controls and protection should come from the communities and neighbors themselves first and should include networking, education, information, clean up campaigns and forestation.

"Guardianes del Riachuelo"

"Guardianes de los Arroyos" was specially adapted for the riverbanks of the capital city. It started as "Guardianes del Riachuelo" in a section of a 30,000 people slum (villa) known as Villa 21-24. It is a long postponed urban area and the local community showed great interest in this initiative.

The coordination of the program is under Fundación Ciudad who signed an agreement with the Ministry of Environment of the City of Buenos Aires. A third partner is the private company responsible for garbage collection in this sector of Buenos Aires. Regular city services do not include the villas due to the high risk for personnel and equipment.

In August 2005 Fundación Ciudad started intensive social work with key referrals inside the villa. By early 2006, and after a series of surveys, the community agreed to build a network of neighbors, a team of Guardianes, that would become an active body in charge of improvement of environmental conditions. Among the issues discussed, urban waste management was considered a top priority. Fundación Ciudad, together with the Guardianes, designed a Door to Door Garbage Collection Program under the motto: "No garbage should go to our river".

A team of 14 young neighbors started the program in August 2006 in an area that includes a total of around 1000 families.

In the triple partnership, public-private-civil society, the Ministry of Environment provides with a monthly salary for the Guardianes. The private company is responsible for the training sessions, the provision of clothing and equipment, plastic bags for the neighbors and containers for perishable garbage and recyclable materials. Fundación Ciudad is in charge of the general coordination that includes permanent information to the neighbors, data collection, monitoring, weekly meetings and health controls for the Guardianes.

The Guardianes, in teams of two, have a daily morning circuit Monday through Friday, and Sundays. Their responsabilities include picking up garbage plastic bags, distribution of plastic bags and informative leaflets, disposal of the bags in special containers and data collection. Two different color bags are distributed: for perishable and reciclable material. Proceeds from recyclable material is used for different community needs. Perishable garbage joins the general circuit of daily city services.

Results

- A total of 150 tons of garbage was collected by the Guardianes program in six months, and is increasing.
- Direct impacts include cleaner streets, cleaner houses and cleaner river banks.
- Other impacts include a sense of pride among Guardianes and neighbors.
- Separation of reciclable materials is around 20%.
- Successful public-private-civil society interaction is an innovative experience in Argentina.
- The Guardianes del Riachuelo has strong support from the basin community based on the public forum´s consensus.
- Because the Guardianes are neighbors of the villa, they perform their tasks safely and efficiently.
- More neighbors want to join the Guardianes team.
- Other sections of the slum claim the services of the Guardianes program.
- The private company has acknowledged the success of the initiative, has improved the quality of the relationship with the villa neighbors and is willing to expand its help.
- Up - stream communities and other jurisdictions along the basin have contacted the Guardianes to explore immediate replication.
- The city health services acknowledge the positive impacts on the community´s overall well being.
- The Buenos Aires art community developed a Summer program with children and teenagers whose families are linked to Guardianes.

Maintain Your Pump and Contribute to MDG's for Future Generations

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Keywords: capacity building, decentralization, maintenance, coverage, MDG's

Introduction

Scattered settlements, long distances to public services; rain fed agriculture, high illiteracy and a low coverage of WatSan services characterize rural areas in Mozambique. 75% of the population lives in rural areas.

According to National Water Policy, access to water is defined with availability of water from a well equipped with a hand pump for 500 people within 500 meters reach. With this standard the national coverage is 40%, and places Mozambique as one countries with lowest rural water supply coverage. The diseases affecting the rural population are water related; diarrheas, dysentery, trachoma and malaria. The HDI ranking for Mozambique is 170 of 175.The challenges to reach the MDG's are hugh for the Government of Mozambique (GoM).

The National Strategic Plan for Rural Water Supply and Sanitations estimates that to reach the MDG's goal (70% of rural pop.served by 2015), 140 Small Piped Water Systems and 18 200 wells need to be constructed and or rehabilitated up to 2015. However, a substantial increase can only happen if the infrastructures are maintained throughout their life expectancy. This imply leveraging resources to invest US$ 20 million a year (doubling the current investments) .Every year 40-50 % of the total investments for infrastructures is budgeted for rehabilitation of old hand pumps.

Breakdowns rates vary and some provinces report rates higher than 45%. Random assessments suggest that low quality of construction, inadequate maintenance, poor spare parts delivery and lack of alternative to current community management are some of the factors contributing to low the sustainability.

Throughout the country decentralized projects are trying different approaches to improve implementation modalities aiming to increase the sustainability. This paper gives an insight of how the "Zoning Approach" for community education contributed to more sustainable water supply in 5 districts of Sofala Province in Mozambique.

Zoning Approach for Community Education

The Zoning Approach can be defined as a cost-effective pre and post-construction support to water user committees (WUCs). An integrated soft package covering large geographic areas aims to deliver adequate soft skills to water users enabling them to meet their operation, management and maintenance requirements. By this approach the program awards to local firms and NGO's specialized in community education, long-term contracts assigning them soft tasks and respective deliverables, so that the impact can be measured at community, household and water point level. The ultimate goal is to have safe, reliable and sustainable water supply services for all.

Actions taken

The Program for Rural Water Supply and Sanitation in Sofala (PAARSS) funded by the Austrian Development Cooperation in partnership with the Provincial Directorate of Public Works and Housing of Sofala (DPOPHS) has since 1999 been implementing a demand responsive WatSan program in 5 districts in the Sofala province by;

- Establishing a communication scheme to overcome the distance between users and provincial structures.
- Stimulating 4 private companies /local ngo's to train and supervise 48 local recruited activists responsible for creating WUCs, initiate community contribution, training the committees in maintenance, hygiene and supporting the committees in transparent pump management.
- Radio program in local languages produced and emitted.
- Training local mechanics in areas where technical breakdowns are frequent
- Making water supply services available for communities by training 15 local vendors in spare-parts handling, providing the initial kits of spare-parts to local vendors in remote rural areas
- Training of local public servants to keep updated records with map using GPS, to monitor the performance of activists, vendors and mechanics.

Results

- More than 350 functional water user committees created where at least 50 % of members are women.
- The coverage increased from 50 % to 67 % in 5 years.
- Improved hygiene in the communities, trachoma is less frequent
- Increased number of latrines constructed with local material.
- The civil servants provide accurate and detailed data reporting.
- The problem with breakdowns has been decentralized to the WUC and the local structure

Conclusions and recommendations

- Water services are provided in a sustainable manner with application of the NWP. The communities are able to manage their own infrastructures.
- Accurate information on location and the status of the hand pump facilitates local planning processes.
- Local mechanics and local funds manage to expand the coverage by repairing broken down hand pumps. Even though spare parts are not available at the locally mecanics procure spare parts all over the country.
- Economical interests generated local knowledge in operation and management even to include small pipe system (solar and diesel engine pump systems)
- Within decentralized local government structure the trained mechanics are key persons in the local water supply.
- In arid areas the pump management is delegated by the communities to private managers through a contract recognized by the provincial and district government.
- Poor people are prepared pay a considerable fee for access to borehole water in a rural context.
- The approach of a zoning community education has been approved by the DNA National Directorate of Water and is included in the national road map forthe MDG's.
- By applying a zoning approach for community training it has been possibly to reduce the number of breakdowns and speed up the coverage.

Building Capacity of Local Governments and Communities in Disaster Management

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Keywords: water related disaster, LGU engagement, community involvement, IEC , disaster management

Introduction

Philippines is one country who is no stranger to water related disasters ranging from flood to landslides. For the last few years, water induced disasters have been increasing and to address the problem, the government has undertaken geohazard survey and assessment in order to come up with geohard maps to better cope with disaster. In 2005, UNDP has funded a project under the DENR, in particular the MGB to undertake a geohazard survey and assessment and come up with maps that will help address the problem at the local levels. One important component of the project was to build and harness capacity of both local governments and communities in managing disaster at their levels.

Local Government Units (LGUs) Engagement as Partners in Water Related Disaster Management

The project recognized the important role of the Local Government Units as partners in the management of water related disaster. One project activity focused in engaging the LGU. The project facilitated building a closer relationship with the local government units within the pilot regions and sites. The team made it a point to coordinate with the local government units, in particular the local engineering departments/units and the municipal planning and involved them in the series of meetings and discussions. Data from the municipality on flooding and landslide incidents in the past years were collected and analyzed.

An Information and Education Campaign (IEC) on water-related hazards was conducted in the pilot areas. Target participants from the LGUs include LGU heads such as the governors, mayors and barangay chairmen. The primary objective was to inform the LGUs on the reality of water-induced hazards such as flooding and landslides and educate them on mitigation measures to cope with such hazards. During the said seminars/workshops, experts were invited to discussed in detail the data and. The LGUs were also taught to understand and use the geohazard maps as guide to local comprehensive land use planning and zoning. To ensure the use of the geohazard maps in local development planning, copies of the geohazard maps were produced and distributed to the municipalities concerned. A compact disk (CD) containing the said maps with explicit information were also produced for the LGUs including a CD on geohazard for information, education and communication (IEC) campaign purposes The IEC CDs which were prepared originally in English, were translated in the local dialect to make it more useful and understandable to the local people. Furthermore, part of the advocacy campaign and in coordination with the LGUs concerned, was the placement of warning signs in English and in local dialects informing the community as to the susceptibility of certain areas within the locality to water related hazards, in particular, those that are highly prone to landslides. The signages are expected to impart information and serve as a reminder to the community as to the threats of building houses within such areas.

Community Involvement in the Management of Water–Related Hazards

Experience showed that almost always when disaster strikes such in the case of flooding and landslides, the first to be affected are the local population, meaning, the people that lives in the community that are highly prone to such disasters. It is therefore logical that the community as a whole should be regarded as the first line of defense for such water-related calamities. The readiness of the communities and their capability to cope with flooding and landslide need to be built up, strengthened and sustained. Thus, the involvement of local communities in managing water related hazards is not only critical but a vital aspect of water-related disaster management programs. In the case of the project, community involvement was made explicit in the project by the active participation of the communities in the provision on relevant information on floodings and landslides that were captured and collected during the conduct of the community survey and assessment. As respondents to the survey questionnaire, the community has provided the project with valuable information that were used in the preparation of hazard maps. Furthermore, the community also provide assistance in the collection of soil samples that were analyzed to provide additional primary information for the preparation of soil profiles.

The communities were the main targets during the conduct of the information and education campaigns. Men and women from the communities actively participated in the information drive activities. Using mainly the flooding and landlside susceptibility maps generated by the project, the information contained in the said maps were communicated and explained to the communities, thus providing the community with the knowledge and understanding of the dangers posed by these water-related hazards. The same knowledge and understanding had helped communities prepare to cope and anticipate such events. Awareness was created among them on the hazards posed by building houses in flood prone and landslide areas. This awareness was instrumental in the acceptance of the community to adhere to zoning regulations by not building or expanding settlements into areas that has been mapped and defined to be highly susceptible to flooding and landslides.

Today, capacity building of local government units and communities have become an important component in disaster management programs of the government. This is in recognition of the fact that building the capacity of these two important actors will ultimately result in coping with future challenges brought about by water-induced disasters.

Building Proactive Water Literate Communities through Rainwater Harvesting Programmes for Future Water Challenges; a Case Study

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Keywords: government, development, waterliteracy, rainwater harvesting, raincenters

At present increasing population, water pollution problem, mismanagement of water resource, over extraction of ground water, high level fluoride, nitrates and arsenic in the groundwater all these factors are creating water related problems in the world. In this situation, it is essential to propagate and mainstream the "Simple, Economical and Eco-friendly Rainwater Harvesting (RWH) technology" in the development strategy of the states. RWH has proved to be a boon in the water scarcity areas. The arid, semi-arid and hilly regions are the areas were this technique can be applied successfully. The most of the RWH technologies are very simple and near to nature, the need is only to make them adoptable in totality with a proper manner and integration. To popularize RWH as a Sustainable Water resource in the States , community participation is very necessary.

Hence, it is essential to build proactive water literate communities, who understand the importance of the Simple, Economical and Eco-friendly Rainwater Harvesting (RWH) technology. The present paper focuses in detail on strategies adopted by Government and NGOs to promote RWH technology in the Karnataka state, India.

The Government of Karnataka State, India, implemented various Rainwater Harvesting Programmes to promote RWH in the state. The main objectives of RWH programmes are, to build awareness on RWH in rural and urban areas, demonstration of cost effectiveness and sustainable methods of RWH, conducting interactive workshops and training programmes, provide technical guidance,etc

During 2005 the Government of Karnataka State through its various agencies conducted series of workshops and training programmes exhibitions in government buildings, schools, colleges, public places on RWH, initiated more than 3500 Rooftop RWH demonstration structures in the state and established District level RWH information Centres "RAIN CENTERS" in all 27 Districts of Karnataka state .These Rain centres consists; 1) Model Rooftop Rainwater Harvesting village. 2) Live demonstration of Rainwater Harvesting Techniques in the farm like trenches, check dams, ground water recharge systems, etc. 3) Rainwater Harvesting training centre. 4) Posters, manuals, broachers, leaflets, handbooks, slogan stickers, CDs on RWH for free distribution. The main objectives of Rain centres are as follows;

1) Demonstration of various RWH techniques and ground water recharge methods in campus to create public awareness.
2) Conducting interactive work shops and training programme on RWH to build awareness on

RWH in Rural and urban areas.

3) Free technical guidance on RWH to help people in implementing RWH.

As a part of the Golden year (2006) celebrations Karnataka Government implemented "SUVARAN JALA" (Golden Water) programmes, under this programme, government implemented Rooftop Rainwater Harvesting (RRWH) Structures in 23,683 Rural School of the state, as a drinking water supply source for the school students and also demonstration model for local people in the area to understand the importance of the RRWH.

On the other side, in Karnataka state many NGOs playing important role in creating awareness on RWH techniques in the state. Initially NGOs conducted mass awareness programmes through public meetings, street plays, rallies, display of message boards in public places focuses on the importance of RWH. The major activities undertaken by NGOs are, building check dams and Rooftop RWH structures, providing technical support service and net working, promoting water literacy, etc..

The study reflect that ,results of Government and NGOs RWH programmes are fruitful and very effective. The study found that due to the awareness creation by Rain centres, the utility of RWH now being realized and the movement of RWH is gathering momentum in the Karnataka state. The study reveals that RRWH projects implemented in Schools are inspiring the students and local people to implement RRWH system in their premises. The present study shows that , Efforts of Govt and NGOs in Karnataka state , in building proactive water literate communities through RWH programmes will make communities to face future water challenges effectively.

Problems and Potential Failures in Recent Ecological Sanitation Projects - Four Case Studies from China

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Keywords: ecological sanitation, political support, acceptance, capacity building, implementation

Introduction

Over the past 10 years we have seen a rapid growth of so called 'ecological sanitation' projects around the world. There have been a number of successes but also disturbing reports of malfunctioning, failed and abandoned projects. The purpose of this paper is to analyze the reasons behind the alleged failures and their significance in terms of capacity building.

Failures and abandoned ecosan projects have been reported from a number of countries. This paper is based on four case studies from China.

Case studies

Case 1: Western Hills eco-toilet demonstration project
In 2002 a Chinese NGO used Sida-funds to provide a water-starved village near Beijing with ecosan toilets. This was basically a demonstration project aimed at high government officials from the capital. - The new toilets worked well and the villagers removed their non-functioning WCs.One day, however, a high official from Beijing turned up and ordered the villagers to remove the eco-toilets and reinstall their old WCs. The dry toilets were, according to him, a sign of backwardness and had no place in modern metropolitan Beijing. The villagers had to comply.

Case 2: Guangxi ecosan programme
During 1999-2003 two committed government officials in Nanning, one of them a senior official at the provincial health authority, managed to convince fellow officials at provincial and local level to introduce eco-toilets in a large number of villages and small towns. During a 4-year period several hundred builders and promoters were trained and an estimated 130,000 households were provided with eco-toilets. In 2004 staff changes at the health authority put new persons in charge. The new officials stopped the eco-toilet programme and instead promoted flush toilets. Today it is possible to find village households with both a urine diverting, dry eco-toilet and a flush toilet in the same courtyard. The promising eco-toilet programme has come to a standstill in this province.

Case 3: Dianchi Lake rehabilitation programme
In an attempt to reverse the severe pollution of Dianchi Lake near Kunming, the local government decided in 2005 to install 110,000 urine diverting eco-toilets in villages surrounding the lake. Within two years 60,000 households had been provided with eco-toilets. 80% of the toilets are not in use - some were never completed and some are now used as storage rooms. The programme has been discontinued.

Case 4: Erdos Eco-Town Project
In a project run jointly by the Erdos/Dongsheng local authorities in Inner Mongolia, China and

Stockholm Environment Institute in Sweden an ecological neighbourhood for 3000 inhabitants has been established in the city of Dongsheng. More than 800 flats have now (2007) been completed in 4- and 5-storey apartment blocks. The area has an 'eco-station' for local processing of faeces, urine, greywater and solid waste. Although many households are using the eco-toilets as intended, some disregard the instructions and use large amounts of water to clean the toilet, some prefer to use public pit latrines in nearby areas rather than the eco-toilet in their own flat, and a couple of households have installed flush toilets and connected them to the greywater pipe system.

Critical issues

The case studies highlight a number of issues related to attempts to introduce ecological sanitation systems in China. Case #1 and #2 failed because of lack of political/administrative support. Case #3 failed because it adopted a target oriented delivery approach that left little room for local acceptance, instruction and follow-up. Case #4 is more complex: lack of political support, problems with untested technical solutions, and insufficient information have all contributed to a potentially dangerous situation that in a worst case scenario could lead to the abandonment of the ecological approach to sanitation in this neighbourhood.

The paper will elaborate on each of these critical issues and outline the important role of capacity building in the implementation of ecological sanitation systems.

Conclusions

The critical issues in implementing ecological sanitation projects in China are leadership, partnership, technical competence, and continued user support/follow-up. The case studies indicate that for ecological sanitation project to succeed more attention must be given to capacity building. The capacity building efforts must be targeted not only at craftsmen and users but also at decision makers at national, provincial and local levels.

The advantages of dry sanitation are different to governments, commercial developers, communities and users. Training institutions must understand the conflicting interests of different actors and promote their capacity building efforts accordingly.

Know-how to Action - Case Study of the Lanzhou International Training Course on Rainwater Harvesting and Utilization

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Keywords: Training, Capacity building, Rainwater harvesting, Know-how dessimination, Developing country

The northwest China Gansu Province is one of the driest and poorest provinces in the State. Water scarcity is the restrictive factor that hinders the social and economy development as well as the efforts on poverty alleviation. Since the late 1980's, the Province has successfully implemented the rainwater harvesting (RWH) projects for solving the drinking problem of rural population and to enhance agriculture production by carrying out supplemental irrigation using rainwater. To share the experiences with the developing countries that have the same problems with Gansu, the China Ministry of Commerce and the Gansu Government have supported the Gansu Research Institute for Water Conservancy (GRIWAC) to conduct the Lanzhou International Training Courses on RWH and Utilization in the year of 2003, 2004 and 2005 for the developing countries. A total of 113 participants from Africa, Asia and South America have attended the three 45-day seminars. Apart from the lecturing by the RWH experts from China and from the international community, the course included 12 day trip to the RWH project sites. This provided opportunity for the participants to see the real RWH projects in Gansu personally and to have interview with the farmers (with interpretation by the course staffs). The course also arranged one day construction exercise to build a water cellar (underground tank with local name of Shuijiao) by manual. All the participants have to make at least one presentation in and/or at the end of the course to introduce the RWH projects in their own countries, their problems in promoting RWH and the innovated ideas for adapting the Gansu experiences to their situations. The participants had so nice friendship that several years after the course the participants keep correspondence with each other to exchange their experiences in applying the knowledge from the course. One of the direct results is that by the participants' promotion, the Governor of Gigawa State, Nigeria has visited Gansu's RWH projects twice and made a decision to implement the RWH project in all the 27 counties of Gigawa. With the help of GRIWAC's technicians, more than 200 water cellars have been built during 2005 to 2006 and most of them have started storing rainwater for the domestic water supply. The Nigeria people have also built two tanks for supplemental irrigation on about 115 ha of land. The Gigawa government has invited the West African countries to attend a RWH course to be held in 2007 in Gigawa. The venue of the course, the RWH School in Nigeria will soon be set up under the assistance of GRIWAC. Another result is that by recommendation of the participant, the Saudi Arabian Ministry of Water and Electricity invited the experts from GRIWAC in 2005 and 2006 to help the Saudi technicians for the planning and design of 12 demonstration projects for RWH both for the domestic water supply and irrigation. Preparation of these designs is now underway. Now some other African and Asian countries have contacted GRIWAC for cooperation with GRIWAC for promotion of RWH. The 2007 course will

ge held in July to August this year. The main experiences of the Course are to combine the lecturing with the site visit of model RWH projects and to encourage participants to integrate the knowledge on the course with his own experiences by adopting the participatory approach. A course in Lanzhou, Capital of Gansu Province has the advantage of providing project sites for visit that would be more effective than lecturing to let the participant know the significance and the methodology of RWH. The problems are that owing to the different conditions of climate, culture and economy, some of the technical experiences from China cannot be directly used in the other countries but the principle and idea of RWH is well accepted by the participants. The practices of the 3 year courses conclude 3 words: participation, practical and adaptation. These would help know-how transfer to be linked with actions.

Role of Food Security Groups' Networks in Poverty Reduction: A Case Study of Chamwino District, Dodoma Region

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Keywords: Poverty reduction, Capacity building, Food secuirity, Networking, Empowerment

Grassroots initiatives are needed to properly address the problem of rural poverty, and the farmers networks are capable of carrying out poverty eradication initiatives. The Tanzania National Strategy for Growth and Reduction of Poverty (2005) reveals that proportion of the population below the national food poverty line is 18.7 percent and that below the national basic needs poverty line is 35.7 percent. According to the Tanzania Development Vision 2025, half of the Tanzanian population lives below the poverty line at USD 0.65 a day. Comparing these results with those of the Household Budget Survey of 1991/92 there has been a small decline in the proportion of the population below the national poverty lines. Basic needs poverty decreased from 38.6 % in 1991 to 35.7 % in 2000 and food poverty from 21.6% in 1991 to 18.7 % in 2000.

According National Strategy for Growth and Reduction of Poverty of 2005, there is a small decline in the proportion of the population below the national poverty lines, even though poverty is high in rural areas of Tanzania where about 87 percent of the poor population lives. Poverty is highest among households who depend on agriculture. As the population grows, the absolute number of the poor raises concern. Poverty remains predominantly a rural phenomenon although the number of poor in urban areas, mainly the unemployed and those engaged in the informal sector, is growing fast. The poor in both rural and urban areas typically lack capital and human assets, they are less educated, and they suffer from ill health. Furthermore, the vulnerability of the poor is increased by preponderance of disease, including the rapid spread of HIV/AIDS. Increases in HIV/AIDS over the past decade aggravate the health status and future prospects of Tanzanians. HIV/AIDS undermines the foundations of development and attainment of the Millennium Development Goals which focus on poverty eradication.

The modest decline in poverty is associated with the low annual average per capita real growth of only 0.6 percent during the 1990s. According to the National Strategy for Growth and Reduction of Poverty 2005, growth was faster in manufacturing, construction, mining and quarrying, as well as in wholesale, retail and hotels, than in agriculture. However, though vital, most of these activities are urban -oriented. Henceforth, it is important to devise strategies that will enable these sectors to widen livelihood opportunities to the poor. To that effect, initiatives to support rural-oriented sectors will be emphasized to empower the rural populations to increase their productive capabilities (NSGRP, 2005).

Farmers' networks can be one of the initiatives, which can support rural oriented sectors and therefore support the National Strategy for Growth and Reduction of Poverty. Farmers' Networks have a potential to empower the rural populations to increase their productive capabilities and as a result reduce poverty. This study focused on the role of food security groups' networks in poverty reduction in Chamwino district, Dodoma region Tanzania. The objectives of the study were to a) describe Food

Security Groups Networks in terms of membership, performance, organization, management, history, activities and sustainability. b) identify the roles and extent to which Food Security Groups Networks have contributed towards poverty reduction. c) identify factors of success or failure and best practices in Food Security Groups Networks. d) identify and describe strategies for strengthening FSGNs. Data for this study were obtained using a case study research design whereby purposive sampling was used to select three villages. Qualitative data were analysed using content analysis whereby quantitative data mainly from structured questionnaire were analysed using the Statistical Package for Social Sciences (SPSS). The FSGNs have played different roles including:

Increasing the capacity of members to meet the cost basic needs necessary for maintaining a minimum standards of living. The gained capacity has enabled them to deal with problems such as high rates of morbidity and mortality, prevalence of malnutrition, illiteracy, high infant and maternal mortality rates, poor quality housing, inadequate clothing, low per capita income and expenditure, inaccessibility to safe water, food insecurity and poor technology. The gained capacity is as a result of accessibility of members of FSGNs to extension services offered by the FSGNs such as (a) increased access to improved agricultural implements such as, improved seeds and drought tolerant crops, (b) increased farmers' knowledge and skills on recommended agronomic practices leading to increased agricultural production (c) exchange of useful experience and information e.g. information about prices and improved seeds. As a result members can sell the agricultural produce at high prices as well as grow quality seeds which lead to increased harvest (d) safe storage for cereals. The cereals are then sold at high prices (from September to March) when there are few cereals in the market (e) increased access to health services (f) increased household food security.

FSGN member have been empowered as they can make choices in different areas such as what agricultural implements to use as they have increased their income and what petty business to do as they have gained commercial skills and useful information from their fellow members and business partners.

Climate Change and Adaptation Accounting

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Keywords: Climate Change, Extremes, Economic and Social Damages, Adaptation Measures, Accounting

Analysis of the Issue

In the recent past, increasing episodes of climate extremes and variability (e.g. floods, droughts) have demonstrated the vulnerability of the human, economic and social (HES) systems to these events. The frequency of extreme weather events are on the rise. Hurricanes, floods and droughts in 2005 were unparalleled in terms of the intensity and frequency of its natural catastrophes. Analyzing data from 1950-2005, Munich Re, one of the world's largest re-insurers and the second largest primary insurer in Germany, concluded that there was indeed a gradual increase in extreme events worldwide. It found, for example, that the incidence of catastrophes in the 10 year period 1995-2005 was 2.1 times higher than the decade of 1960-1970. In the past, many adaptation measures have been implemented but found to be inadequate to reduce economic and social damages (see Figure 1). On the other hand, without those measures, the damages would have been much higher which indicates some progress in adaptation has been made.

Presentation of the Results

It is projected that climate change and variability (CCV) may increase in the future and may eventually make future development efforts unsustainable. According to the Third Assessment of the Intergovernmental Panel on Climate Change (IPCC), the world could be 1.5 to 5.8 degree Celsius warmer by 2100 than 1990 depending on various development paths we would likely to follow. The global mean sea level has been projected to be increased by 13-88 cm over a 100 year time-window. There is a high likelihood that extreme temperature and precipitation would increase in many regions bringing heat waves and flooding. Many other regions would see increases in drought severity due to low rainfall and high temperature, for example, Africa. Glaciers would melt at higher rates than now causing water shortage for agriculture and energy. Sea level rise could inundate large tracts of coastal territories in the low-lying deltas in the world. Millions of people would lose their settlements and livelihoods. Cyclones/hurricanes could be more frequent and stronger than now and would pose threats to lives of coastal and offshore populations.

Humans have learnt to deal with extremes since they were first born on this earth. They engineered methods/mechanisms to live with extremes. Sometimes they succeeded and in many cases they lost to the power of nature. Presently many societies around the world have apparently developed adaptive capacity and able to face natural calamities better than before. On the other, in many societies, adaptive capacity declined due mainly to ill planning and vision, lack of economic, technical and human resources.

But how to measure adaptation? We witnessed the development of environmental science since 1970s when environmental problems started appearing because overuse of our natural capital. The issue of the state of environmental health became a subject of concern. In the traditional environmental

accounting science, indicators such as air and water quality, per capita forest cover, per capita emissions, etc. are used to measure environmental development. In this paper a range of indicators are suggested supported by empirical evidence of climate hazards –Red River floods in Canada and floods in Bangladesh to measure adaptation. One such indicator is number of casualties/sq.km area inundated. Macro-economic recovery is another indicator calculated for both Bangladesh and Canada. However, for Bangladesh case, hazards related increase in poverty was another indicator calculated. This was more sites specific but could be masked by macro-economic indicators.

Figure 1: Economic losses and insured losses – Absolute values and long-term trends. Source: Munich Re, 2005.

Conclusions and Recommendations

There are many challenges on the way to derive indicators. First, reliable hazards damage data and access. Second, de-coupling development occurred naturally and development that occurred due to safety notion communicated by adaptation measures. In such a case, it is very important to address risk transference issue. This was found to be more evident in Bangladesh case then the Red River Flood (Winnipeg City Case Study). For the Winnipeg City, the flood bypass created favorable environment for development but the structure has not failed yet to cause a large scale economic catastrophe.

There has been an increasing effort to develop and implement climate change-related adaptation measures and mainstream them in these development programs. Under the Kyoto Protocol, adaptation funds have been created to finance projects in developing countries. It is therefore necessary to assess present level of adaptation with the baseline indicators. Such accounting will assist in building capacity for a future with changing climate.

Decentralized Household-Centered Initiatives to Enhance Environmental Sanitation for Sustainable Development

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Keywords: Decentralised, Household- centered, Initiatives, Environmental sanitation, sustainable

Sustainable development is a complex issue but an environmental catchphrase from the 1990's to date that dominates international and various countries' domestic environmental, economic and social policies. To meet the needs of the present without compromising the ability of the future generation to meet their own needs is one of the conscious objectives of KWI, working with over 300 women in 7 women groups in Wakiso district in Uganda; in which decentralized approaches at local level have proven successful thus indispensable to attain sustainable development.

Working down to local communities through women self help groups, KWI facilitates communi• to increase gender equity and seeks to address the Discriminative practices inhibiting Women's potential in economic production in the communities and to acquire skills and knowledge so as to make and implement responsible choices, thus creating a setting that has facilitated autonomous community functioning vital in the sustainable development process.

Through the household centered approach, a range of relevant and sustainable strategies to improve management of excreta and solid waste have been promoted. KWI has promoted sanitation whose designs build on the concept of protecting eco-systems, treating excreta as a valuable resource to be recycled for re-use. To this extent, communities have accessed policies, operational frameworks all which support and promote needed changes in hygiene practices, and access to environmentally friendly technologies to enhance a natural balance.

The strategies include the promotion of Ecological Sanitation, a new and urgently needed technology in sanitation based on systematic closure of local material flow cycles which also introduces the concept of sustainability. It enhances integrated ecosystem-oriented water and natural resource management to environmental sanitation. With a basic principle to close the nutrient loop between sanitation and agriculture, it enhances recovery of organics, macro and micro-nutrients and water contained in this waste which is applied as organic manure in household gardens.

Household waste management and small scale water treatment among KWI women has addressed the need for quality water, reduced the risk of contamination of environment from broken sewer pipelines and provided entry point for education on water, hygiene and sanitation enhancing individual action results thus sustainable solutions.

Improved agricultural products to women members, where by all households have come up with backyard gardens for vegetables to improve on their nutrition. The major vegetables that have been grown include; carrots, spinach, eggplants and cabbages. In addition to nutrition the surplus has been sold to markets to improve on their incomes and fodder for their animals.

Education and training at all levels are required to pass on key knowledge on environmental sanitation to preserve ecosystems essential in the process of sustainable development which can only be attained if vital natural resource information that eases the processes of shared responsibility on natural resources is disseminated among local communities.Further still Household- centred initiatives should address gender mainstreaming where both men and women participate in the decision making of the sanitation technology option to suit the household. this will reduce on the social cohesion and maintain good operation of the system. KWI has trained 7 women self help groups with over 300 women households with vital components of skill and knowledge and developed as sustainable solutions using local expertise that have enhanced proper functionality of sanitation technologies in their households.

The poster will highlight the local actions undertaken by KWI women members in their own capacity after various trainings, which have enabled members to register success on improved nutrition, safe excreta management in water logged places, safe water management, and reduced risk of contamination of the environment. This has revealed for replication the strategies to enhance environmental sanitation holistically vital for sustainable development.

Building Capacity through Improving the Effectiveness of Research in Developing Countries

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Keywords: poverty, research, capacity building, harmonisation, water for development

Improving the management and use of water resources is critical to assisting people to move out of poverty, as water is often a determining factor in survival and life expectancy rates, health, quality of life, employment and many other factors affecting people's livelihoods. There is a general consensus that addressing poverty requires bridging the gap between the availability of water and the demand for water for domestic, agricultural, industrial and environmental uses.

The principles of more effective utilisation of water resources are becoming better defined and understood, but more work is required to identify and address the gaps in knowledge and build the capacity of professionals and other development workers to apply sound practices appropriate to countries where human and financial resources and information and data are often considerably limited. In the past, research work on water for development has often been funded by donors supporting bilateral projects researching different aspects of water issues in specific countries. For example, the UK's Department for International Development has supported projects researching on water for over 15 years, and other European countries have had similar research programmes. This fragmented approach to funding research has resulted in duplication of efforts and the opportunity to build the capacity of those working with water unfulfilled. In order to make a more substantive contribution towards building the capacity required to meet the MDGs on water, the European Union has supported the establishment of the European Union Water Initiative - European Research Arena Network (EUWI ERA-NET) to harmonise the funding of research efforts on water for development.

The purpose of the EUWI ERA-NET is to improve the effectiveness of EU member state funded research on water for development and build capacity of local organisations to coordinate and communicate research activities, and to provide leadership in the OECD-DAC coordinated efforts to increase alignment of donor actions with developing country partners. The main activities of the EUWI ERA-NET are to build capacity by developing best practices for improving research and impact management; engagement of the main actors in research communities and beneficiaries using participatory approaches and knowledge transformed into appropriate practices through consultation, and develop joint activities and programmes (between national research and technology development programmes and other partners) and informing policy. The EUWI ERA-NET includes research issues related to water sciences and technology in the developing world and includes physical sciences and engineering as well as socio-economic issues, and aims to provide a flexible, facilitating framework to address primarily research (creation of knowledge) but also the transfer of new knowledge to the benefit of society (demonstration and training, communications, dissemination, and methods to optimise the uptake of research outputs) and building the capacity of all stakeholders (identification of research topics, planning and implementing research projects and utlising research findings). Other outputs from the programme include the collation and sharing of knowledge and experiences of European supported water research for developing countries developing joint activities and programmes between national research programmes.

The EUWI ERA-NET was launched in January 2007, and is a consortium of 15 ministries, organisations funding water for development research from 11 European countries including France, Germany, Denmark, Italy, Norway, Austria, Czech Republic, Finland, Belgium, Switzerland and several multilateral research organisations. The harmonisation of the funding of water for development research has the potential to building capacity of all those working with or utilising water in countries with scarce resources, thereby contributing real improvements in the living conditions of the world's poor.

Strengthening Scientific Capacity for Research on Water Resources in Developing Countries

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Keywords: scientific capacity enhancing activities, water resources research, assessment, partnership,

A large portion of the new science in the world is conducted and controlled by researchers from industrialized countries and much of that science neglects the problems that afflict most of the world's population. Numerous challenges to conducting scientific research in developing countries have been identified, ranging from limited material and financial resources to poor physical and communication infrastructures (Ståhl 2003; Harris 2004; Öman, Gamaniel et al. 2006) and this paper presents methods to address these challenges. Also, water resources research tends to be the domain of men to the disadvantage of women. For women to be able to compete, they need role-models, fair recognition in relation to merits and socially accepted tools for how to combine work career with family responsibilities.

Experiences from development projects in the water and sanitation sector in West and Central Africa, have shown that for sustainability, promotion of research must be integrated in a process of training, capacity building, and ownership (Klutsé 2005). Further, scientific research must be performed taking into account the local conditions and realities of the researchers, thus. the Centre Régional pour l'Eau Potable et l'Assainissement à faible coût (CREPA) is building its research strengthening support upon six principles:

- Training; strengthen the capacities of researchers in conceptualizing scientific projects, use proper scientific methodology, and having access to scientific literature
- Promotion of young researchers; with consideration of gender and equity issues
- Consolidation of basic information; research actions are oriented towards relevant thematic issues focusing on the capacity of communities to use the research results, and research results are aimed at filling gaps of information (lack of publication, difficult access to information) , providing data for data bases and generate knowledge and enhance community and partners skills to promote local development
- Coordination of research actions through networking; provide a platform for researchers to work together and to be closely linked to the communities, and keep updated with ongoing research in the region through information sharing, in order to avoid duplication and implement research results
- Dissemination of results from scientific projects; results obtained trough research are disseminated through training courses, manuals, reports and papers published in international and national journals, and training modules and printed information are exchanged trough networks, libraries and web sites
- Impact assessment, of research actions and their contribution to population well-being and devel-

opment; addressing researchers (capacity building, skills to better deliver service to community), beneficiaries (ownership, improved health, well being and living conditions) and CREPA Staff (knowledge gain, individual capacity development)

To strengthen regional activities, the International Foundation for Science (IFS) has developed a method for capacity enhancing support which addresses the areas where support needs have been identified by CREPA and other stakeholders. The method aims at supporting young researchers at the beginning of their career with a research grant for purchasing equipment and performing field studies, and by providing capacity enhancing support activities which add value to the grant, as compiled below:

- Grants; research grant awarded on competitive terms
- Mentorship; peer-review of applications by regional scientific committees, mentor programme
- Mobilizing operational networks and groups; thematic networks, scientific equipment networks, research groups
- Scientific equipment; running and servicing scientific equipment, repair and installation development of equipment policies
- Sharing scientific results; preparing scientific presentations, writing and publishing scientific papers, implementation of scientific results, participation in scientific meetings, publication grant
- Training workshops; scientific methodologies, preparing research proposals, revision of applications, access to scientific literature, generation of quality data, good sampling practice, good laboratory practice, statistical methods and experimental design, participatory approach, implementation of results visit to well equipped centres
- Thematic workshops; on relevant scientific topics

Throughout the support the gender balance is addressed through individual support to, and recognition of skilled women researchers as well as highlighting of role-models. The method and the outcome of the training sessions provided in the field of Water Resources research at IFS is assessed at four levels as proposed by (Kirkpatrick 1998); reaction, learning; application; and impact. The initiative is yet in an early phase but the results so far have indicated the following. Questionnaire surveys show that the reaction is very good. In terms of learning it has been found that short term events do significantly increase the scientific capacity, but not to top international level. It is thus concluded that training events must be complemented with follow-up support. Such follow-up activities (yet only few) have indicated adequate application of the training. It is yet too early to assess impact.

In order to provide an efficient and at the same time demand driven scientific capacity strengthening support; CREPA and IFS has developed a strategy for close and balanced collaboration. The partnership builds on mutual trust and intensive communication.

The conclusions from the first phase of the joint IFS-CREPA initiative are that the outcome of scientific capacity enhancing activities is significantly improved through

- continuous support to devoted researchers
- establishment of well functioning network of scientist on relevant domains of water resource
- sustainable impact assessment process of research actions
- trustful and efficient collaboration between international and local partners

Using Micro-Credit to Facilitate Sustainable Point-of-Use (POU) Device Provision for Low-Income Users in Uttar Pradesh, India

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Keywords: Sustainable, Micro-Credit, Point-of-use water treatment, Low-income, India

AED/POUZN with USAID support are implementing an innovative model of partnership using local manufacturers of point-of-use (POU) devices, micro-finance institutions (MFIs) to ensure sustainable use of safe drinking water in low-income households. Several filter manufacturers have created filters that do not require electricity or a direct connection to a water source. While costs for filters are falling dramatically, the filters are not sufficiently low-cost for purchase by low-income consumers without credit, a concern that no filter manufacturer has yet overcome. Providing micro-credit to low-income consumers could allow filter devices to go to scale, not only across India, but in developing countries around the world.

Diarrhea globally causes 1.8 million deaths annually and 500,000 in India alone. The National Family Health Survey (NFHS) II in1999 reported that 97.5 % of rural and 85.4% of urban households in UP did not purify their water and only 2% rural and 34% urban households have access to piped water. Studies and anecdotal evidence suggested that a poor family spends more than Rupees (Rs) 4800 per year on diarrhea treatment in addition to nutritional loss and long-term impact on growth.

Several different methods of POU treatment exist and AED is dedicated to expanding consumer choice for different effective POU methods. Increasing data point to the effectiveness of filters. For example, a recent Cochrane Review (Clasen T, Roberts I, Rabie T, Schmidt W, Cairncross S, Interventions to improve water quality for preventing diarrhea, submitted for publication) notes that many POU interventions are effective, evidence exists that filtration offers the most consistent and effective results.

In India, National Institute of Epidemiology (NIE) in a study to be published soon investigated for one year the use of Pure-It filters manufactured by Hindustan Lever Ltd. (HLL) in a peri-urban area of Chennai. NIE distributed the filters for free and no other hygiene intervention was done outside of a brief training in the filter's use. The results showed a 49.7 % reduction in total diarrhea episodes in households using POU devices compared to the controls.

Recent studies have noted that even boiled water can quickly become re-contaminated. An advantage of filters is that many of them limit re-contamination by incorporating safe water storage in a closed container with a tap attached. In addition, leading filter brands in India are convenient, easy to use and are attractive, all of which increase the likelihood of their use. Indeed, anecdotal evidence suggests that filters are becoming an aspirational product, which will facilitate their marketing.

Indian industry estimates suggest that the vast majority of high-income households have POU devices, while the penetration is exceedingly low among the lower-income urban and rural populations.

For example sales to 15 million high-income homes approaches that number of filters, while only five million of 45 millon urban poor and two million of 160 million rural poor are believed to have purchased a POU device.

AED's goal is increase low-income individuals knowledge of and access to high-quality and low-cost filter devices. POUZN works with MFIs to incorporate POU device loans into their portfolios. While the vast majority of micro-credit loans incorporate income generation for the borrowers, numerous examples include a percentage of the loan for other benefits, such as home loans, schooling for children and health care. POUZN developed micro-credit options with MFIs to incorporate POU into loans. Several private sector filter manufacturers were excited by this methodology and committed to work with POUZN, including most notably Hindustan Lever and Eureka Forbes. POUZN is currently early in the process of assisting the NGOs to generate awareness among their clientele on the importance of clean drinking water and create linkages between the NGOs, their clientele and the manufacturers, though firm data is expected by June.

The MFI movement and their clientele, known as self-help groups (SHGs) are an ideal vehicle for this intervention. A typical SHG has between 12 to 20 low-income women from the same area and that work for common purposes, often both civil and financial. The group creates its own savings and then acts as a guarantor for loans from banks and government programs. The group meets regularly and discusses administrative and other issues. The SHG is ideally suited for demand creation, demonstration and acquisition of the POU devices by the members. First started in the 80's, today more than 11 million SHGs exist in India and their number is growing each day. More than 1,000 NGOs are involved in formation and capacity building of these groups.

The PPP model followed by POUZN is in process to create a strong partnership between POU device manufacturers, MFIs, grassroots NGOs, international agencies involved in POU work and various federal and state government agencies. Data on project success is expected by May 2007. The project will provide useful direction to other micro-credit efforts for POU introduction to low-income consumers. Using micro-finance for filter purchase could allow them to go to scale in both India and around the world.

How the South African Water Sector has Collaborated Using Water as a Catalyst for Growth and Development

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Keywords: accelerated service delivery, sector orientation, institutional support, economic growth & development, coordination and integration

Introduction

Addressing the water supply and sanitation backlog was one of the first priorities of the new government in 1994. In line with its poverty reduction policy, the Government has targeted 100% water supply and sanitation to its population by the year 2008 and 2010 respectively since lack of access to water supply and sanitation constrains opportunities to escape poverty .

In terms of the Constitution of the Republic of South Africa, local government is responsible for providing basic services, including water supply and sanitation. The Department of Provincial and Local Government was, at the time, grappling with the transformation of local government to address disparities in service provision in general. The majority of local authorities that existed did not have sufficient capacity to address the water service backlog.

To address a pressing water service delivery need, the Department of Water Affairs and Forestry embarked on a programme to accelerate access to basic water. The focus was on rural communities, the majority of which did not have access to potable water. In addition to the physical provision of water services, DWAF developed a comprehensive legislative framework for water supply and sanitation services.

While there was significant progress in addressing the backlog, service provision had the following challenges:

- A project orientation approach towards the provision of water supply and sanitation
- Lack of coordinated planning and development for service delivery
- Lack of / inadequate involvement of women in service delivery
- No consideration for environmental impact from services provided
- Emphasis on high class technology without engaging communities in selecting appropriate technology
- Lack of public sector capacity for water service provision functions
- Service sustainability challenges as a result of lack of cost recovery.

In an attempt to continue with addressing the service backlog and addressing the challenges as stated above, DWAF initiated a multifaceted sector support programme for the provision of water supply and sanitation services. This programme was aimed at integrating processes and resources that would result in coordinated and effective service delivery. The programme was given the name “Masibambane”, a Zulu word literally meaning, “Let us join hands”. In terms of documents reviewed and responses from key informants, the adopted meaning of MSB was “Let’s work together” [2].

Thus, the sector support model was born out of the realization that the project based approach had elements of inefficiency such as duplication, provided no opportunity for the rationalization of resources and did not take the economies of scale as presented by a sector wide approach.

The objective of the programme was " to provide basic water supply and sanitation services through a variety of activities including the support to strategic policy development, water services provision to selected rural communities through institutional support to assist various levels of public sector institutions to perform their appointed functions within the context of existing policy and legislation". The Masibambane sector approach hooked well into the National Treasury's Medium Term Expenditure Framework (MTEF) which emphasized the importance of planning and budgeting, supporting water services institutions and local government in taking responsibility for the provision of services as well as policy coordination between government departments.

Masibambane was launched in April 2001, with strong leadership from DWAF, at national level and in the three provinces where the combined water services backlog constituted 80% of the national backlog (Eastern Cape, KwaZulu-Natal and Limpopo). It required a lengthy process of high-level discussions between interested government departments, SALGA, civil society and donors.

Past & Present Focus

Masibambane was premised on the three provincial MAAPs, through which three themes emerged:

- Sector orientation – ensuring an appropriate policy framework, approaches and implementing mechanisms.
- Service delivery – ensuring a sustainable programme based on integrated planning.
- Institutional support – supporting all three spheres of government and other role players to fulfil their water services functions (with a strong focus on building institutional capacity of WSAs).

In keeping with the principle of supporting the sector to deliver against its own defined objectives and targets, Masibambane acted as a catalyst for the development of the National Water Sector Plan and the Provincial Water Sector Plans which provides strategic thrusts to be achieved within a five year period.

Currently the water sector is preparing for Masibambane III which is focusing on Water for growth and development ' This is mainly for the sector strengthen the use of water as a catalyst for economic growth to support Accelerated and Shared Growth Initiative (ASGISA) of the government. This is a comprehensive strategy which is tackling economic growth, unemployment and poverty in a more comprehensive and targeted way. As part of this theme we will:

- Work towards ensuring that the poor are incrementally stepping the ladder from basic to higher levels of service and also piloting water for multiple use such as livestock, brick making etc to align ourselves with local economic development initiatives at local level.
- Strengthen collaboration and interface between Water Services and Water Resources ensuring that the following issues are addressed :
    - Water Quality Monitoring.
    - Integrated planning at municipal level.
    - Waste discharge monitoring
    - Water conservation and demand management.

Conclusion

Collaboration has enabled us to work together towards resolving the blockages in service delivery and we have learned a lot of lessons that could be shared internationally.

"Strategic Communication in Water Resources Management: Building Community Capacities for greater Sustainability"

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Keywords: Water Resources Management, Communication, Sustainability, Behavioral change, Gender

Communication is being increasingly recognized as critical for achieving the goals of sustainable development. Assuming that development interventions universally entail adoption of 'change' – generally based in new technologies, new services or even new institutional frameworks – the significance of communication becomes paramount. For adoption of most of these changes, among other concerns, the need for change in the existing behaviors in the community is seen as important, and communication undoubtedly plays a vital role in this process. However, in the water sector, where the overarching development goal is sustainable access to safe drinking water for all, primarily through installation of new low-cost technologies that users can build and manage themselves, it appears that the intricacies of the linkage between behavioral change and achievement of the goal are yet to be fully explored and adequately addressed.

A detailed research was undertaken for identifying the barriers that thwart the fulfillment of water needs of local users in India from gender perspective despite the installation new of technological interventions for the purpose. As revealed by the results, realistically achieving the goal of 'sustainable access to safe water for all' is not an issue of mere technology development and delivery. A number of complexities are involved in the process. The study showed that technology delivery is not the solution, but emerges as a problem in its own right because of problems of effective adoption, equitable access, and sustainable management of the technology at community level. The causes underlying this set of problems in turn lie embedded in the realm of behavior of the targeted technology beneficiaries and their larger communities, analyzed from gender perspective. The findings of research led to highlighting of the need for developing 'strategic communication' in water sector that entails adoption of an innovative approach aiming at bringing about behavioral change in the targeted beneficiaries and their communities by fulfilling their underlying communication needs, further identified from gender perspective.

The government as well as agencies like the UNICEF has drawn communication strategies in the sector, and water-related IEC (information, education and communication) is designed and implemented in the field by different agencies, largely with the aim of sensitizing and educating people towards water problems and the water technologies available for their redressal. However, the research showed that the ongoing efforts are not sufficient. Different segments of the beneficiary group/community are heterogeneously placed in terms of their behavioral response to the IEC provided, thus constituting a 'behavioral change continuum'. These levels are as follows: Level 1 - Unaware (need knowledge on the problem/solutions); Level 2 - Aware/knowledgeable but reluctant to change (need right motivation for change); Level 3 - Concerned and motivated to change (need support for sustained access

to technology/requisite resources); Level 4 - Try the new behavior (Need motivation for sustaining new behavior); Level 5 - Sustain a newly experimented behavior (reached the goal but may need continued support).

Each of these levels in the continuum has its own specific communication needs for undergoing necessary behavioral change and these may be different for women and men. But the ongoing IEC campaigns tend to target the communication needs of only the beneficiaries at level 1 – aiming at awareness-generation and knowledge-building alone. The needs of the remaining categories, which largely deal with attitudinal barriers of various kinds, do not appear to be sufficiently addressed. Additionally, for some of those at level 3, behavioral change may need further support and this involves initiating a change in the attitudes of those in the dominant section of the larger community who oppose their access to the technology. In this case, then, the latter would require undergoing behavioral change in order to facilitate the access of the motivated targeted beneficiaries.

Given this situation, where capacities of communities to create and manage their own water resources is to be built, and the current communication strategies fall short of equitably addressing the communication needs of all, there is need to define a strategic communication framework in the sector. On the basis of findings of this research, it is proposed that such a framework should have four progressive steps, namely, (1) assessment of aspects such as the behaviors that need to be encouraged or discouraged, messages to convey, audiences to be reached, etc. (2) planning for devising a clear course of action on the basis of above information, (3) implementation of communication activities using multiple channels, (4) monitoring and evaluation carried out simultaneously with implementation so that audience response is known and corrective measures applied on time. Through these stages, the following strategic points would be significant: (a) defining and segmenting the audience to be reached, the audience must be segregated by gender,(b) Tailoring strategies and messages to audiences – these should be easy, socio-culturally as well as gender sensitive, and (c) ensuring adequate exposure for intended audience. It must be recognized that good communication creates messages that solve problems that audiences recognize. Messages must fit into the mental and socio-cultural context of peoples' lives and the frameworks that audiences use to understand and define their actions concerning a problem.

In conclusion, the need to strengthen communication in water sector through adoption of a new strategic perspective must be recognized. Otherwise, capacities of local communities will continue to be low, leading to difficulties in achieving the development goals in relation to water.

Progress with Capacity Development for IWRM

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The issues facing the development of capacity in Integrated Water Resources Management (IWRM) have been briefly summarised under 'capacity for what' and capacity for whom'. This is then followed by some experiences of capacity development and the presentation ends by drawing a few conclusions.

Capacity for What?

While IWRM has a compelling logic the promotion of it as a tool for achieving sustainable use of water resources has not been accompanied by appropriate strategies and systems for implementation. Nor has there been adequate recognition of the time it will take to implement IWRM. It is often recognised that water resource management is strongly a political process as well as a technical one however the political and social nature has not been adequately taken into account when trying to take IWRM from a concept into a practice.

Lack of capacity is raised as a serious issue at almost every water meeting. As one whose job is to address capacity development and who works with many similar professionals around the globe it is common to find that complaints of lack of capacity are not readily accompanied by an explanation of who needs capacity to do what. This makes the capacity building task more challenging especially if the capacity builders themselves are not familiar with the practical needs only an academic understanding.

The fact that we are not managing our water resources very well and IWRM as a proposed process to address this have been catalysts for major water sector reforms in many countries of the world (GWP,2006). This is an impressive result which shows how fundamentally important the issue is to politicians. The surprising aspect is how little attention has been given to the practicalities of transforming this commitment into action to achieve the ideals of economic development, social equity and environmental sustainability.

Before the real benefits of an IWRM approach can be achieved we have to assist water managers and other stakeholders on the ground on to implement successfully the expected changes. For example implementing a polluter pays system; ensuring that beneficiaries from water use pay for the benefits; establishing appropriate management structures; linking groundwater and surface water management; and above all ensuring that the political and social dimension is addressed through a new participatory decision making system; are some of the difficult tasks to be faced.

The problem for capacity builders is getting ahead of the game so that they can gather the necessary knowledge to advise and support the reform and implementation process. This includes gathering knowledge local on what is working and not working through research but also linking with other professionals and sharing experience and skills across countries and regions facing similar challenges. However while the principles of IWRM may remain the same the solutions and priorities for action will differ from country to country.

Capacity for who?

IWRM is bringing changes in management that involves both technical professionals as well as

a variety of stakeholders from communities to politicians. New players need to be empowered to contribute effectively, old players need a mixture of encouragement and coercion to overcome resistance to these changes and all need additional capacities to make good decisions on the format and implementation of these reforms.

It is evident from the concept of IWRM that management decisions are required from a more participatory process than in the past. This may not readily be accepted and already we are seeing so-called IWRM reforms where the status quo of decision making remains in the same hands as before. As mentioned above water resources management is as much a political as a technical process. If this is not recognised and openly taken on board by incorporation of a wide range of stakeholders in decision making then we shall not advance beyond the previous supply driven management penalising the poor and benefiting the wealthy.

Capacity of water users, not only primary water users at community level but also the big water users such as utilities, power companies and irrigators, needs to be addressed so that they can understand each others constraints and also what role is expected of them in a new water management dispensation. It is true that there is an inherent competition between the goals of economic efficiency, social equity and environmental sustainability but the best decision is specific to each community and river basin and best achieved by those most impacted by the consequences.

Key targets for capacity development are therefore the politicians who give support and drive to sector reforms, the water professionals who may not understand either the purpose of reforms or how to successfully implement the necessary changes, and other stakeholders who are expected not only to give their support to changes in management systems but also to participate in those management decisions.

The problems for capacity building professionals are that they may themselves lack access to knowledge of what works and what doesn't work because of the lack of good cases and also may lack contact with the real problems on the ground because of other issues such as the lack of engagement with practitioners.

Experience of Capacity development and IWRM

Lessons have been drawn from capacity development experience over the last three decades. For example UNDP (www.undp.org/dpa/publications/CapforDevelopment.pdf), OECD (//siteresources.worldbank.org/INTCDRC/Resources/oecd_challenge_of_capacity_development.pdf), Cap-Net (www.cap-net.org/FileSave/65_Capacity_building_ofr_IWRM_3_principles.pdf)

CB has to be delivered from local institutions to be both relevant and sustainable. This is the conclusion of UNDP and OECD as well as others reflecting on decades of development assistance. Cap-Net a UNDP programme addressing capacity building for sustainable management of water resources, has taken this fully on board and works with national and regional networks of capacity building institutions around the world. These networks deliver CD services to support IWRM implementation.

The networks also serve another purpose. They provide a platform for exchange of knowledge, experience, skills and materials which is critical to address some of the problems mentioned above. Because not much is documented on how to implement IWRM, experience is scattered and most of all because an integrated approach to water resources management demands a multidisciplinary solution capacity building networks are a powerful tool.

Networks are difficult to manage but when successful provide a strong unifying force and an important entry point to mobilise local skills and knowledge for the long term process of capacity building for IWRM. Some of the results include

- Masters programmes in water resources management created across several education institutions at regional level (WaterNet, Southern Africa) and nationally (Argentina and Sri Lanka);
- Many courses on IWRM principles for both trainers and water professionals;
- New training programmes on specific areas related to improved water management practices for example (institutional arrangements; economic and financial instruments; IWRM for water utilities; facilitation skills; conflict resolution)
- Improved training materials availability;
- New knowledge from case studies and research.

Training and education institutions around the world now have IWRM in their curriculum and schools also tackle the IWRM concepts but with less technical jargon.

An enormous challenge comes on how to measure capacity. As stated at the beginning the strategies and systems to implement IWRM are not yet very clear although the goal may be. Progress towards the goal may be measurable, and tools for this are being developed by UN-Water and other partners, however there is a long way to go in developing good performance indicators for the new and reforming institutions.

Conclusions

IWRM is complex and risks loss of commitment due to lack of attention to implementation strategies. The engagement of local knowledge centres in IWRM implementation is weak, partly due a lack of recognition of local expertise but also reflecting a lack of commitment to water sector reforms.

Middle East and North Africa: Approaching Water Scarcity Problems by Developing Capacity of Experts and Organisations

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Keywords: Capacity building, MENA Region, governance, regional cooperation, water sector reform

Introduction

70,000 is the number of employees of Egypt's Ministry of Water Resources and Irrigation. This Ministry is one among the 12 ministries that govern water issues of the country, which has almost as big population as Germany. For comparison, Germany's Federal Ministry for Economic Cooperation and Development has 600 employees, and the Federal Ministry of Environment 830 staff. A myth these days is that education and capacity building solves most bottlenecks of development. So, Egypt and the rest of the Arab world should be mastering their water resources exceedingly well. But the myth is again miles and miles away from the reality. At least volume does not mean capacity. With its sizeable public sector—which is increasingly argued to be seriously overstaffed, bureaucratic and inefficient—Egypt is not much different from the other 22 countries of the Middle East and North Africa (MENA) Region.

Capacity Building Program for the Mena Region

In the MENA Region, improvement of the water sector performance has become highly imperative. The region is increasingly facing water stress due to limited availability and high population growth. Inappropriate technologies and inefficient management techniques often cannot supply urban and rural water users sufficiently. Access to water is anticipated to diminish unless significant processes of reform are made. Some countries in the MENA region lack basic water institutions; others display fragmented institutional structures, or overlapping decision-making structures, which often exclude users' demands and civil society. Moreover, water is a matter of regional cooperation – many MENA countries face similar challenges, and many share basins and rivers.

Thus, reform of the water sector requires not only the adoption of integrated approaches and of modern water policy guidelines, but the promotion of regional and international cooperation too. Participation of all stakeholders concerned is another core element for keeping the region's waters flowing. This includes capacity building and empowerment of the public and private sectors as well as community organizations to realize and fulfil their roles.

InWEnt has formulated a four-year Program on Capacity Building in the Water Sector for the MENA Region, focusing in 8 countries: Egypt, Morocco, Algeria, Tunisia, Jordan, Palestine, Syria and Yemen. About 40 activities are planned, many of them being already under way.

The objective is to support reform processes which make a significant contribution to a sustainable use of water resources and to combat poverty. In order to achieve this objective, we strengthen technical and methodical competence and build platforms for regional cooperation. Our target is to

connect experts and decision-makers working on different levels and actors of civil society through the establishment of lively networks.

The outputs of the program will include the improvement of human and organizational performance of the water sectors concerned, the awareness of policy-makers of the priority issues involved, and a functional regional network within the region.

Learned by Now

Water professionals of the MENA Region agree broadly on capacity building needs in local, national but in particular in the regional dimension. Regional activities mushroom and the need for such programs is obvious. The sharing of experience and data, creating networks, etc., are issues that would bring the water sector forward and broaden the national focus to a regional one.

South-south co-operation could be enhanced by the development of regional financing instruments and institutions. The region includes several high-income countries and the finances for regional programs could come much more from the regional sources than the case is today. The MENA countries are infamous for allocating exceptionally low share of national budgets to education and training.

There is a pungent need for the assessment and invention of regional activities and coordinating them in order to cut overlaps, increase efficiency and to allow more strategic operations. Donor harmonisation is necessary. Dialogues exist but the need to boost the dialogues is important.

Training programs respond to an array of capacity building needs. In many cases, the highly educated trainers are a bottleneck and therefore university links have been increasingly recognised. Long-term programs seem to be short in supply.

Many training activities are being linked to research, and the tendency seems to be to move from knowledge management to knowledge development. The MENA Region is still seen too much as a knowledge consumer but it should move towards being a producer of knowledge. At the same time, a caution is at place for keeping the applied research close enough to practical needs.

The organisations that develop their human capacity in both public and increasingly private sectors should recognise that capacity building is a part of their business. Ownership and commitment in human and financial terms calls for amplification.

Water sector is a sector in its own right, but at the same time water is an important aspect within many other sectors. Social sciences, economics and environmental sciences are among many fields that water experts must increasingly cope with throughout the MENA Region.

Distant learning, the use of internet and other modern communication means is in rapid development in the region. The possibilities are still not fully tapped but instead there exists an extensive growth potential.

Conclusion

It should be recognised that whereas water resources are extremely scarce in the MENA Region, the water problems are dominantly related to governance and management shortcomings. Human resources deficiencies are a key part of the water scarcity problem. Therefore, education, capacity building, training and organisational development constitute a cornerstone for the development of the water sector in the MENA Region.

Towards Sustainability: Building a Structured NGO Approach in WASH Capacity Development

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Keywords: Capacity Development, NGO approach, Water supply, Sanitation , Hygiene Promotion

There is less than 10 years now to 2015, the year aimed by the Millennium Development Goal. However, given the general trends, there is serious doubt many countries achieving their goals of poverty eradication given that the targets of water and sanitation have not been seriously addressed. There is a mad rush by some donors to push increased water coverage through more investments towards the water sector and sanitation is now being given additional attention but these are not yet enough to ensure adequate coverage and systems that are sustainable, efficient and effective. While there is increasing investment in water supply and sanitation to achieve the Millennium Development Goals, in sub-Saharan Africa 42% of the population is still without safe water. Sanitation coverage has increased from 34% in 1990 to 49% in 2002 but by 2015 it is anticipated that 2.4 billion people will still be without adequate sanitation unless there is a dramatic increase in investment in services. The financial investment to achieve the MDG targets is large however similar but smaller investments in the past have been marked by the disappointing results.

To a large extent failures of the past have been attributed to poor technology selection, inappropriate financial systems, poor management systems and overall a lack of stakeholder involvement in the process. Many of these problems can be partly attributed to the lack of capacity of various actors at critical stages of implementation, management, operation and maintenance. Clearly, for the MDGs to be achieved, the present strategies must not be limited to infrastructure but should be accompanied by capacity building targeted at key players to avoid the mistakes of the past. It is necessary to provide proportionate investment in capacity development if facilities are to be appropriate, acceptable and have any prospect of functioning beyond the project period.

The STREAMS of KNOWLEDGE is a global coalition of water and sanitation resource centers are working with its members and partners in capacity development for water, sanitation and hygiene promotion. Its capacity development program is anchored on the years of combined experience its members have in building knowledge, skills, expertise and the necessary behavior change among different levels of stakeholders in delivering sustainable and efficient water and sanitation service delivery. All of its members are actively involved in training, research, policy advocacy, knowledge generation, management and knowledge transfers. Given the magnitude of the work that has to be done, its members will work on a structured approach in WASH capacity development, linking itself with appropriate partners at local, national, regional and global levels. This structured approach takes off from the system that has been in place and is working in a few countries like Bangladesh where the NGO Forum have mobilized 725 NGO partners and also in a region like West Africa where CREPA, another STREAMS member is working with 120 NGOs.

The framework for capacity development can be divided into three categories namely institutional development, organizational development and human resource development. It is important that there

is an enabling environment- with policies, legislation and financing among others components- that is conducive for the existence of organizations. Similarly, there is need for sustainable strengthening of the internal capacity of organizations – in terms of improvements in decision making processes, procedures and organizational incentives to name a few- so as for them to be better able to achieve their objectives and fulfill their missions. On the other hand, organizations require skilled personnel to assist in the delivery and management of services. This entails improvement and maintenance of the quality of personnel within the organization (Visscher et al, 2006). It is also through able institutions, organizations and personnel that community empowerment and community capacity development can be achieved. While a lot of attention has been paid to infrastructure development, capacity development has taken a back sit. It is appreciated that capital development should benefit the end users, but if capacity building is negated then we risk not achieving the set goals.

Groundwater Governance in Asia - An Innovative Approach and Platform for Capacity Building, Research and Knowledge Sharing on Groundwater Management

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Keywords: Groundwater management, research and capacity building, Asia, interdisciplinary, knowledge sharing platform

Groundwater overexploitation and degradation and their associated environmental and socio-economic impacts are widespread phenomena in many parts of the world today, including Asia, and the gravity and the need for curbing further negative impacts is being increasingly recognized at many different scales and levels of society. At the same time it is clear that devising lasting solutions requires substantial efforts and capacity, often beyond the capability of existing systems.

One of the key constraints to proper groundwater management, and to water management in general, is the lack of inter-disciplinary capacity within existing structures for developing, utilizing, allocating and safeguarding the water resources. Typically, the development of groundwater is within the hands of technical staff, with little knowledge of environmental and socio-economic impacts. Allocation of groundwater, either through formal licencing, or through indirect methods (influencing incentives to exploit groundwater by farmers who are the main users of groundwater in many parts of developing countries) may be controlled by politicians, legal advisors, with the help of economists or simply driven by open market mechanisms. Safeguarding the resources and the associated health and livelihood benefits, or advocating for the same (in the lack of pro-active and institutionalized controlling mechanisms), is driven by environmentalists, self-driven activists, NGO's with support from international donors and local to global coverage media.

In order to make a change on the ground and move towards more informed and sustainable groundwater management, the various parties need to come together to embrace the problem complex in an integrated manner and device solutions that built upon a comprehensive understanding of the driving mechanisms and the potential combination of interventions that may work under given circumstances.

Another striking feature of present day groundwater problems is that they are prevalent in developing as well as developed countries and no role model country, or blue print master plan exists from developed countries for guiding less advanced nations, simply because the problems are complex, partly unique to the settings, and continuously evolving.

Having said that, it is also clear that similarity of issues across national borders and within larger international river basins may foster incentives for collaboration, knowledge sharing and continued dialogue on possible management approaches.

On this background, successful approaches to groundwater management will have to emerge from practical experiences on the ground, in a 'live laboratory' subjected to different trial-and-error efforts, assuming that the business-as-usual or 'laissez-faire' model does not suffice for the aggravating problems of today.

In order to support these self-learning mechanisms of developing sustainable, adaptable groundwater management, IWMI in collaboration with a vast number of associated partners in the Indo-Gangetic and Yellow River Basins as well as from nations outside the South and South East Asia region is developing and implementing an innovative and unique training program of inter-disciplinary capacity building cum knowledge sharing, action research, and policy dialogue within groundwater governance. The program is developed under the Challenge Program for Water and Food 2005-2008 project entitled: 'Groundwater Governance in Asia: Capacity Building through Action Research in the Indo-Gangetic (IGB) and Yellow River (YRB) Basins'.

The program consists of a 5-week intensive residential training course, divided into a first introductory part (4 weeks) covering basic theory of groundwater hydrogeology, chemistry and environmental science, socio-economic aspects, policy and institutional aspects and communication/awareness/media/knowledge sharing topics, catering to the 24 junior and media participants. The last week is devoted to the integrated, case-based analysis of groundwater governance in various parts of the world, involving in addition 9 senior professionals and experts within groundwater research and management from the region. Following the course is the research phase where fellows are exposed to the realities of groundwater use and management in their own countries through applied action research in the field (junior and media fellows) or in third part countries, e.g. the USA and Australia, through intensive study tours (senior fellows). The whole program culminates with a Summary Workshop at the end of the 6 month program where all the participants, including the project researchers and resource persons join to share and discuss research outcomes, program evaluation and policy recommendations.

Investigating the Social-Ecological Resilience of Water Management Practices among Minority Hill Tribe Villages in Northern Thailand

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Keywords: water, social-ecological resilience, management practices, stress, minority hill tribes

As the world in which we find ourselves living in becomes more complex and complicated, social-ecological resilience can be viewed as an important attribute that is intertwined within a system's ability to deal with stress and change. Due to this complex and ever changing world, comprised of both social and ecological systems, it is basically impossible to ever assume that a system will remain unchanged forever, or that policies can be put in place to stop change from occurring. The non-linear system that this paper will explore will be on the community level of a minority hill tribe village. Making up a small percentage of Thailand's population, these marginalized communities have settled and lived in the mountainous regions of Northern Thailand ever since they started immigrating from Burma and Southern China. The six biggest groups of tribes today are the Karen, Hmong, Mien, Akha, Lisu and Lahu. Among the minority hill tribe communities living in the highlands of Northern Thailand, water is seen as precious commodity that they are dependent on for both their household and economic livelihoods. In the past, these hill tribe groups lived quite isolated within their communities, growing their own crops, raising livestock and living in harmony in nature. However, as villages have become more permanent and stable due to decreasing availability of land, Thai government policies, increased economic development and connection to low-lying Thai cities, minority hill tribe communities have dealt with various forms of water stress, and adapted in different ways. As villages began to become more connected and integrated into Thai society, many water intensive cash crops soon took over the fields, such as fruits, vegetables and flowers. Competition over water can be seen through the irrigation systems that villagers have developed, with the rich have money to buy plastic piping, while the less fortunate still rely on old canal style systems. The increase of population (2.9 %/year) has also increased the demand for high quality drinking water and other household needs, as well as the ever demanding irrigation and economic needs. This paper will seek to investigate the social-ecological resilience of two different hill tribe villages to explore if social-ecological resilience is evident in today's water management practices. An historical overview of past water management practices will first be developed to act as the base of reference, with today's current practices measured against it. Differences and variations within the water management practices will then be examined and analyzed from this historical setting. A second round of analysis will further take place when seeking to gain more insight into how these villages are learning to deal with change concerning past and present water situations, as well as their ability to change and create opportunities for self-organization. The various ways in which the villages have adapted will form the essence of this resilience analysis and will indicate the ability and capacity, or lack thereof, of these communities to deal with future water stresses and shocks.

My main research question will be:
How are/have past and present water management practices contributed to social-ecological resilience building, or non-resilience building strategies within two different Northern Thai hill tribe com-

munities, and how have the villages dealt with them?
In seeking to answer this question I intend to focus on the following five questions:

1. What exactly are/were the past and present main water management practices on a community level? What differences appear between the two villages?

2. What has changed over the past 30-40 years with water management practices within the communities?

3. How are both villages learning to live with change concerning water management practices? How are villagers dealing with these changes?

4. How are both villages nurturing the ability to adapt to change or not?

5. How are both villages creating opportunity for self-organization?

Workshop 7: Water – A Brake on Economic Development?

The Implications of Increasing Water Demand and Potential Climate Change in the Volta Basin for Ghana's Socio-Economic Development

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Keywords: Water Demand , Volta River Basin, Climate Change, Water Resources Management, Akosombo Dam

The Volta River basin occupies almost 28 percent of the total West African Coast and the hydrographical basin of the Volta Rivers covers a surface area of about 414,000 km2. The basin is shared by six West African states, with 83 percent of the total surface area located in Burkina Faso and Ghana. The Akosombo dam in Ghana is by far the most significant structure built in the basin with the Volta Lake being the largest man-made lake in the World. With over 70% of the populace being primarily dependent on rainfed agriculture for their livelihood, the Akosombo dam is undoubtedly of strategic importance to Ghana's economy. Moreover, 80% of the power for socio-economic development is hydro-based from reservoir inflows that are further dependent on rainfall availability and distribution. Transportation, fisheries, domestic water supply, tourism and irrigation constitute other significant uses of the dam. However, population increases and lower household incomes within the basin have resulted in overexploitation of the natural resources thereby affecting the sustainable development of the region. The increased pressure on land for farming has expanded pasturage, led to over-use of manure, uncontrolled bushfires and soil erosion. Rapidly developing Ghanaian infant and mining industries are becoming important consumers of water and power. Many industries utilize own power generation and water storage facilities to maintain operations during water or power cuts, thereby diverting resources from potentially more productive investments and hampering industrial growth. Furthermore, downstream water flow in the reservoir is affected by the rising number of dams being built as reservoirs for irrigation water in Burkina Faso. This is a potential source of acute conflict as Ghana rejects any plans that will reduce the volume of water reaching the Akosombo dam on which it depends for almost all its energy needs. Low water levels in the dam in 1998 resulted in the slashing of the generating capacity by half and causing a major energy crisis in Ghana. This was blamed partly on the prolonged lack of rainfall and largely on Burkina Faso's water development approaches, resulting in severe power rationing across the region. Not surprisingly, Ghana has since changed from being West Africa's biggest electricity exporter into a net importer. Power rationing is still prevalent in the Ghana and the effects in terms of revenue losses and associated triggers for social vices such as armed robbery have been enormous. With plans to provide electricity to the entire country by 2020 the Government of Ghana decided to concentrate its efforts on gas fired power plants rather than further hydroelectric investment. This policy is also consistent with objectives of the West African Gas Pipeline (WAGP) project and considered an economic viable alternative to dam construction. However, progress on developing the various cross-border interconnectors that are required to complete the physical infrastructure of the West African Power Pool has been slow to date. As a result, Ghana's association with hydro power is set to continue in next decade through the modernization of the Akosombo facility and the construction of 4 new dams, including the controversial Bui hydro project. Ghana is obviously well blessed with water resources but possibly the number of suitable sites for dam projects is limited because of the number of people who would be affected by flooding and the extent of

the likely environmental damage. With all diverse interrelated concerns of dwindling water resources in mind, a trans-disciplinary cross cutting research effort is required from the various stakeholders. This study comprises of an integrated cluster of sub-projects involving economic modeling of water demand in the Volta basin within the framework of the GLOWA Volta project. This research project that is funded by the German Government, involves an interdisciplinary analysis of the physical and socioeconomic determinants of the hydrologic cycle within the Volta Basin. Against the background of the trade-offs of water allocation for irrigated agriculture, hydropower generation, domestic and industrial uses, the project was designed to evaluate the impacts of changes in climate and land use on the quantity, quality and availability of the basin's water resources with the goal of developing a scientifically sound decision support system (DSS) that will help stakeholder authorities in Ghana and the other riparian countries to optimize water allocation within the basin. Considering the seasonal and erratic rainfall pattern of the region, economic analysis of hydropower generation cannot rely on static assumptions concerning inflows. Similar, it is no longer safe to assume that fuel prices can be extrapolated accurately over the lifetimes of new projects which may prove to be as uncertain as oil and gas prices. The integrated hydrologic-economic modeling framework thus allows appropriate modeling of uncertainty and risk in hydropower through stochastic analysis of precipitation and system inflows. Since the economics of both hydro and thermal power are increasingly subject to uncertainty, the study attempts to evaluate alternative power sector investment plans. Some research evidence suggests that climate change would in the future have adverse effects on reservoir inflows as a result of declining rainfall amounts. Ghana would have to diversify its energy sources, with the Volta dam venture being accompanied by new hydro schemes and a number of gas fired power plants with the hope of obtaining a balanced generation mix to ensure sustained power supply that will trigger other sectors of the economy. Regional collaboration and monitoring in the area of transboundary issues is also weak. It is envisaged that the newly established Volta Basin Authority will take up the mantel to address legal and institutional issues for efficient water management across borders.

Economic Growth or Environment? Politics of Groundwater Depletion in India

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Keywords: Groundwater, Depletion, Politics, Environment, Economic growth

The excessive usage of water in general and groundwater in particular is due to the manner in which the Indian state percieved development. Understanding economic growth as development and vice versa not only led to the overexploitation of resources like water, but also long term environmental affetcs were grossly ignored. While water has an ability to recharge itself, it is the misunderstanding and mismanagement that led to the current crisis of groundwater depletion. This depletion resulted only in further increase of cost in extracting groundwater thereby giving rise new kind of inequities and conflicts.

In the above backdrop, this paper attempts to analyse the politics of groundwater depletion in the context of economic growth and environment. Similarly, it looks at the flawed understanding of development with reference to three sectors – agriculture, industry and domestic – and the resultant stress on resources like groundwater. Finally alternatives are suggested in order to check the further depletion of groundwater.

The paper identifies the root causes for over development of groundwater resources and thereby affects the environment and economic development. The crucial factors contributing groundwater depletion are rapid process of development through modernisation, the open access nature of groundwater resource, demographic shifts and latest technological innovations.

The analysis based on macro data reveal that the groundwater has emerged as most critical input in the agriculture and industrial sector development and primary source of drinking water in both rural and urban areas. As far as irrigation water is concerened, groundwater contributes about 57 per cent of the total irrigated area. At the same time the area under traditional sources such as tanks has been rapidly reduced from 11.76 per cent to 5.48 per cent during 1970-75 to 1999-2000. Interestingly, groundwater extraction through tubewell technology has been the major source. Traditional techniques such as openwells using animal or human labour has been disappearing from the groundwater show.

This intensive development of groundwater irrigation has created way for intensive water market in many parts of India. Though selling and buying water was a old phenomenon, it has got extensively commercialised in Indian agriculture in recent period. These markets have evolved not only in irrigation sector but also to meet urban demand for drinking water transfering from rural and peri-urban areas. Thus, the stress on groundwater resources has been increasing constantly. Further due to the demand for safe potable drinking water, water markets have come up, with water in itself becoming a huge industry.

Simultaneously extraction of groundwater through latest technological inputs is giving raise to higher consumption of diesel and electricity, etc. This in turn is again putting pressure on the industry and

the country's economy. In the present context, the growing climatic changes also is having adverse impact on both surface and groundwater. In this backdrop three main sectors have been affected badly due to depleting groundwater and vice versa – agriculture, industry and domestic. The groundwater use has resulted in speedy decline of groundwater table in several parts of the country When groundwater resources are depleted or their quality becomes degraded, agricultural livelihoods are threatened and poverty can increase.

Industries are not only involved in monopolising the water, but also polluting it by releaseing effluents into surface water bodies and in to the ground. This has in turn put huge pressure on the water in general and livelihoods in particular forcing the people to migrate to safer regions. To cite examples, Kanithi Balancing reservoir is there just to meet only the needs of Vizag Steel Plant in Andhra Pradesh, India. The water for this reservoir comes from Godavair river which is about 373 kms away from the plant. The Coca Cola plant in Plachimada in Kerala has been extracting about five lakh litres of groundwater per day. As a result soon the surrounding wells and surface water bodies have dried up leaving little option for the people over there. In turn a conflict erupted between the local people and the Cola plant, which ultimately led down to the closure of the plant.

As far as quality is concerened, groundwater, once treated as a source of potable water, is deteriorated in its source itself due to overexploitation. The problems of groundwater quality is different in urban and rural areas. In rural areas, due to excessive use of chemicals in agriculture leading to increase in the levels of dissolved solids and brackishness of water. Groundwater is also polluted due to lack of good drainage for sewage causing problems in urban areas.

In the above context, this paper suggests for addressing the issue of (a) social heirarchy as this is the key element in community participation; (b) in urban areas care should be taken to protect surface water bodies by keeping a strict vigilance on land encroachments; (c) there is a need of state intervention in the community groups and it shoud have 'positive checks' on the system to ensure sustainability of the resource use. Water users' associations and community groups should be in convergence with the local Panchayats, which, in turn will strengthen decentralisation process; (d) community organisastions should involve active participation from the Gram Panchayat to ensure legitimacy and to avoid future complications in resource management; (e) the decentralisation system should ensure the accountability and transperancy in the community management of natural resources as this is the key element for economic development; (f) industrial clusters should address the issue of regionalism to spread the development process evenly and reduce the stress on natural resources in general and groundwater in particular.

A Framework for Evaluating the Hydrologic and Economic Repercussions of Bioenergy Development within the Columbia River Basin in the USA

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Keywords: water policy, renewable energy, sustainable development, economic trade-offs, climate change implications

Water, Energy, Agriculture, the Environment, and Economic Development are explicitly linked in any discussion concerning the feasibility of long-term sustainable bioenergy production. This is true everywhere in the world but particularly here in the Pacific Northwest where population growth, climate change, and droughts have already produced unsustainable water use in many watersheds. Feedstocks for bioenergy may consist of a wide variety of forestry residue (e.g., tree branches), agriculture residue (e.g., wheat straw), herbaceous crops (e.g., switchgrass), short rotation woody crops (e.g., hybrid poplars), oil crops (e.g., canola), and municipal/urban residue. A common denominator is that all of these biofuels require significant water use. Economic development in the region has been driven by low-cost hydropower and future expansion will undoubtedly be tied to our ability to provide energy at reasonable prices.

In order for the inland northwest region to significantly contribute to the 2000 National Biomass Initiative goal of increasing biomass energy production from 840 million MWh in 2001 to 3790 million MWh in 2030, both irrigated and non-irrigated agriculture will have to contribute. Graham (1994) concluded that only about 4200 square miles of land in the entire Pacific Northwest would be suitable for non-irrigated production of energy crops, of which very little was located east of the Cascade Mountains. However, this feasibility analysis was done using outdate energy prices and technology so a more thorough investigation is needed to accurately shape decisions for the future. Moreover, the complex ecosystem and economic impacts of a shift in agricultural priorities are not well understood which makes developing effective policy decisions impossible. Further complicating this process are the wide ranges of predictions regarding future energy prices across sectors, technological improvements in biomass water use efficiency, feedstock harvest and transportation costs, and agricultural price support practices combined with the effects of global climate impacts on feedstock production, energy demand, and water availability.

Regional climate change is projected to unleash unprecedented stresses on water resources in the Pacific Northwest in the coming decades (Science 2004). Even under moderate warming scenarios (i.e., a 1.5 oC increase in average temperature by 2050), the region's snowpack is expected to plummet by 60% as winter snow levels ascend. With precipitation no longer being stored as snow over the winter, winter stream flows are expected to increase, as is the likelihood of winter and spring flooding. In the summer, stream flows that are dependent on spring snowmelt are expected to drop on the order of 20%. In essence the region will experience summers that are drier and winters that are wetter.

These changes will have severe impacts on regional agriculture. With less water in the summer, the current amount of irrigated acreage cannot be sustained, particularly in arid areas such as the dry

lands east of the Cascades. In particular, those with junior water rights will find it difficult to sustain agricultural activities. Low summer flows will add further strain to stressed aquatic ecosystems, including endangered salmonids. Releases from already low storage reservoirs will be required to support many fish runs, and this will further exacerbate low irrigation supplies during the summer. Finally, an increase in the frequency of catastrophic winter flooding will exacerbate erosion, impacting both agricultural lands via the loss of topsoil and downstream aquatic ecosystems where excessive sediment accumulates. The economic consequences are just beginning to be understood but must be included in any future predictions.

A new multidisciplinary approach involving physical-chemical, biological, social, cultural, and economic factors is needed to address bioenergy potential. The linkages between water policy, economic growth, environmental consequences and water variability under climate change scenarios need to be discussed and better understood by decision makers and stakeholders. This methodology would ultimately include development of a comprehensive decision support tool combining all aspects of bioenergy production to evaluate the viability of alternative agricultural land use patterns given the forecasted availability of water, energy price, and ecosystem cost. Two agricultural scenarios, a reactive scenario in which current agricultural practices are continued indefinitely and a proactive scenario in which agricultural practices are modified to anticipate and adapt to imminent and dramatic changes in regional water resources, are included in the framework in order to demonstrate the economic consequences of various strategies.

The generic methodology would be applicable to any region using local information and user-defined priorities defined through weighting factors. In arid and semi-arid climates where agriculture significantly contributes to per capita income and employment opportunities, such a model would be beneficial to assist donor countries in prioritizing future water projects.

This poster proposes and explains the conceptual elements of the generic methodology. It clearly identifies opportunities and barriers to implementation.

Water for Economic Growth and Development: A Strategic Analysis of the Moroccan Economy

Author: **Dr. Hynd Bouhia** (Invited Speaker)
Economic Adviser to the Prime Minister of Morocco

This paper provides a real life application of an advanced methodology for analyzing the fundamental interrelationship between sustainable management of a country's water resources and the formulation of effective socio-economic development strategies.

The scarcity or overabundance of water is constraining economic growth and leading to serious social implications. This is exacerbated by ad-hoc, fragmented policies with regard to water resources. Governments' plans were driven primarily by water supply. But, climate change and increased pressure on the demand side combined with globalisation, are calling for integrated approaches to water management. To develop and implement such approaches, governments should have access to models and ensure that water is embedded in their poverty reduction strategy, their economic growth agenda and their international aspirations.

Specialists around the world thought about these questions and built analytical tools presented as decision support systems to policy makers and government bodies. Such tools were created to optimize investments in water, social and growth oriented sectors. Thus, it is possible to compare potential investments through their impact on economic growth, poverty reduction—human development indicators—and the competitiveness of the country—the balance of trade.

To illustrate the application of decision support systems to water resource management, this paper focuses on Morocco, a country which has been transformed in a single lifetime from a water-rich, fertile region into one facing a water crisis, rural poverty and economic competitiveness. In spite of this, Morocco is today a success story of an all-embracing national plan that elaborates sectorial strategies by treating water as an integral part of the overall economy. The ultimate objective is to fight poverty through economic growth and to reach a new and sustainable developmental level. This approach was catalyzed trough the launch of an innovative participatory and action oriented National Human Development Initiative (INDH). This Initiative places water at the heart of its major sectors. Consequently, there are two main indicators that drive the government agenda: economic welfare—GDP growth—and social well being—Human Development Indicator (HDI).

The model applied in Morocco first evaluates the current situation, through detailed sectorial studies coupled with an analysis of Morocco's share of world markets. The second stage examines Morocco's global competitiveness, through systematic benchmarking of Morocco for the input factors—such as water—compared to a number of countries around the world, followed by analysis of global trends in the value chain for sector targeting and investment choices.

The challenge for Morocco is that 90% of the mobilized water goes to agriculture. In addition, agriculture absorbs 42% of the active population, but contributes only 15% of the $65 Billion GDP. Agriculture requirements, the burgeoning population, the growing cities and the booming economy—tourism and some industries—put a serious burden on water resources.

As a consequence, the government investment in the water sector doubled these past five years. The objective is to generalize access to potable water both in urban and rural areas, ensuring an efficient and good quality service, and therefore improving the HDI; and getting closer to the Millennium Developmental Goals on poverty. Although the immediate link between improving HDI and economic growth is not computed, long term implications are many. By improving the conditions of living, there will be more incentives to launch projects at the micro level, contributing thereafter to the region's welfare.

The model shows that 6% GDP growth is required for Morocco to position itself internationally, reduce unemployment and raise the HDI. Injecting capital in agriculture and irrigation without any restructuring has limited impact on growth. Nevertheless, agro-industry is one of the pillars of the Moroccan economy as defined by the model, and the restructuring of its production chain will make it possible to double the agricultural GDP. This means shifting from heavy water use products to higher value crops, targeting the export market. The model suggests the development of 8 to 10 targeted businesses, including the acceleration of traditional water efficient products such as fruits and vegetables and the diversification in high value-added business (bio) and high potential products such as olives, almonds, etc.

Investing in industry remains the fastest way to protect the economy from unpredicted external shocks. Thus, a growth rate of 6% would require more than 30% increase of the non-agricultural sector's value added. By focusing on the growth rate drivers and targeting high value water consumers, there are 7 export-oriented sectors representing 60 to 80% of Morocco's economic growth over the next 10 years: namely, service outsourcing (off-shoring), auto-parts, electronics, textile, agro-industry, fisheries processing and crafts industry. This voluntary targeting of growth drivers needs to be accompanied with a continuation of long-term cross cutting projects (education, infrastructure, government reform) and a discontinuity in resources—capital and natural. The management of Morocco's water resources would include options such as water reuse and desalination, in addition to inter-basin transfers and more efficient irrigation networks.

Finally, factoring water into national planning goes beyond measuring its physical aspects. It is a way to assess both the economic and social value in order to ensure sound investment strategies, sustainable development planning and the country's positioning within the international competitive world.

Water and Development: Quantifying the role of variability and resilience requirements

Author: **Dr. Casey Brown**
International Research Institute for Climate and Society, USA

This talk discusses the hypothesis that the seasonal and inter-annual variability of rainfall is a significant and measurable factor in the economic development of nations. Studies of the causes of disparity in the level of economic development between the wealthiest countries and the poorest have overlooked a fundamental factor that differs between these sets of countries: the availability of water. The amount of rainfall, and in particular its temporal variability, presents challenges to food production, trade and infrastructure development. Recent country-level studies suggest that the impacts of hydrology and rainfall variability on economic development are significant (World Bank, 2004; Grey and Sadoff, 2006; see Figure 1). Current work indicates the relation between rainfall and economic growth in Africa may be widespread (see Figure 2). An analysis of global data sets reveals a statistically significant relationship between greater rainfall variability and lower per capita GDP (see Figure 3). Having established this correlation, we construct a water resources development index that highlights areas that have the greatest need for storage infrastructure to mitigate the impacts of rainfall variability on water availability for food and basic livelihood. Typical formulations of water resources indices ignore the impact of variability, relying on mean values of water availability. Such indices are less informative for efforts focused on overcoming the hydrologic barriers to economic development. According to our metric, the countries with the most critical infrastructure needs are among the poorest in the world, and a majority of them are located in Africa. The relevance of securing water availability in these nations increases everyday in light of current population growth, economic development, and climate change projections of increasing rainfall variability. Future research will quantify the economic development impact of climate variability and identify the deep determinants of climate resilience. An index based on this methodology will enhance the prioritization of infrastructure investment and inform the economic valuations of these investments.

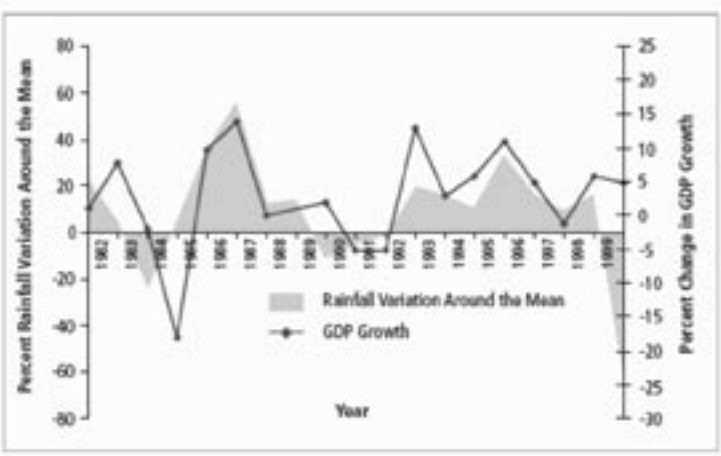

Figure 1: Time series of rainfall variation and GDP growth [1].

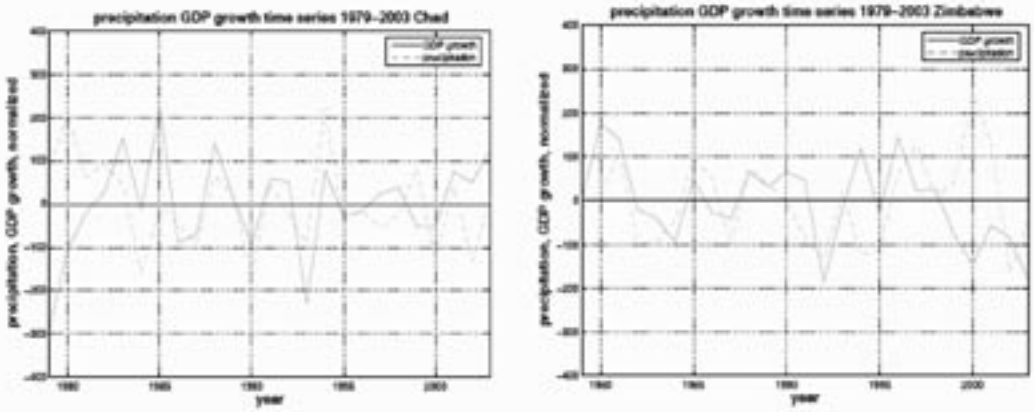

Figure 2: Time series of GDP growth and precipitation in Chad (left figure) and Zimbabwe (right figure) for 1979-2003.

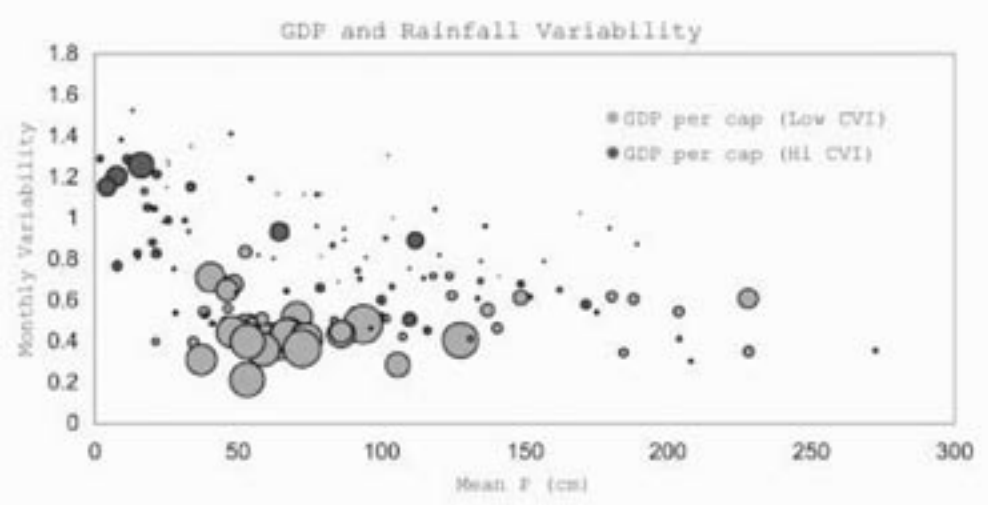

Figure 3: Scatter plot of mean annual precipitation (P, x-axis), the coefficient of variation of monthly rainfall (CVM, y-axis) and per capita GDP (size of circle).

Impacts of a Watershed Resource Degradation: The Case of Dying Flamingos in a Drying, Polluted Lake Nakuru

Authors: **Dr. Wanjiku Chiur**i et al.
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Keywords: impact, watershed, pollution, development, degradation

Kenya is classified as a chronically water scarce country. The country's natural endowment of fresh water is limited by an annual renewable country's fresh water supply of only 647 cubic metres per capita. Globally, a country is categorized as 'water-stressed' if its annual renewable fresh water supplies are between 1000 and 1,700 cubic metres per capita, and 'water scarce' if its renewable freshwater supplies are less than 1,000 cubic metres per capita (World Bank, 2000). Efforts to develop the water sector have been based on water being both a basic human need and a catalyst to accelerate social and economic development. This objective for example has been articulated in various development policy documents such as Sessional Paper No. 10 of 1965 that emphasized the need for the provision of major basic social services including water. The importance of water resource in national development has been reaffirmed in recent policy documents including the Sessional Paper No. 1 of 1999 on national policy on water management and development. The current development plan of 2002-2008 places great emphasis on the value of water towards attaining the country's development objectives. These are currently being pushed through the national goal to meet the Millennium Development Goals (MDGs) and New Partnerships for Africa's Development (NEPAD) objectives. Degradation of the water resource base of a country causes chronic long-term problems. Although the effects of water resource degradation are not always as apparent as those from rainfall variability, their incremental nature and the effects are often felt at a distance, both in time and space, from the source of degradation. The principle causes of water resource degradation in Kenya include excess abstractions of surface and ground water, soil erosion causing turbidity and siltation, high nutrient levels causing eutrophication of lakes, toxic chemicals, including agricultural pesticides and heavy metals which are toxic to the water dependent biota among others. Sustainable supply of Water thus, is crucial not only to humans but also to the wildlife in these habitats. Wildlife in Kenya makes a large part of tourist attraction that serves as a foreign exchange earner. However, with the continued degradation of water in rivers serving major Ramsar sites and wetlands, humans and the wildlife dependent on these waters have been threatened. Lake Nakuru's survival is dependent on the surrounding watersheds whose main streams feed the lake. These include; River Njoro, Makalia, Nderit, Lamudiac and Ngosur. This paper makes a case study of River Njoro watershed, which is the main watershed that serves Lake Nakuru. It raises issues associated with upstream watershed degradation and pollution, from the suburban and urban Nakuru. All these have implications on tourism. Lake Nakuru is an alkaline-saline shallow lake in rift valley and one of the most productive natural ecosystems (Odada et al, 2006). It has heavy wildlife concentration (70 manual species, 400 bird species and over 200 plant species). However the park is internationally known for its high concentration of lesser flamingos because of the lakes generous production of Cyanobacterium, Arthrospira fusiforms which lesser flamingos prefer. There are other birds in the park, which receives over 200,000 visitors every year. This makes the park one of the most important foreign exchange earners in the country. However the survival of this lake as a tourist attraction is threatened by watershed degradation, and pollution ending up in the lake Nakuru national park. The paper outlines degradation processes in river njoro watershed and proposes recommendations for all stakeholders who must work together to provide interventions for watershed rehabilitation in order to save the lake, for the sake of the park and maintain Nakuru National Park as the most visited park in Kenya while ensuring that lesser flamingos (Phoenicanaias minor) have a home.

Socio-economic and environmental impact of the innovative water management for rice production at Khulna district in Bangladesh

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Keywords: Production, income, reduce salinity, integrated pest management, effective water use

The core problems in the coastal areas are mainly the extreme prevalence of soil and water salinity for dry season for dry season rice cultivation and the total area is almost mono-cropped with local rice variety. It's yield ranges from 2.0-2.5 t/ha/year, which is very low. However, to increase the production potential modern variety and appropriate water management technology have been introduced to the farmers' community. The tenure of dry season rice cultivation ranged from mid November to mid April. But the water from mid February to June of Kagibacha River is not suitable for rice cultivation as its Salinity rises as high as 20ds/m. In order to avoid high level of salinity, special structural arrangement are being made to capture fresh water in the polder canals with the help of flash gates and sluices to irrigate dry season rice. Here, the technique that farmers followed is, they use river water to irrigate their land with lower salinity level that flows from December to mid February under gravity flow system through flashing of tidal water surge. From mid February to rest of March, the farmers start using reserve water to irrigate of dry season rice. This irrigation practice has changed the traditional cropping patterns Fallow-Local Rice-Fallow to Fallow-HYV Rice-HYV Rice. As a result, the production potential has significantly increased to 8.0-9.0 t/ha/year and these irrigation practices have enhanced rice provision ability per capita of the farming communities. In total net yearly benefits from HYV rice was Tk. 32500-37500/ha as against Tk. 15000-20000/ha from local rice. Soil salinity in the dry season decreased due to use of relatively non-saline river water and integrated pest management practices.

1. How does the proposed paper advance knowledge of/innovation within the subject?

Farmers had a strong believe that rice cultivation in the costal regions during dry-season not possible. But these farmers have disproved their traditional beliefs through implementing participatory research project. The relative efficacy of this technology is environmental -friendly and increased on-farm activities of the farmers. It enhances land productivity and generates employment and income substantially.

The farmers of the coastal region usually cultivate traditional rice varieties and harvest about 2.0-2.5 t/ha/yr. Some farmers grow sesame and mug bean and usually harvest 0.5-1.0 t/ha. Therefore, total grain production stands at 2.5-3.5 t/ha/yr, where rice yield alone accounts 3.0-4.5 t/ha/yr by the research farmers, which much higher than the total grain yield. By adopting modified cropping and water management approach, the participating farmers were able to harvest 3.05-5.5 and 3.5t/ha rice in the wet and dry seasons respectively. Previously they used to harvest 2.5-3.5 t/ha/yr grain from rice and sesame/mungbean. But with the modified approach the farmers of Kismat fultola village able to harvest 6.5-9.0 t/ha/yr rice. The participating farmers informed that their yearly income was doubled by modified cropping practice.

2. What are the practical applications of the contents of the proposed paper?

Dry season rice was fully depend on irrigation water. It was directly provided to the rice field from the river kagibachha during neap tide through the flash gate from mid-December to mid-February, when

its salinity remained below 4.0 ds/m and farmers need not to incur any cost of irrigation. River water was diverted through the sluice gate to a reservoir canal in the first week of February and conserved it in a sluice canal before it gets saline. The conserved water was used to irrigate rice from mid-February to end of March with help of low lift pump. On the other hand , wet season rice was cultivate during high tide through the flash gate and irrigation canal network to facilitate growth and development of HYV rice, when drought occurred in the wet season.

3. What is the replicability of the procedures or practices described in the proposed paper?

The research farmers were 27 in project area. After the completion of the project total 110 neighboring farmers accepted dry season rice production technology in two unions of Batiaghtat Upazilla.

Costal water resources were productivity utilized for rice cultivation hampering or disturbing the environment. Integrated pest management techniques were adopted for controlling the attacks of insect and pest. Conservation of relatively non-saline water in natural canals posed positive impacts on health of the animal kingdom of locality. Both men and women community appreciated rice-rice cropping practice due to higher yearly rice production. Women farmer take rice production as worship of Laxmi (the goddness of wealth n Hindue mythology) . After the research project different farmers committee were formed to use the canal water effectively . The committee includes samll, medium and large farmers, private and public representative. The committee were playing active role to replicate the cropping pattern in that area.

Industrial Pollution and Inter Stakeholder Conflict on Water: A Multi Pronged Approach to Find out a Solution

Author: **Mr. Saugat Ganguly**
Gamana, India

Keywords: Stakeholders, Externalities, Multi Pronged Approach , Self Help Groups, Economic Tools

Backdrop

In the third world countries the problem of water scarcity is mostly associated with the necessity of development at a fast pace. The semi arid region of the city of Hyderabad and its neighborhood district of Medak present a perfect backdrop to understand the conflict of interest of various stakeholders. The stakeholders can be basically categorized as households, industries and agriculturists. About 20 years back the region was mainly dependent on agriculture as the main source of livelihood. The need for fast pace of economic development encouraged the Government to go for industrialization. With the advent of industrialization the demography and the livelihood system in the region changed its character totally. Industrialisation encouraged inwards migration. Industrialization also brought about the problem of water pollution and the requirement of a huge quantity of water for the production process. As many of the industries were large scale Bulk Drug, Fertiliser and other Chemical Products manufacturer, the problem took an acute turn very soon. The area started facing the problem of water scarcity, both for agricultural activities and household activities (including potable water).

Present situation

With a present population of over 2.5 million, Medak district is a water-starved area due to the factor of both quantity and quality of availability. The area faces the problem of health implication due to industrial pollution. The agricultural productivity has gone down considerably during the last two decades. Agriculture is no more a viable option of livelihood. More than 7000 acres of agricultural land have been damaged due to industrial pollution. The economy is shifting its pattern from a predominantly agricultural to industrial activity related. But the industries are unable to give employment to most of the farmers or agricultural laborers who have lost their livelihoods due to the industrialization process.

Possible solution

Taking a multi pronged approach can solve the problem. The approaches can be basically divided into short term and long-term measures. We can categories the measures as short term and long term.

Short term measures

The externalities (Economic and Environment) related to the industrial activities have to be taken care of at the first place. The industries draw water from the already depleted ground water sources and release it after polluting. The industries can be charged a levy based on the externalities they cause due to the pollution. The amount can be used to reclaim local water bodies.

Monitoring groups can be formed involving the local people. They will work as a watchdog against the polluting industries. Suitable monitory compensation should be provided to the groups. Pollution control board should use the money recovered from the polluting industries as penalty, for the purpose of reclamation of water bodies and fallow lands.

Long-term measures

Reclaiming the land and making it fit for agriculture again will involve a huge cost. Other income generating activities like cattle rearing should be encouraged. The agricultural land can still grow dual-purpose crops like millets, which require less water. Though there will be very limited market for the cereals, the fodder will be useful for cattle rearing.

Women Shelf Help Groups (SHG) should be encouraged to take up income generating activities like making of packaged food products, detergent powder, and fabric printing etc. Most of these products have ready market. Empowerment of women groups will further ensure better childcare, better health situation and better education.

Industrialization should be encouraged but no polluting or water intensive industry should be permitted to start in the area. The Government should use economic tools of pollution prevention i.e. price rationing; quantity rationing and liability rules to encourage the industries opt for cleaner technologies. Dairy industry should be encouraged, as it will give fillip to the cattle rearing activities.

The cattle rearing business will support the fodder crop growers. Also the animal waste generated can be used to produce organic manures, which has a huge demand in the city of Hyderabad.

Virtual Water Accounting as a Key Mechanism for Assessing the Water-Related Social and Ecological Impacts of the Growing Biofuel Industry

Authors: **Ms. Sara Hughes*** et al.
* University of California, USA

Keywords: virtual water, biofuels, trade, development, global water crisis

Policies that are seemingly unrelated to water use, such as institutionalized support of biofuel production, can have major water-related impacts. Mounting evidence has prompted an almost universal declaration of the existence of global water scarcity, or a "global water crisis" (UNEP 2001). This is particularly true when trends are examined with an eye toward the future, as water shortages experienced by humans and ecosystems throughout the world often impose serious risks to long-term sustainability of linked socio-ecological water systems (Gleick 1998; UNEP 2006). Understanding how water is "naturally" distributed is just the first piece of the puzzle, because global trade in agricultural and other commodities influences how water is consumed among countries. The volume of water that farmers use to grow a crop, which is not physically embodied in the final product, is dubbed the crop's "virtual water" content (Allan 1998). Virtual water accounting has been developed as a useful empirical tool, as, for example, Hoekstra and Hung (2005) quantified the flows of virtual water contained in thirty-three crops traded between and among the fourteen regions of the world. Virtual water accounting is a tool that has been developed to increase our understanding of the way water is used in the production of goods, and particularly how this affects the global distribution of water through trade in these goods.

Extensive studies have addressed the land competition that may arise with increasing production of biofuel stocks (SIWI in press). However, applying empirical and theoretical understandings of virtual water flows to the assessment and development of biofuel trade and development policies has not been conducted and is critical if such efforts are to have the sustainable and equitable outcomes that many are hoping for. This paper assesses our current understanding of global water resources and the impacts of trade on their distribution. We place virtual water at the center of efforts to understand global linkages between energy security, agricultural trade, and water resource sustainability. We put forward three specific and complementary types of policy developments that could address these issues in the domestic, international, and private sectors. Considering these issues simultaneously, we propose ways to improve three types of policy proposals to address these issues: 1) domestic regulation, 2) international regulation 3) self-regulation within the industry.

Increasing biofuel use and production has the benefits of decreasing carbon dioxide emissions as well as potentially revitalizing deteriorating rural agricultural communities around the world. These are both critical for development goals, as industrialization and consumption patterns change with affluence and sustainable agricultural communities are a priority for many investment efforts. Biofuels have been particularly touted as a significant benefit to rural development. However, the multi-faceted nature and interconnectedness of today's global economies and ecosystems mean that costs and benefits of the production of biofuels must be assessed in integrated ways. This is particularly the case with regard to the impacts on the world's water resources, as 80% of the world's freshwater use

is currently for agriculture, which includes any irrigation of biofuel crops. Much empirical work has been done to assess the distribution and transfer of virtual water resources around the world, and we know that four of the five crops most responsible for the global flow of virtual water are also used in the production of ethanol and biodiesel; global trade in wheat alone is responsible for 30 percent of global virtual water flows (Hoekstra and Hung 2005). If the trade in these commodities is to greatly increase in the future to meet the growing demand for biofuels it seems more than reasonable to propose an assessment of how this will impact the water resources in producing and consuming countries and to address these concerns in the policy frameworks which will undoubtedly arise around the trading regimes. As trade in biofuels increases, virtual water metrics should be used to improve global water governance.

International trade in biofuels or in their ingredients causes additional virtual water flows, above and beyond existing crop trade. As our understanding of the complexity of alternative energy development, such as biofuels, increases we will need to utilize tools such as virtual water accounting to inform policy making and to incorporate a wider array of social and environmental goals. This will be of particular use to assessing the economic development implications of biofuel production in an integrated and sustainable way. As Hoekstra and Hung (2005) observe, virtual water can give us the "what," of global water distribution, but it is still up to us to discover the "why." Underlying political and economic conditions may or may not be persuaded by virtual water methods. Incorporating these values into decision making is a worthy goal, however, and should be looked at as an opportunity for future problem solving.

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From Ridge to Reef: The Guatemalan Highlands to the Mesoamerican Barrier Reef, Navigating Toward IWRM in the Motagua River Basin

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Keywords: watershed assessment, water resources management, public health, coastal areas management, poverty reduction

The Motagua River, a transboundary watershed shared between Guatemala and Honduras, sustains over five million people. Although it supplies drinking water to its population, and is a major resource for industry and agricultural producers, it also carries greater pollution loads than any other watershed in the region. Like many surface waters across Latin America, the Motagua carries wastewater, solid waste, agricultural pesticides and fertilizers as well as soil from deforestation in the form of runoff. These land-based sources of pollution carry waterborne diseases that are harmful to human health and contaminants that are harmful to the ecology of the Gulf of Honduras, where the Motagua discharges its waters. The Gulf of Honduras is home to the second largest barrier reef in the world, the Mesoamerican Barrier Reef System. The pollutants from the Motagua River further threaten the health of this regional economic and environmental resource.

This thesis is an effort to improve the information available on the Motagua watershed so as to assist in the management of the basin, the estuary and the reef system, and help the municipalities that depend on these resources. To this end, after a thorough literature review, this thesis identifies the principle sources of pollution in the Motagua watershed and the human and ecological impacts of these sources of pollution. It then looks at the obstacles and opportunities that exist for the riparian nations and the region as they move toward Integrated Watershed and Coastal Area Management (IWCAM).

Empirical research—key informant interviews, direct observations from the field, a stakeholder meeting and a water quality model—serve as the main source of data.

The Motagua River provides sustenance to over five million people in Guatemala and Honduras. Its watershed is home to over one-third of the population of Guatemala and one-sixth of the population of Honduras. According to a variety of water quality models, the Motagua watershed contributes greater pollution loads to the water quality in the Gulf of Honduras than any other watershed in the region. The pollution threatens the Mesoamerican Barrier Reef System (MBRS) and the water supply of those who live in the watershed. Like most surface waters in Latin America, the river carries contaminants and disease from sewage, solid waste, agriculture pesticides and fertilizer run-off, industrial waste, and soil from deforestation and atmospheric deposition. With over 50% of the population employed in agriculture, nitrogen loads from livestock are higher than any other source and untreated human wastewater is the second largest source of nitrogen loads in the Motagua. Rural and urban water supplies are not routinely and systematically treated and morbidity from water-related disease is the second highest in the country. Municipal wastewater is piped untreated into tributaries. Once

it reaches the coast, it contaminates water quality in and around the reef, posing significant threats to economic security for the coastal inhabitants and the tourist industry.

Improving the water quality in the Motagua River is recognized as an essential strategy to reduce poverty and drive economic growth in the region. Consequently, it forms the basis of the final portion of this thesis, policy recommendations and a Mesoamerican Barrier Reef System Project's Action Plan, based on empirical research and a stakeholder meeting. The recommendations include: protected areas in the watershed, improved water quality monitoring along the watershed and in the coastal zone, promotion of sustainable use and health awareness through education and possible funding sources. The opportunities and obstacles, based on socioeconomic, political and cultural constraints to successful IWRM, are also reviewed and include: 1) Obstacles: public perceptions of environmental problems, low educational attainment, little law enforcement and transparency; Opportunities: civil involvement, decentralization and international investment in the region.

Sachet-Vended Water in Tamale, Ghana

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Keywords: Sachet-water, Water quality, Water vendors, Bagged water, Affordable drinking water

Issue

Water Vendors are "small or medium scale entrepreneurs who have made water distribution their main source of income and who generally invest their own capital to initiate their services" (Conan, 2003). Ghana has small to large-scale water vendors that pack and machine-seal sachet water in factories. This is locally referred to as "pure water". The factory-produced sachet water is treated via a point-of-entry system then filled and bagged by machine. Sachet water is also sold in polythene bags that are filled with water and tied by hand. The hand-tied sachet water is locally known as "ice-water." The sachets hold approximately 500 and 700ml of water respectively. Ghana's rapidly emerging water vending business offers sachet water as a cheaper alternative to bottled water. Whereas bottled water is sold at an average of US$ 0.50 per liter, sachet water cost nearly 5 times less at approximately US$0.10 per liter.

This project identifies ways to improve the services offered by sachet-water vendors in Tamale, Ghana, especially focusing on the microbial quality of the water. The sampled water is compared to the regulatory requirements given by the Ghana Standards Board (GS 175-Part 1:1998) that sets the maximum turbidity of drinking water at 5 NTU and 0 total coliforms and E.coli per 100ml of drinking water. The research was conducted in collaboration with Pure Home Water (PHW), a non-governmental organization which aims to provide safe drinking water to the Northern Region, Ghana, by selling household water treatment and safe storage (HWTS) products. The study also considers the feasibility of promoting PHW products to sachet-water vendors as a means to improve water quality.

Methods

Water quality tests were conducted on hand-tied and factory-produced sachet water from 30 vendors. The microbial water quality was obtained through 3 tests, namely: Presence/Absence H2S tests (P/AH2S), Membrane Filtration Tests using m-ColiBlue24® broth (HACH, USA) and the 3M Petrifilm test. Turbidity tests were also carried out on all samples using a HACH 2100P turbidimeter. In addition to the water quality tests, the author visited 5 factories that produced sachet water and 5 individuals who produced hand-tied water. Those involved in both businesses were interviewed to obtain information such as the source of water and the treatment, storage, packaging and distribution systems applied. Interviews were also conducted on a random sample of 30 individuals to get their perceptions of sachet water. Besides the 5 hand-tied sachet water producers that were visited, 10 other vendors who sold hand-tied, sachet water were also interviewed to obtain further details of the business.

Results and Discussion

Turbidity:20% of the factory-produced sachet water and 93% of the hand-tied sachet water had turbidities greater than 5 NTU

P/A H2S Test:7% of the factory-produced samples and 27% of the hand-tied samples returned positive results indicating presence of hydrogen sulfide bacteria
3M Petri film Test:While none of the factory-produced sachet water returned positive results for E.coli, one brand had a count of 1/100ml total coliform. 7 samples of the hand-tied sachet water showed total coliform counts that ranged from 1/100ml to 24/100ml, while 1 sample had a count of 1/100 ml E.coli

MF test:43% of the factory produced samples showed presence of total coliform with counts that ranged from 1/100ml to 110/100ml, one of which also had a count of 5/100ml E.coli. All the hand-tied sachet water samples had total coliform counts that ranged from 4/100ml to 2060/100ml, excluding one sample that had total colifomrs that were too numerous to count with a 1:10 dilution. One of the hand-tied samples had a count of 49/100ml E.coli.

Source of water, treatment and storage:While the source of all the factory-produced sachet water was municipally-supplied tap-water, the source of hand-tied sachet water, in addition to tap water, included water from tankers and other distributing vendors, as well as water from boreholes and dugwells. Sachet water produced in all the 5 factories visited was treated by filtration and UV disinfection. The hand-tied water was either not treated at all or filtered using a cloth filter or sponge. 2/4 water samples from tap points that supplied water to hand-tied sachet water vendors showed less microbial contamination compared to the sachet water produced. This indicated possibility of contamination from storage and/or handling.

General Perception of Sachet Water:10% of the interviewees drank only hand-tied sachet water, 47% drank only factory-produced sachet water and the remaining drank both. While the hand-tied sachet water was considered affordable by all the interviewees, 33 percent felt that factory-produced sachet water was expensive. Approximately 50% of the respondents felt that the quality of hand-tied sachet water was not always good, while 14% thought the same for factory- produced sachet water.

Conclusions and Recommendations

The higher microbial contamination in the hand-tied sachet water indicates greater need for interventions to improve their water quality. Pure Home Water 's ceramic Filtron-type filter and/or their safe storage container product with a spigot for drawing water hygienically were identified as viable options for treatment and safe storage for hand-tied, sachet water. With the given flow rate of 2 liters per hour, at least 5 filters would be required for the average production and sale of 100, 500ml sachets per day, with 5 hours set aside for packaging.Awareness and training on the importance of simple hygienic behaviors such as washing hands before packaging water is strongly recommended.

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Keywords: Irrigation in Andalusia, Water shortage, Economic efficency, Water assignment, Net productivity

Mediterranean countries, both European and African, have a mild climate, and for this reason they all have a very productive agriculture, which has water shortage as a mayor constraint due to the low rainfall,with the exception of some of the French coast and the north of Italy.

In this paper, the irrigation situation of Andalusia, a Spanish autonomous region situated in the South of the Iberian Peninsula, is studied. Andalusia has an area of 8,726,800 Ha of which 893,009 Ha are irrigated land that was introduced mainly during the 20th century using superficial regulated and flowing water in the first place and from the 60's onwards, using groundwater intensively. Groundwater is practically the only water available in the East of the region and has meant a strong economic impulse for this area.

The average runoff in the Andalusian territory is 12,000 Hm^3 of which 5,426 Hm^3 are regulated by dams and aquifers, out of this amount 80%, that is 4,346 Hm^3, is used for irrigation, this means an average supply per unit of 4,883 m^3/Ha/year, this supply is poor, which is why Andalusian irrigation suffers a constant hydric stress that will with no doubt worsen when the new necessary measures to obtain a good ecological condition of the Andalusian water bodies comes into force as the Water Framework Directive prescribes.

The problems caused by over-explotation of groundwater are specially severe, these waters have an increasing bad quality and the energy necessary to obtain them is constantly higher due to the permanent descent of the water level. Looking at this hydrological data it may seem that this region suffers a physical water shortage, however the opinion of Gibbons (1986) should be taken into account in The economic value of water : " Physical water shortage is not the mayor problem in most regions. It seems, rather, that the conditions of economic scarcity prevail: There is enough water to satisfy society's necessities but there are very little incentives to obtain an intelligent and thrifty use of these resources or to assign them efficently between alternative demands".

To confront this situation and due to the fact that obtaining new hydric resources in the conventional way is nearly impossible it is necessary to do a socioeconomic analisis of irrigation, this is the reason why in this paper the net productivity per cubic metre of water used for irrigation has been calculated for the five river basins that supply the Andalusian region, the twenty-five resource explotation systems and the eight Andalusian provinces and their evolution between 1996 and 2002. This productivity has been compared with the cost of water payed by farmers and the number of work days generated by irrigation in these fields has also been calculated.

From this analisis a great variability in the economic efficiency of water use in Andalusian irrigation has been detected, this varies from 0.01 €/m³ to 3.82€/m³. This wide productivity range shows that some regions have a low efficency and it is necessary to resolve the hydric deficit using water in a more efficent way which will imply in some cases changes in the choice of crops if the climatic and edafologic conditions make it possible, and in other cases changes in the system used to apply water to the field.

Obtaining an efficient economic use of water would solve, according to the analisis that has been done, the problem of water shortage in Andalusian irrigation. However, this task is difficult due to the fact that this resource is not only an economic good and to the socio-cultural traditions of farmers. For all of this, it is necessary that farmers, experts and the authorities collaborate once an economic evaluation of water use has been done. The latter should also introduce in water assignment the mecanisms of a regulated market, taking into account the heritage aspect of this resource.

Sink or Swim: Water Security as a Key to Unlocking Growth

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Keywords: water security, growth, poverty, vulnerability, S-curve

Achieving basic water security, both harnessing the productive potential of water and limiting its destructive impacts, has always been a societal priority. To capture this duality, water security is here defined as the reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks. In the absence of water security, people and economies have remained vulnerable and poor.

This paper looks broadly at those countries that have achieved water security, the paths they chose and the costs they paid. The paper also looks at those countries that have not achieved water security, the constraints this poses for their economies and societies, and the options and obstacles they face. It defines three typologies: (i) countries that have harnessed hydrology, (ii) those hampered by hydrology, and (iii) those remaining hostage to hydrology. It finds that countries remaining hostage to hydrology are typically among the world's poorest countries, and face challenging hydrologies often characterized by high inter- and intra-annual rainfall and runoff variability. With increasingly 'difficult' hydrology, the level of institutional and infrastructure investment needed to achieve basic water security becomes significantly greater. This paper seeks to capture the dynamics of achieving water security in a hypothetical water and growth 'S-curve' which illustrates how a minimum platform of investments in water infrastructure and management can produce a tipping point beyond which water makes an increasingly positive contribution to growth, and how that tipping point will vary in different circumstances.

Achieving water security, however, is never without costs as there are inevitable trade-offs involved in water development. It is clear that some countries have achieved water security at significant, often unforeseen and even unacceptable social and environmental costs. For this reason, poor countries must not see water infrastructure alone as a panacea. Without the development of appropriate water institutions, poorly conceived and badly-managed infrastructure will likely not support growth, in fact such investments and their associated debt may even forestall growth.

This brief analysis suggests that the only historically demonstrated path to achieving water security at the national level has been through investment in an evolving balance of complementary institutions and infrastructure for water management. In this regard there has been a steady process of learning and innovation that provides numerous lessons for following this basic path in a more sustainable and balanced way. Both good and bad experiences provide insights for all countries to strengthen institutions and management capacity, and ensure better design of new (or operation of existing) water resource infrastructure.

Drawing on international experience, insights are provided for better balancing and sequencing investments in water infrastructure and institutions that are designed to adapt to changing values and priorities; for considering all potential options; for tailoring these choices to country-specific circumstances; and for pushing down the social and environmental costs of achieving water security.

These insights are increasingly becoming accepted good practice guidelines that need to be applied in a pragmatic way to ensure that all countries attain water security.

The paper concludes that most poor, water-insecure countries face a far greater challenge than that faced by those who had achieved water security in the last century, and are wealthy countries today. Today's water-insecure countries face more difficult hydrologies, much larger populations with more varied water demands, and a greater understanding of, and therefore greater responsibility for, the social and environment trade-offs inherent in water management. To protect vulnerable people and livelihoods, to provide basic human needs and broader human opportunities, and to achieve growth, water security is nonetheless an imperative. Achieving water security at the global, regional, national and local levels is a challenge that must be recognized and can be met. The costs of poor countries not achieving water security, in terms of human suffering, sustained poverty, constrained growth and social unrest would be very high.

The Role of Small Scale Wastewater Treatment in the Development of Water Resources in West Bank of Palestine

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Keywords: wastewater, treatment, small scale treatment, irrigation, reuse

There have been substantial developments in wastewater management and treatment technology worldwide during the past decades. Approximately 95% of the generated wastewater in the world as well as 93% in the West Bank is released to the environment without treatment. Wastewater has been identified as the main land based point source pollutant causing contamination of the marine environment. The increase in population and therefore in sewage production imposes a great challenges to develop and introduce sustainable sewage collection and treatment .The efforts in providing these essential services especially for poor regions of the world are hindered by the shortcomings of the current concept of water management and financial limitations. In Palestine, the only substantial water resources available are ground water. Presently the application of wastewater treatment is limited because of high cost and technology complexity of convention systems. Seepage from domestic wastewater from on-site cesspits, in adequately performing off-site sewage treatment plants, this implies that proper treatment should be applied at the household to conserve the environment. Small scale treatment plants can be effective in treating the wastewater, as well as this treated wastewater can be used for irrigating the garden

Palestine is suffering from severe shortages of fresh water caused by Israel's exploitation of the majority of the Palestinian water resources. The expected population growth and rise in living standards could further threaten the water supplies. Wastewater is a valuable resource that may successfully be used after treatment for irrigation. The rural population in the West Bank constitutes around 60% of the total population living in more than 450 villages. . At present, rural Palestinian areas dispose of the waste water using cesspits. Most of the cesspits are left without a cement basement or liner so that sewage infiltrates into the earth layers polluting the ground water and the owners avoid using the expensive services of the vacuum tankers to empty them. Only 12 % of the Palestinian communities have waste water collection system and only one waste water treatment plant is operating well, those systems does not exist in rural areas, while 43% of the population are connected to wastewater networks . The uncontrolled flow of sewage causes many environmental problems and health hazards.

In a study of the water quality in the Palestinian areas, ARIJ used detergents as a marker of waste water pollution of the ground water resources. ARIJ findings showed the Palestinian ground water wells are threatened by the waste water pollution from cesspits. Proper treatment of wastewater provides a convenient means of sewage disposal and pollution prevention, while allowing for the reuse of the effluent for irrigation. It is unlikely that Palestinian rural areas will have wastewater collection and treatment plants. Thus, it may be more appropriate to introduce small scale treatment plants at the household level. The conventional centralized wastewater management systems applied in urban areas cannot be successfully used in rural areas.

Collection of waste water and constructing large treatment plants might be difficult in Palestine due

to the great capital needed as well as the need of large areas to locate treatment plant s which might be very difficult, in addition to that constructing large treatment plants required large area to be located in the same region to be planted and irrigated by the treated waste water. Reusing treated wastewater for agriculture in small scale would play major role in increasing the agricultural area in Palestine as well as conserve the environment.

Generated wastewater in most of the rural areas of Palestine is disposed in open areas, directly in the street between houses or directly in the backyard for irrigation. These wet areas attract flies and mosquitoes with the associated health risks and produced a considerable amount of noxious odors and presents a considerable public health risk. Few villages (1-2% of total villages) succeeded in installing wastewater collection system.

Water and Economic Development through Protected Area Managment Project, SriLankan Experience

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Keywords: Protected, conservation, ecological, management, wildlife

In the developing world more and more water is needed to support development and food production., but rivers and ground water are getting increasingly overcommitted and many water sources are polluted. Where, Water-A Brake on Economic Development. This has raised interest in making better use of naturally infiltrated rain, i.e. the potential of green water and increase of blue water withdrawals. The challenge is now to broaden green water policy development and proper linkages to land use management policies by integrating green and blue water governance in IWRM. MDG targets highlight the pivotal role played by access to safe water and sanitation in fight against poverty Where its crucial role for achieving basic livelihood security through water supply, health , hygiene, and food is complex, and also it is an essential resource in income generation in the industry and service sectors. The gains in water cannot happen in isolation from wider economic and political development. Economic efficiency, ecological sustainability and social equity are central criteria of IWRM.

The problem

The protected forest areas are located in the central hills, four major river basins are originating in this upper-water sheds, is the most biological diverse regions in the country, housing in its extensive forested areas diverse species, birds, fish and animals. The farming communities in the surrounding villages had a close relations between appropriate management of their forest and the consequent protection of their water-shed basins. With the rapid expansion of population forests are being cleared at a faster pace than they can regenerate, the result is an alarming decline in natural forest canopy to its present low (20 % left).As a result of that some of the rivers run dry without water, hindering to the whole human kind and to the natural habitat, braking the economic development.

This poster will elaborate the water and development scenarios through the PAM & WC project experience in Sri Lanka .

Most people would agree that conservation and development must happen at the same time, yet we are surrounded by seemingly incompatible demands to improve livelihoods, reduce poverty, advance societies, grow economies and safeguard our natural resource .

Meanwhile the rapid urbanization has had a tremendous impact on the water sector, insufficient drinking water and sanitation of our cities, evils of overcrowding insanitation, spread of diseases and pollution, Municipal .Authorities had to spent huge amount of money and time to cure the problem, instead of development activities.

Sri Lanka is gradually shifts towards the status of a Newly Industrialised Country, the effluents and discharges from these factories, are released in to waterways and drains, polluting surface and ground water supplies , making them inhabitable for both man and beast. There is no economic development why, the gaining from industries have to spent for water pollution base recoveries,

In considering the above situation The Sri Lanka government have initiated Protected Area Management and Wildlife Conservation Project, (PAM & WC)under the Director Wildlife Conservation in the Ministry of Irrigation, Environment and Water Management with the grant from ADB/GEF/ Netherlands. The project address the resource conservation poverty nexus more strategically by emphasizing up on the protection and sustainable use of natural resources and the environment as a means to reduce poverty and as a vehicle for sustainable development.

PAM & WC project implementation has been strategized by five action components.

Strategic Action 1: Integrated buffer zone community development focusing on biodiversity conservation and livelihood development. 1.1 Starting of small nad medium level industries without destroying the ecosystem. 1.2, Providing grants and Bank Loans to start entrap ices 1.3 Promote education facilities for second generation.

Strategic Action 2: Strengthened institutional mechanisms to involve the community in decision making and watershed management 2.1, Give legal status to Community Based Organizations to control the culprits, doing operation and management activities, 2.2 Preparation of conservation plans and implementation. 2.3 Organize monthly meetings to discuss the monthly schedule 2.4, Distribution of water and mini-hydro power electricity.

Strategic Action 3: Use of non-timber forest products on a sustainable basis and tree planting and conservation 3.1, Promoting biogas instead of wooden fuel for household consumption 3.2 Tree planting campaign to promote the biodiversity. 3.3, Financial assistants to promotion of non-timber products.

Strategic Action 4 : Establish networking among local authorities and private sector. 4.1, Strengthening judicial policies to improve forest protection. 4.2, Water management and sanitation improvements 4.3, Health and Insurance policies development

Strategic Action 5: Awareness programs on watersheds, soil conservation, and environment management 5.1, Setup activities for each stakeholder group to educate and raise awareness on water and river system 5.2, Training on tree planting, soil conservation, and agriculture development. 5.3, Training on waste management, pollution

During the last two years period PAN &WC project performance were improved tremendously. People have established their livelihoods and improved their day today life parameters while protecting the ecosystem and biodiversity. To meeting the basic MDG needs, the gains in water cannot happen in isolation, but with from wider land management and economic and political development. Because water is seen as a leverage in driving livelihood improvements and development of a country.

Effects of Change in Water Resources on Moldovan Economics: Likely Threat for Future Development

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Keywords: global environmental change, water resources, economic transition, adaptation, Moldova

Presentation of the topic and analysis of the issue

Securing equal access to the natural resources and development possibilities for future generations is the main concern that mankind is facing at present. This concern has numerous facets depending on various natural and economic conditions on the Globe. For Moldova, one of the main concerns (declared, among others, as priority directions by governmental activity program) consists in promoting economic development and reducing poverty. Achieving those goals is considered through rehabilitation of Moldavian village, and, implicitly, through promoting sustainable agriculture. In the light of global environmental change issue securing water resources for sustainable use (including, agriculture) may constitute a problem. The goal of the presentation is prospective analysis of the likely changes in water resources in Moldova and identification of the most threatened areas.

On the one hand, recent studies, undertaken on the continental and country level, in spite of various methodologies, show constant trend of warming and drying up of the country's territory that varies just in rate but not in sign of changes. Naturally-induced changes manifests through: redistribution of precipitation among seasons in such a way that decreases its amount in the vegetation period; rising temperature that causes growth of evapotranspiration; increasing risk, severity, and area where droughts occur; increasing risk and severity of extreme weather events (like heavy showers). These changes contribute to reducing water quantity and quality and, at the same time to increase of water demand.

During the past 16 years Moldova has been facing effects of economic transition from planned socialist to market economy. Their impact has had direct and indirect consequences on availability of water resources. Direct consequences are caused by diminished investments in the water-related activities that have led to almost total decline of irrigation and failure of irrigation systems, to decrease of the number and retaining capacity of reservoirs. Indirect impact is manifesting through changes in land cover (for instance, cutting forests) and in agricultural practices (intensification of grazing on the grasslands, reduction (due to impossibility) of implementing soil protection measures) that contributed to diminishing share of lands with high capacity for infiltration and increasing runoff. This double effect of economic changes, even under the constant climate, reduces availability of surface water resources (as well as of groundwater).

Totalizing, we should mention that natural and anthropogenic factors both contribute to diminishing available water resources. Rehabilitation of wetlands is the only positive (relatively, positive) aspect of economic decline.

On the other hand, Moldavian economics has become more agrarian in recent years and depends on the two main sources of incomes: local and export-oriented agriculture and food industry (more

than 50% of exports) and remittances (more than 25% of GDP; first country in Europe and 3rd in the World). Russia is main economic partner of Moldova, but consecutive closing of its market for Moldavian export forces Moldova to seek other markets and to be more competitive.

Results/findings

As a result of reviewing economic premises we can expect increasing role of agriculture and food industry in the country. This will lead to increasing requirement to water resources and to growing rate of using them. In such a way two contrary trends appear: diminishing water resources versus increasing demand, with focus on stable water supply. Stability under changing conditions can be secured just through developing water storage system: surface (reservoirs and ponds) and underground (pumping water in aquifers).

Leaving behind the problem of what kind of water storage systems should be developed; the issue to be solved is what are the territories most likely to be affected. Main finding consist in, on the one hand, that not southern part of the country (which is more exposed to drought, water scarcity etc.), but eastern, and partly, central, parts, where irrigation was almost absent in the past and retaining capacity of reservoirs is extremely weak, are the most vulnerable to likely changes. On the other hand, extreme weather events (droughts and heavy showers) will start to occur in the region, which is not prepared for such changes. In addition, important part of Moldova's population is located in this region (including three of the four its biggest cities).

Possible ways out of the problem (with special attention to the agricultural practices in the most vulnerable areas) can follow two types of arrangements: passive adaptation through increasing water demand that will lead to unsustainable use and finally to overuse and quick depletion of water resources, and active adaptation. Active adaptation in its turn can be of two types as well: introducing more drought-resistant cultivars of the already cultivated crops, and change of crop patterns. South of Moldova can adapt itself easier by introducing drought-resistant cultivars; main adaptation problem is changing crop patterns, because it includes modification of multi-year practices and human mentalities. The latter threatens central and eastern parts of the country.

Conclusions and recommendations

In order to achieve multiple goals of country's development attention should be paid on adaptation issue: creation of water storage and water distribution systems (especially, in areas where they are underrepresented) with minimal losses due to leakages and evaporation; promoting and facilitating adaptation through change of cultivars and crops, with special attention on effects of crop pattern change; focusing on the most vulnerable regions (eastern part). Underestimation of water impact can, ultimately, be an important obstacle on economic development of the entire country.

Water Futures for the MENA Region: The Vicious Circle of Economy, Urbanisation, Employment, Governance, Environment, Climate and Water

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Keywords: MENA Region, MDGs, economic development, future water challenges, uncertainty

Introduction

The Middle East and North Africa (MENA) region is not only very scarce in water, but also subjected to a complex mix of development tendencies that make the future development of the water sectors of these regions particularly difficult.

How can the region be expected to develop by the year 2015? Since the water sector is profoundly tied to geography, human resources, economy, climate, and several other regional and national features, as well as to many corresponding global tendencies, this analysis relies principally on them. The past tendencies in economic and social development of the MENA countries have been far below the world's average.

If the development tendencies keep continuing until 2015 and beyond in the same direction, the region will face various problems and challenges. Most likely, however, these trends will change in a way or another. There may be even dramatic changes, but such changes are not easy to foresee.

Findings

The MENA water sector should seriously vaccinate itself against various challenges and surprises that follow from the many components of the vicious circle of the exceptionally rapid and partly uncontrollable urbanization, mounting informal sector, difficulties in getting revenues from taxes, split of the public sector-dominated society into more privatized system and growing environmental problems. Investments needed in the water sector will escalate from the already high level as urbanization goes on in very water scarce areas. So, the finances must be there. If there was a major investment boom to industries, then the water sector should be able to deal with these expenses. Otherwise, the possibilities to face the coming situations will be very tough.

Another source of potential challenges comes from political factors, both inside the countries and internationally. The past decades have seen stabile periods in many of the region's countries, but also conflicts and unpredictable changes in regimes and political-economic systems.

The MENA water sector documents and MDG analyses have so far been too immune to the consideration of such factors and their potential roles in shaping the Region's future water strategies. The MDGs comprise of 18 targets—most of which are related to the water sector.

The region as a whole is relatively well on track in meeting the water and sanitation target 10. Several countries are approaching the full water supply coverage. The low rural coverage is, however, a massive challenge in more than half of the region's countries, and the tendency in the improvement of

rural coverage is low or non-existing in very many countries. Several countries, including Mauritania, Oman, Libya, Yemen and the Sudan have large challenges in both urban and rural areas. Oman, Mauritania, Iraq, Morocco, Tunisia, Syria, Saudi Arabia, Yemen, Libya and the Sudan must work particularly hard in rural areas.

The low level of progress, in many cases even regression, with respect to several crucial MDGs must not be forgotten. The MENA region has serious problems in meeting the poverty goal (MDG 1), the education goal (MDG 2), the child mortality goal (MDG 4) and obviously also the maternal health goal (MDG 5). All these issues are profoundly interconnected to water, being either preconditions to water related development, or hampered by water related problems.

Conclusions

The links to the progress in other MDGs and targets as well as to economic development are crucial and should be appreciated, since they in many ways precondition the possible progress in the water and sanitation sector.

The following list includes some potentially very important future topics of water policies, which are underrepresented in much of the water sector debate today:

- From rural to urban. How the water sector could target the doubling urban population? The number of urban poor may grow still essentially faster. Will slum-upgrading policies become a crucial task for the MENA Region's water sector? Will the region be able to afford the use of most of its waters on agriculture with very low economic revenue?
- From natural resources to human resources reliance. How the extremely scarce freshwater of the region could be used to create more economic and social welfare than today? The modern industries and trade are still in their infancy in the MENA Countries. Scarce natural resources are becoming increasingly under pressure but the huge human potential should be tapped to develop the region. Basing the economy on human resources and modern industries instead of continuing on the exceptionally high reliance on natural resources, in which the region has a growing competitive disadvantage should be an issue of the water sector.
- From physical scarcity to environmental quality. Water quality and pollution abatement deserve definitely an increasing concern. Water quality and environmental protection of water resources have largely been given lower priority in terms of investments, without considering the associated environmental and health degradation costs. The MENA Region cannot afford for this to continue.
- From national to regional policies. The MENA Region will most likely be exposed to increasing trade and globalisation pressures. The water sector will be linked growingly to economic policies and the regional dimension is likely to grow. The future of transboundary water issues that are already very high on the region's political agenda is still unclear to predict, but may have the potential of resolution if more regionally focused water policies would see daylight.

Accordingly, the pressures and potential surprises to the water sector come largely from trends, tendencies and occurrences that are external to the water sector. The water sector must be prepared to tackle with exceptional development pressures in the MENA Region in coming few decades.

Lubricant of the Social and Economy Development in the Extreme Water Scarce Area – A Review of the Rainwater Harvesting in China

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Keywords: Rainwater harvesting, Water security, Poverty alleviation, Income generation, Intergated development

China is a water scarce country with available water resources per capita of only one fourth of the world average. Numerous water resources have been constructed to mitigate water shortage, for example the South to North Water Diversion Project. Among the water shortage areas, there are regions having extreme adverse water condition, where the surface and subsurface water are not available or are very difficult to explore. The typical example of the former is the northwest loess plateau in Gansu, Ningxia, Shaanxi and Qinghai Province (Autonomous Region). The latter situation happens in the rocky mountainous areas of the southwest China Guizhou, Yunnan, Guangxi and Sichuan Province where the rainfall is abundant but the rivers lie in the deep valley and the flow often seeps into the deep karst caves. Population staying on the high hilltop is very difficult to get water from the rivers or from the cave. The local population had no access to the safe water supply. In the normal year what they can get is the mud water collected from the runoff on the natural slope and/or the salty or bitter water fetched in the gullies. While in the dry year they had to rely on the relief water sent by the government's tanker. The water scarcity was the root cause of the common impoverished life of the population. The only industry is the primary subsistence agriculture for food production that can only survive people at a very low standard. Concentrated with the key impoverished counties at the state level, the areas became the focus regions for poverty alleviation in China. To change the fundamental situation for improving people's life and enhancing the agriculture production, some strategies have been adopted. Firstly the dry farming measures have been strengthened, including reforming the land (terracing, contour planting), cultivation measures (plough, tillage, mulching), breeding varieties that can better adapting to the timing of natural rain, etc. These measures proved to be effective but the effect is limited especially when the recurrent drought happens. The reason is that just to store rain in the soil cannot fully bridge the time gap between the crop water demand and the rain feed. People realize that only with artificial water supply to the crop, can the production be enhanced significantly. The problem is how to get the water? One way is to divert water from the neighboring basin. However, this option needs high input not only the initial cost but also the O&M cost that is unaffordable by the local users. The environmental problems brought about with this solution could be unsustainable in the future long run. Furthermore, many of the population with a widely scattered living pattern can hardly enjoy this kind of centralized project that can only distribute water to a belt zone. Since the late 1980's, the northwest Gansu and Ningxia first started adopting rainwater harvesting for the domestic water supply in the rural area and the supplemental irrigation. Then 15 provinces (autonomous regions) followed up. Many large scale projects have

been implemented. Among them the "1-2-1" Rainwater Catchment Project in Gansu, the "1-1-2" Water-saving irrigation Project in Inner MOngolia, the Water Cellar Irrigation Project in Ningxia, the "Thirsting for Water" Project in Guizhou, the "Sweet Dew" Project in Sichuan, etc that carried out in the recent 20 years have benefited hundreds of thousands even millions people. The RWH project was warmly welcomed by the rural inhabitants because it has solved the drinking problem that puzzled them for generations. Up to now, there have been 12 millions RWH systems being built, supplying 36 millions of people with stable and cheap source to meet their basic water needs and providing supplemental irrigation water for more than 2.7 million ha of land. Practices in the past decades show the RWH system not only can meet domestic water demand but also supply water for low-rate irrigation to enhance crop production. With water in the tank, farmers start to reform the production structure to meet the market need, thus generating income to alleviate poverty. Furthermore, the RWH project have resulted in promoting many sustainable practices, like the solar heater to boil water for sterilization, simplified greenhouse to generate income, the mini-catchment to concentrate rain, the method of irrigation during seeding, and the low cost traditional water cellar (Shuijiao). All these have made best use of the rainwater with high efficiency. To review the past RWH projects in China and make decision for the future development, the Ministry of Water Resources has decided to support a nation-wide evaluation of the RWH project to study the potential and restriction of this approach. The RWH has proved to be effective in meeting people's basic needs. However, China has set up goal to build an overall well-off and harmonic society that demands equity of the basic provision of a safe, healthy and prosperous life to the people. Is RWH feasible to meet the further demand in a sustainable way? Are there any restrictive factors in resources, fund, culture, etc for RWH to serve the goal? It is expected that evaluation of the RWH project can answer these questions and bring about a sustainable development of this approach.

Workshop 8: Managing Future Consumer Demands

Factors Affecting Adoption of Water Conservation Practices in the Household Sector in Riyadh City, Saudi Arabia

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Keywords: water, conservation, adoption, household, consumption

Water is considered one of the scarcest natural resources in the world. The UN reports indicated that more than 2.8 billions people in 48 countries are suffering from water shortage. Since 1990 the Kingdom of Saudi Arabia has been classified among the countries that are suffering from absolute water scarcity as it lacks rivers and lakes and the rainfall is very low and irregular. Currently Saudi Arabia is obtaining more than 50% of its water requirements from un-renewable underground water reservoir. Moreover, the water scarcity problem in Saudi Arabia is exacerbated by the high population growth rate. The per capita share from fresh water in Saudi Arabia has declined from 689 cubic meters in 1950 to 411 cubic meter at present, which represents only 4.7% of the per capita share from fresh water worldwide. Despite the critical situation of the water resources in Saudi Arabia, yet the per capita water consumption is considered relatively high and water is being inefficiently used in all sectors. For example in the agricultural sector, which consumes more than 75 percent of the total water consumption, more than 40 percent of the cultivated area is irrigated with traditional flooding irrigation which is very inefficient. In the household sector inefficient water use is reflected in lack of proper maintenance of the water pipelines and frequent leakages of large amount of water, lack of use of household water saving equipments such as water saving showers, flushing systems etc… The Ministry of Water and Electricity had conducted an experiment to measure the reduction in water consumption as a result of the use of water saving equipments and it concluded that the current water consumption could be reduced by at least 30 percent if all water users use water saving equipments.

In the past the government emphasis was on how to develop the water resources so as to meet the increasing demand and it was concerned with what is known as supply management of water resources with less emphasis on demand management. Recently, the authorities in charge of water resources realize that the emphasis on water supply management alone is not enough and the critical situation of the water resources in Saudi Arabia necessitates adoption of water saving and conservation practices and measures in all sectors (i.e. water demand management policies). Consequently, the Ministry of Electricity and Water had implemented three campaigns that aimed at increasing people level of awareness about the problem of water scarcity and the importance for its conservation through adoption of water saving practices and technology.

This study is intended to determine the adoption rate of water conservation practices in the household sector in Riyadh city and explore the factors affecting the adoption process. The study data were collected through personal interviews with the heads of 4000 randomly selected households in Riyadh city. Descriptive statistics and regression analysis were used to analyze the study data.

The study results indicated that 73.5% of the respondents have adopted some of the recommended water conservation practices. The results also revealed that about 70 percent of the respondents have neutral attitude towards the policies that aim at water saving, 15 percent have positive attitude and

15 percent have negative attitude. This suggests the need for more effort to increase people level of awareness about water problem and the need for taking more measures to rationalize its use. Moreover, it has been found that adoption of water conservation practices by the households is influenced by the family size, the number of hired drivers and workers (males and females) working for the family, the number of kitchens in the house, the number of dish washing machines in the house, the respondent's educational level, and the respondent's age. The study recommended the continuity of the Ministry of Water and Electricity campaign to raise the level of awareness of water users in the household sector about water scarcity problem so as to convince those who did not adopt water saving practices to do so.

Ecological Efficiency of Water Consumption in Asia and the Pacific

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1. Background of the topic

The Asian and Pacific Region extends over a total area of about 36 million km2 or 27 per cent of the world's land area (1997). With nearly 60 per cent of the world's population and over 60 per cent of the world's irrigated land, the Region is more densely populated and more intensively cultivated than any other Regions. Asia-Pacific is known for its highest potential renewable water resources in the world. However, in view of the large population, the region has the lowest potential water availability per capita.

The Economic and Social Survey of Asia and the Pacific-1997 pointed out that the ESCAP Region has made major strides in economic and social progress during the past half-century and per capita income growth has been much faster than elsewhere in the world. However, the overall impressive economic achievements together with the rapid growth in the population have put increasing pressure on the limited availability of freshwater resources in the Region. Furthermore, the developing countries in the region have generally made voluntary moves towards policy liberalization with the expectation that such liberalization would have a favourable long-term impact on their economies. Such policy liberalization is resulting in significant changes in economic structure in many countries, including substantial changes in farming systems, the result is often very different external environments for water planning and management agencies. Combined with rapidly mounting pressure on the freshwater resources, the result is increasing complexity in the management and development of freshwater resources in the Region.

2. Findings

The growth rates in water consumption in the region are similar in other regions, although at higher rates. In most of the subregions of Asia-Pacific, availability of water resources reduced significantly in average while fluctuation between years appeared to be higher.

Although the current per capita per year use of 400 m3 appears to be only 12 per cent of the per capita renewable resources of 3,360 m3 of the region, only a small portion of the renewable water resources can be tapped. Naturally, the per capita availability has been decreasing with the high growth of population.

Agriculture remains the most important sector in water consumption, but its growth rate appeared to slow down in recent years and has actually reduced in most subregions, with the highest reduction rates experienced in South Asia and North-East Asia. Irrigation in Asia has been one of the most important factors accounting for the increase of agricultural production since the early 1960s. Following the rapid growth of the 1960s and 1970s, the pace of expansion in irrigation slowed considerably, owing to a lack of suitable sites for reservoirs, and opposition to new construction by environmentalists and local farmers who feared displacement. Further increases in yields and production in the Region will therefore have to come primarily from increased efficiency and more rational use of water on existing irrigated land, and on rainfed agricultural land, rather than from expansion of irrigated areas. Currently, about 40 percent of Asia's cropland is irrigated and helps produce about 70 percent of its food.

In the developing countries of Asia, however, water demands in industry are rising rapidly, with increased concentrations of effluents being released. Direct investment from industrialized countries sometimes involves the establishment of polluting industries in developing Asian countries which have less strict controls on pollution than in similar establishments in the home country. Many industrial products require the use of large quantities of water for each unit of output, high rate of water withdrawals per unit output industries are over represented in the Region, and even controlling for type of industry, water inefficiency in production processes is high in the Region. Furthermore, there are great variations in water withdrawals among industries producing the same product. Therefore, there is considerable scope to increase the efficiency of water use by improving regulatory framework as well as by introducing market based instruments. Countries in the region have to improve their water consumption efficiency if they are to continue their much needed economic growth.

Domestic water use accounts for about 7 per cent of total withdrawals in the Region, however, the rapid growth of urban centres in many developing countries has put a severe strain on the availability of safe water in large cities. The lack of, or inadequate availability of, water has in turn become one of the limiting factors in socio-economic development – adequate supplies of potable water is an important indicator of the quality of life in urban areas.

The first priority is to improve efficiency in municipal water utilities, which often have volumes of unaccounted-for water amounting to up to 50 per cent of total water supplied in some of the largest cities of Asia. Some deferment or reduction in the urban water supply investment requirements could be achieved if the countries were able to improve the operating efficiency of the existing infrastructure, particularly in large cities. Considerable water savings may be achieved by reducing leakages and wasteful consumption practices. Leak detection programmes in Bangkok and Manila, for example, have led to a greatly decreased quantity of unaccounted-for water usage, allowing for the postponement of construction of new facilities. Water pricing, including effluent charges, is also an important instrument for stimulating efficient use of water in the household and at commercial establishments.

Demand side management of water utilization has not been practiced widely in the region. However, there is an increasing interest in improving efficiency of water utilization in many countries in the region, of which the case of Singapore is an outstanding example. There are also improvement in the management and investment in of water supply, such as in the case of Hong Kong, China. Similarly, progress has also been made on the improvement of water resources management such as improvement of river water quality.

3. Conclusions and recommendations

In all, there is an increase in the recognition of the importance of enhancing ecological efficiency of water consumption in many countries in the region. Efforts are being made to enhance the efficiency of water use in all sectors. Within this context, UNESCAP is currently promoting the Green Growth approach, which is focusing on improving the ecological quality of growth. Green Growth is now focusing on eco-tax reform, sustainable infrastructure, sustainable consumption patterns and greening of business.

In improving efficiency of water consumption, Asia Pacific region needs considerable investment for water infrastructure, demand side management and proper policy framework for integrated water resource management.

Changing Diets and Changing Water Demand

Author: **Dr. Charlotte de Fraiture** (Invited Speaker)
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What people eat and where and how that food is produced, determines to a large extent, how water for agriculture is being allocated and used. Yearly some 7100 billion cubic meter of water is evaporated by crops to meet global food demand, equivalent to more than 3000 litres per person per day. With a growing population, rising incomes and changes in diets, food demand may double by the year 2050. Without improvements in agricultural water productivity, the crop water consumption may go up to 11,500 km^3. This is a big concern given the growing water scarcity and related environmental problems in many parts of the world.

The Comprehensive Assessment of Water Management in Agriculture (CA)[1] proposes three broad pathways to reduce agricultural water use. First, changing the way water is used in crop production (i.e. maximizing the benefits per unit of water consumed in rainfed and irrigated agriculture). Second, changing where food is produced (i.e. trading agricultural produce from water abundant to water scarce areas). And thirdly, changing food demand patterns (i.e. influencing what people consume and reducing waste in the food chain). The three combined could more than offset all increases in agricultural water by 2050. This presentation focuses on impacts of changing food demand on water demand.

With rising incomes and urbanization, food habits change towards more nutritious and more diversified diets. Generally this leads to a shift in consumption patterns among cereal crops and away from cereals toward livestock products and high-value crops. For example in south-east Asia the per capita rice consumption peaked at around 120 kg per capita per year during the 1980s while per capita wheat consumption more than tripled between 1961 and 2002 and is still increasing. Meat consumption grew by a factor 7 from 6 to 40 kg per capita per year. Consumption of high-value crops –such as fruit, sugar and edible oils- also increased substantially.

Projections of future cereal demand range from 2800 to 3200 million tons by 2050, an increase of 55% to 80% from today. A large part of the projected increase will be fed to animals to meet future meat demand. Today some 650 million tons of grains –or nearly 40% of the global production- is fed to livestock. This may increase to 1100 million tons by 2050. But while the changes in diets as a result of income growth follow similar patterns, regional and cultural differences are pronounced –and are expected to remain so in the coming decades. For example per capita consumption in India remains relatively low, projected at 15 kg per capita per year by 2050, while China is projected to consume six times more.

What does this mean for water demand? While estimates on water requirements of crops and livestock products widely vary, most studies agree on the main points. Higher value crops such as sugar, vegetables and oil typically require more water than staple cereal crop. The production of meat and dairy products is more water intensive than vegetal products. For example, the quantity of water evaporated in the production of one kilogram of wheat varies between 500 and 4000 liters depending on climate, agricultural practices variety and length of growing season, and crop yields. But to produce a kilogram of meat takes anywhere between 5,000 to 20,000 liters per kilogram, mainly to

grow feed. The water requirements of livestock products highly depend on how the cattle are fed. Meat derived from grazing cattle tends to require less water per kilogram produced than from cattle in industrial feedlots.

Diets based on meat from grain-fed cattle may take two times more water than pure vegetarian ones. Thus, the potential to reduce pressure on water resources by changes in food consumption patterns seems high. For example, in the four scenarios used by the Millennium Ecosystem Assessment the meat consumption varies from 41 to 70 kilogram per person per year, depending on income, price, and public perceptions about health and environment. Under the high meat scenario global agricultural water consumption is 15% (or 950 km^3) higher than under the high vegetable scenario. Changes in diets are also desirable because of health reasons (malnutrition, obesity and spread of animal diseases). But measures and policies to change diets are notoriously difficult to implement and sometimes controversial. It is therefore not surprising that most of the discussion on how to reduce pressure on water resources have dealt with the producer rather than the consumer side of agricultural products.

Another pathway to reduce gross food –and therefore water- demand is minimizing losses that occur in the food chain. While estimates are sketchy and rather outdated, available evidence points to a staggering amount of agricultural produce lost in the food chain, i.e. from field to fork. There are several stages in the food chain where substantial losses occur. Losses in the field (between planting and harvest) may be as high as 20% to 40% of the potential harvest in developing countries due to pest and pathogens. Losses in processing, transport and storage are conservatively estimated between 10% and 15% in quantity terms, but could amount to 25%-50% of the total economic value because of reduced quality. Lastly, substantial losses occur during retail and consumption, due to discarding excess perishable products, product deterioration and food not consumed (so called plate waste). In the US around 25% of fresh fruit and vegetables are not consumed (by humans)[2] during retail and consumption. In developing countries this is estimated at around 10%.

These numbers suggest considerable inefficiencies in the food chain and therefore, large scope to reduce gross food and thus water demand. But this is by no means easy. There are many steps and many actors from field to fork, such as farmers, agricultural workers, truck drivers, shopkeepers, government officials and consumers. Individually they have little incentive to improve efficiency because the waste in each step is small and costs or efforts may outweigh benefits.

Thus far, the discussion on reducing water for food demand has been focused on the producer side. While this is indeed a promising pathway to reduce water use, the CA concludes that even in the most optimistic productivity scenario, increases in water demand under prevailing food demand projections are inevitable. It's time to pay attention to the consumer side as well.

1. A five year research program bringing together some 700 researchers, practitioners and policymakers. The summary of the synthesis report 'Water for Food, Water for Life' is available for download from http://www.iwmi.cgiar.org/assessment/index.htm

2. Part of it ends up in compost or animal feed

Dynamic System Engineering to Inform Policy in Managing Consumer Demands

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Keywords: System engineering, Dynamic simulation, Resource management, Environmental impact, Consumer impact

Fresh water is a limited resource in Australia's arid environment, and large parts of urban Australia have now been in drought for over a decade. New urban developments are increasingly striving to minimise consumption of potable water and energy (due to associated greenhouse gas emissions). These key drivers, along with the expense of importing potable water to the city fringe, are leading to cases of dual reticulation with a local, suburban scale sewage treatment plant. Recycled water is typically used for suburban irrigation and toilet flushing, however often struggles to meet irrigation demand during summer. Mandates on water efficiencies of consumer goods are rare; however a Water Efficient Labelling Scheme for white goods is well established.

A thorough investigation of the far-reaching impacts of consumer demands on the water cycle requires a large-scale system approach, rather than the traditional method of considering each subsystem separately. The system covers the entire water cycle throughout urban, industrial, irrigated, rural areas and the natural environment, from the rainfall and water harvesting, through runoff, consumption, wastewater, treatment, recycling/reuse and disposal. The interaction of the water cycle with the material and energy cycles also plays a central role in the system model. A dynamic, process-based system model is being developed in MATLAB/Simulink, which is used to simulate the effects on this large system of alternative consumer trends and policy measures. The following time-varying data is produced for each alternative scenario:

- Material flows: in water and other process materials (including N, PO43-, Cd2+, Zn2+, pesticides, hormones); and in infrastructure materials;
- Energy consumption: in system construction, operation, maintenance; and embodied energy in infrastructure material;
- Total environmental impact, calculated as per Life Cycle Assessment method;
- Economic cost; and
- Dynamic real-time measurement of environmental performance varying with economic cost/revenue.

This data provides a rigorous, scientific basis on which to compare alternative policy measures.

The use of dynamic system modelling to inform policy is illustrated using a simplified case study. Aurora is an innovative urban subdivision on the outskirts of Melbourne in south-eastern Australia. Aurora has dual reticulation to each of its 8500 houses and a local treatment plant, which recycles sewage to Class A for use in irrigation and toilet flushing. A small amount of potable water is imported to the site, which is expensive and energy-intensive due to the site's elevation. Accumulation of salt within the water recycling loop must be carefully managed to ensure salt remains low enough for

irrigation. In this simplified illustration, alternative policy measures are compared and evaluated on the basis of only four indicators:

- potable water import;
- total water flowrate;
- energy of operation; and
- salt (TDS).

New policy measures are considering a mandate on minimum efficiency of household washing machines, to minimise water and energy consumption. Two choices of washing machine are available:

- a top-loader; and
- a front-loader (which uses less water, energy and detergent).

The production of each machine type has a different water and energy footprint. Three sources of water for the washing machines at Aurora are considered:

- potable;
- recycled; and
- rain water (with potable top-up during drought).

The dynamic system model produces time-varying results for each of the four indicators, for each policy scenario. This data provides a solid basis for comparing policy measures. In this illustrative example, it seems obvious to mandate minimum efficiency standards in washing machines, due to the reduced water, energy and detergent consumption. However, in the case of Aurora this is not clear-cut. Installing washing machines which use less water leads to less recycled water (and associated reduced energy consumption), however more potable water must be imported to meet irrigation demand. Running washing machines on recycled water affects the salt balance (detergent is a major source of salt) as well as potable import, and running washing machines on rainwater is at the mercy of the unreliable local rainfall.

The introduction of policy measures to curb environmental impacts from consumption patterns may result in large changes, in many different parts of a complex system. Being fully informed of the magnitude and type of changes anticipated is essential for making decisions to benefit society. This dynamic, large-scale system engineering technique is unique in its ability to model system complexity and yet present results simply. The fundamental, process-based core of the dynamic model leads to wide flexibility in application. It is a powerful tool for policy formulation and environmental protection.

Water Demand Management for West Bank

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Keywords: West Bank, Demand Management, Demand Measures, Integrated Water Mangement, Groundwater

There are three primary groundwater basins underlying the West Bank (Eastern, Northeastern and Western Basins) as shown in map at end of this paper. Both the Northeastern and Western basins are shared between Israelis and Palestinians. The Palestinians have a limited access to the Northeastern Basin and strictly limited access to the Western Basin. In addition to the quantity of available water resources, the quality of water is emerging as a critical issue. Threats to ground water quality include disposal of untreated wastewater, increasing salinity due to agricultural activities and intrusion of native groundwater of poor quality.

Water demand management and conservation aims to conserve water, and as result improve quality and quantity by controlling demand. Effective policy requires an understanding of the worth of water and the actions surrounding its use. This involves the application of select incentives to promote the efficient and equitable use and allocation of water. Measures of water demand management and conservation are technological, behavioural, economic and institutional. Water demand management and conservation must combine appropriate measures while demonstrating a clear understanding of issues and constraints faced by the implementer and the constituents. Selected measures should address a broader water management strategy that clearly defines the human and financial costs, capacity of the institutions responsible and the resulting benefits of implementation.

As resolution to political conflict is pursued, it is clear that water resources management issues remain at the forefront because of the transboundary nature of the hydrologic regime. Demand Management appears to be one of the main alternatives to control high increase in the demand until there is a political solution to the water issues with the Israel. Palestinian Water Authority (PWA) is the responsible body on water supply and demand management. Due to the limited resources and control of the Israeli side on West Bank groundwater resources, the need for tough demand management policy becomes necessity. Through the period between 1995 to Year 2003, PWA has implemented concrete steps in this regard.

This paper lists the implemented demand management measures in West Bank which is politically unsettled and explores the demand management challenges facing both the Palestinians under Israelis occupation. The implemented polices and measures are;

- Furthering their role as the regulator of the water sector, PWA had developed an integrated water resources management plan for the West Bank which achieves consensus stakeholder objectives, quantifies resources and demand, confirms strategic principles for sector development and identifies specific actions for achieving stated objectives
- The goals, objectives, standards, police and priorities identified and clarified in the integrated water resources management plan provides elements of a water demand strategy in the West Bank. This strategy is driven by the following principles;

- The water tariffs was set to cover the real cost of water providing the political, economic and security situation are improving.
- Sustainable management of water resources. This goal is a key principle which implies management actions in the development of West Bank water sector. Specifically, aquifer sustainable yields must be well understood and aquifer management plans defining well abstraction scenarios must be developed and implemented
- Reduction of water losses in the water infrastructure. A target reduction of physical losses to 20 percent of the gross water was identified in the integrated management plan. This principle includes improved metering, leak detection and network rehabilitation.
- Supply should meet demand, this principle implies that either to enhance water supply or to reduce demand. Supply actions such as internal resource development and importation of external resources can be considered along with demand management actions
- Wastewater, Brackish Water, and Water Harvesting Management, this principle will help in reducing pressure on available resources for domestic water where the treated wastewater or brackish water or harvested water will be used for Irrigation or industrial uses. This implies construction of urban collection, treatment, distribution and reuse and harvesting systems.
- Financial management, all actions taken or to be taken in the water management must be financially viable. A target full cost recovery for water sector projects has been set as a target. However, in the short term it may only possible to recover O&M costs providing that the political, economic and security situation in the West Bank is improving. This principle implies development of a sound tariff structure and continued development of bulk and local service utilities
- Institutional, administrative and legislative development, this implies capacity building actions, development of service utilities, support regulations of the water sector.

- Even though the water resources management in the West Bank depends on the political situation, the water policy is still oriented to demand management.
- PWA has developed a visionary National Water Plan (which includes demand management plan) drafted and ratified a comprehensive National Water Law and organized a National Water Council charged with providing ongoing guidance to water sector development.
- Endorsement of privatization through start of several changes in the institutional and legal reforms in the Water Authority Mandate
- Update Water Legislation
- Implementation of Public Awareness programmers

Replacing Fresh Water by Reclaimed Wastewater for Irrigation in Gaza, Palestine – Possibilities and Constraints

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Keywords: Fresh water, Reclaimed wastewater, Water deficit, SAT, Water demand

As a policy in the water resources management in Gaza, there is attitude to get other non conventional water resources such as seawater desalination and wastewater reuse through artificial recharge to enrich groundwater and irrigating crops directly from treated effluent in order to minimize the agricultural water demand which is almost constant since the agricultural areas are limited or even decreased. However, the domestic demand is increasing due to rapid growth of population. This of course increases the produced wastewater, and consequently the treated effluent becomes an important resource of water that improves the water balance in the region. The reuse of this effluent could be accomplished by two ways, either by direct irrigation to farms and/or through artificial recharge to groundwater and then pumped to irrigate farms (reclaimed wastewater). Different crop types are tolerable for different constituents of the reused wastewater. This has been practiced in Gaza wastewater treatment plant, where about 10,000 m^3 of effluent has been pumped to infiltration basins designed for this purpose to the east of the treatment plant. The infiltration basins were operated through wetting of one day and drying for two days.

Through monitoring of groundwater level in the surrounding water wells, an increase in the water levels has been observed and reached 0.6 meters in one well. In terms of quality, nitrate level has been decreased in the neighboring monitored wells explaining the efficiency of Soil Aquifer Treatment (SAT) in denitrification process, where most of the water wells in the Gaza Strip suffer from high nitrate levels in their water. However, Boron which is toxic to plants slightly increased in some monitored wells. In one well, Boron increased from 0.232 mg/l to 0.482 mg/l.

The increasing water demand and the fixed water supply in Palestine, in general and in the Gaza Strip, in particular led to depletion of the water systems in both aspects, quantitative and qualitative. The aquifer in the coastal region (Gaza Strip) suffers from high pressure by domestic and agricultural needs. According to CAMP study, the overall water demand is 173 millions m^3 (Mm^3) per year, where the overall supply is only 122 (Mm^3) per year. This means that there is a deficit of about 50 (Mm^3) every year. This deficit led to continuous declination of groundwater level and deterioration of groundwater quality. So, an urgent need for new water resources is needed.

Reuse of wastewater is a strategic option together with seawater desalination forming the non-conventional water resources, where each will contribute of about 60 Mm^3 in the year 2020. Part of reclaimed wastewater will be delivered to the farm directly from the treatment plant, and the remaining part will be infiltrated to the groundwater system through spread basins to undergo SAT processes. In the design of each treatment plant, Infiltration of the treated effluents takes the first priority before it is decided to be discharged to the sea or Wadis. So, there is an urgent need in Gaza to look for new non conventional water resources such as reuse of reclaimed wastewater, which has been adopted by the Water Authority to be used, where only minimal amount of fresh water will be used for irrigation.

To achieve this, effluent should be treated well in the treatment plant so that its constituents do not exceed the standards adopted by the Water Authority. There are many possibilities and constraints of implementing large scale projects that absorb all amounts of treated wastewater. Enough treatment is a must before applying the effluent either for direct irrigation or pumping it to designed spread infiltration basins. Accordingly, a decision support system (DSS) for wastewater treatment and reuse includes all these things is essential for decision-makers. Monitoring program including location and frequency has to be set before implementation of these projects to help in early prediction of pollution.

Learning from the Extreme and Moderate Food Consumption Patterns – Experiences from Sweden, Japan, and the United States of America

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Keywords: the food consumption pattern, water footprint, seawater footprint, public awareness, the sustainable development in

This presentation primarily analyses the food consumption patterns in the developed nations and their impacts on the hydrosphere such as freshwater and marine environment. Particularly, the focus is placed on the Swedish, Japanese, and American food consumption patterns because Japan and the United Stated have the extreme food consumption patterns, while Sweden has the moderate one among the developed nations. Paradoxically, the results of this analysis produce the inputs to the developing countries which would face the same kinds of problems if their expectation to be satisfied with the abundant foods was accomplished.

The key findings are threefold with respect to the Japanese, American, and Swedish food consumption patterns, respectively. (1) The first finding is that the Japanese food consumption pattern discovers the currently invisible dimension of the impact of the food consumption pattern. The average amount of fishes and seafood taken by the Japanese in 2003 was 66,18kg/cap/year, while 33.63kg/cap/year by Sweden and 21.13kg/cap/year by the United States of America, which indicates that the Japanese food consumption pattern has been deteriorating not freshwater, but either the quality of seawater. One example is the eutrophication problem in the Gulf of Thailand and the problem is caused in the two ways, resulting from the shrimp farming. One is the indirect way due to the destruction of mangroves in order to make ponds for the shrimp farming. Mangroves have a capacity to absorb polluting nutrients, and 4.8 m^2 of mangroves is required to absorb extra Phosphorous when farmers try to make 1 m^2 of shrimp farm. Similarly, 1.6 m^2 of mangroves is required to absorb Nitrogen. In the Gulf of Thailand, however, mangroves have been disappearing at the fast rate. From 1975 to 1991, 50 % of mangroves disappeared. Since the loss of mangrove means the loss of capacity to absorb the extra nutrients, the loss of mangroves causes eutrophication indirectly. The other way that causes eutrophication in the Gulf of Thailand is the direct inputs of nutrients. In shrimp farming, artificial feeds provide most of Nitrogen, Phosphorous, and organic matters inputs to the pond systems. Only 17 % of the total amount of feeds is converted into shrimp. Some of the rest is consumed by phytoplankton and the increase of phytoplankton by this consumption causes eutrophication. Thailand's market share of shrimps by Japanese imports has been almost 10 % since 1998. From this example, it is clear how the Japanese food consumption patterns negatively affect the quality of seawater. (2) The second key finding is concerning American food consumption pattern; since American food consumption pattern has been extreme in that the American has been heavily dependent on the meats. The average amount of meats by the American annually in 2003 was 123.42 kg, while 76.87kg by the Swedish and 43.45 by the Japanese, and meats production is one of the most water consumptive products within the livestock products. On average beef needs 15497m^3/ton freshwater, whereas pork requires 4856m^3/ton and chicken meat needs 3918m^3/ton respectively. Therefore, the American meats oriented food consumption pattern has been too much using freshwater. As a result, the average water

footprint of the American 2483 m^3/capita/year, while that of the Swedish is 1621 m^3/capita/year. As mentioned above, since the Japanese food consumption is fish and seafood oriented, the average water footprint of the Japanese is low, which is 1153 m^3/capita/year and lower than the world average 1243 m^3/cap/year. (3) Third key finding is regarding the Swedish food consumption pattern; as we can see from the data above, the Swedish food consumption pattern is well balanced between meats and fish or seafood extremes, so that it has been going on the midway. Therefore, it is induced that the Swedish food consumption pattern has had less negative effects on the freshwater, and the quality of seawater or the ocean ecosystem than the Japanese and American food consumption pattern do.

Based on the findings above, this paper includes the three practical recommendations. First is that it is necessary for water footprint and freshwater scientist to notice that there is not only "freshwater footprint", but also "seawater footprint", as the Japanese food consumption pattern shows, in order to analyze the relation between food consumption pattern and impacts on the hydrosphere. Second is, accordingly, that as the extreme food consumption patterns by Japan and the United States and the following impacts on the freshwater, seawater, and ocean ecosystem implicate, it is the crucial task to increase public awareness for the purpose of keeping the balance between the fish, seafood oriented and meats oriented foods consumption patterns. Finally, but most importantly, it is important to emphasize the necessity to develop the linkage between Sustainable Development indicators developed by UNCSD and OECD. Both of the organizations acknowledge that it is the urgent task to develop the linkages among these indicators. We might consider the linkage between "freshwater" and "secure food supply" indicators, or the linkage between "coastal zone" or "marine environment" and "secure food supply" indicators. These linkages between the indicators enable us to address the two recommendations above more easily and therefore enable us to manage the future consumer demand.

A Need for Efficient Water Management in The Deduru Oya Basin in Sri Lanka – A Case Study Based on Minimum Daily Water Requirements

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Keywords: Water Management, Sri Lanka, Deduru Oya, Daily and Household Consumptio, TCS

Sri Lanka is considered as an island blessed with enough water resources to carry out its routine water related activities. However, the dry zone areas face with spatial and temporal water shortages. The island has a central mass of highlands and mountains surrounded by rock knob bearing rolling area of low lands. The annual rain fall vary from very small amounts in dry zone areas up to 5000mm in the wet hilly regions. Based on average annual seasonal rainfalls the country has been divided in to the "dry zone" with rainfall less than 1250 mm isoheyt and the "wet zone" above it. Considering global standards, provided that this rainfall could be stored and resulted runoff could be regulated, the rainfall received is sufficient enough for yearly domestic and considerable agricultural requirements. However, recent investigations pointed out that the water stress is becoming a problem in Sri Lanka which leads future community facing with significant water shortages. To test this situation a survey was conducted in the Deduru Oya basin of Sri Lanka in order to assess daily minimum domestic water requirements for drinking, cooking, washing, toilets and bathing of communities living in rural and urban households.

About 250 families from Hedeniya, Aladeniya, Rakogama and Weerakodiyana villages and from Chilaw town were randomly selected for the survey. Mean daily consumptions of water for drinking, cooking, washing, toilets and bathing were estimated and given in the following table.

Name	Drinking (l/day)	Cooking (l/day)	Washing (l/day)	Toilets (l/day)	Bathing (l/day)	Total (l/day)
Chilaw	2.3	3.4	10.2	6.8	77.1	99.8
Weerakodiyana	3.5	4.2	11.9	7.0	62.8	89.4
Rakogama	2.6	3.7	5.6	5.3	87.4	104.6
Hedeniya	3.6	5.2	11.6	9.7	126.2	156.3
Aladeniya	2.7	4.2	9.1	6.5	86.7	109.2
Average	3.0	4.1	9.7	7.0	88.0	111.8

The results show personnel needs vary from 89.4 l/day in Weerakodiyana in the dry zone to 156.3 l/day in Hedeniya in the wet zone. In addition the results indicate that to achieve a minimum acceptable quality of life a person in the Deduru Oya basin should be provided with 111.8 l/day.

The household water requirement irrespective of the mebers has been examined for the entire sample of 250 contributors. The block criteria based on >250, 251-500, 501-750, 751-1000 and <1000 l/day have been used. The average overall water consumption per household has been summarized and observed that 45% of contributors use water in the range of 251-500 l per day. However the average water consumption based on coded data analysis for the entire basin is 455 l per day while the standard deviation is 239 l per day. These numerical figures could be used to regulate and control water usages in households.

It is observed that more than 75 % of the total domestic requirements are mainly used as a supplement for the bathing purposes. However, in the ancient periods water was obtained through common wells, irrigation tanks and diversion canals for bathing purposes. Since these water bodies are continuously replenished or recharged with reused water the bathing water requirement could be considerably supplemented leading to a low water stress in the ancient period. These point sources used for bathing in the dry zone of Sri Lanka were continuously recharged by a series of reservoirs lined up in a cascaded system along the lowland drainage basins. This sequence of tanks has been identified as a Tank Cascade System (TCS). In addition the diversion of Major River flows to supply water for flood irrigation of paddy lands can also recharged surrounding wells. These ancient Tank Cascade Systems (TCS) and diversion based irrigation systems were not only supply water for the irrigation but also for domestic requirements through wells, springs and ponds as discussed above. Even during the dry season the communities were still able to get the daily bathing provisions by ground water associated with the tank bed. However current more modern society is depending upon public water supply programs with distributor structures. This in turn hindered the reusability of water for bathing; instead one could see point discharge of water at household in an unproductive manner. Unless a sustainable alternative sociotechnical mechanism is introduced such as common bathing places, water pools, or recreation water worlds in a mass scales the overall requirements as shown in the above table may be in jeopardy due to current water stress. A basin wise efficient socially driven water management plan is therefore necessary to cope up with the future water requirements in the dry zones.

Compliance to Food Safety Standards – a Stick and Carrot: The Case of Nile Perch Fishery in Tanzania

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Keywords: Nile perch, Export supply chain, Virtual water trade, Consumer demands, Food safety standards

Presentation of the project/topic and analysis of the issues

Over the past two decades, the share of virtual water trade in traditional tropical products for developing countries has been declining while that of non-traditional products has increased. This shift presents new possibilities for these countries to increase export revenues from virtual water trade in non-traditional foods. But, it also poses new challenges upon these countries to meet consumer demands in international markets. Consumers in developed countries have become more concerned about the food they consume and for the private sector food safety has become a competitive variable in commercial strategies. Past experiences with Bovine Spongiform Encephalopathy (BSE), Foot and Mouth Disease (FMD) and most recently, Avian Influenza, together with discussions of genetically modified foods and antibiotic use, have increased consumers' awareness of possible threats through food consumption. Consequently, governments in industrialized countries have laid down stringent food safety standards to safeguard consumers. This trend is likely to continue unabated in the future, with the result that over time food safety standards will become increasingly demanding. This implies that, access of developing countries like Tanzania to food export markets will depend more and more on their capacity to upgrade their standards conformity levels.

Non-compliance to food safety standards by developing countries will ultimately lead to lost export opportunities as it happened for the Nile perch (Lates niloticus) exports to the European Union from the riparian states of lake Victoria over the period 1998 – 1999. This can have significant negative impacts both at macro and micro levels. At the macro level, decline in Nile perch exports may lead to decline in foreign exchange and government revenue. At the micro level, decline in export demand may lead to reduction in landed price to fishermen and boat owners as well as a fall in income of the actors at the beginning and intermediate stages of the fish export supply chain, including the local fishing communities and other people who depend on Nile perch for their livelihoods.

But, compliance to food safety standards involves non-trivial costs, including the costs of upgrading production systems, processing and storage equipment, and quality control. It may also involve big investments, technological skills and a well-functioning institutional framework. All these add up to high costs of compliance. Conversely, compliance to food safety standards may also help achieving a lean and clean production and modify resource pressure significantly. It may work as a catalyst to modernization and contribute to the creation of competitive advantages; resulting in increases of both export volume and unit value. Yet, little is known about the magnitude and distributional effects of the costs and benefits of compliance to safety requirements in this trade. This information is key to the process of formulating effective trade policies and regulations. Based on this ground, a study was conducted in the Tanzanian side of Lake Victoria (in Mwanza and Mara regions) between March and August 2006 to evaluate the economic effects of food safety standards on the livelihoods of actors in

the artisanal Nile perch export supply chain. The economic effects were evaluated using the "Change in Net Income Approach." The costs and benefits of compliance to safety standard were imputed as equal to the residual values under the "with compliance" vis-à-vis "without compliance" scenarios. The study constituted part of the on-going research activities under the Fish Sub-project of the Standards and Agro-food Exports (SAFE) for Developing Countries programme, implemented by the Danish Institute for International Studies (DIIS) and Sokoine University of Agriculture (SUA).

Presentation of the results/findings

The results of analysis showed that the number of fishers, fishing boats and other fishing gears, particularly those targeting Nile perch, has increased significantly over the past five years. Fish handling facilities have also improved for most Nile perch landing sites/beaches. The profits accrued from Nile perch fishery are the major driver for these changes. The costs and benefit analysis in this study showed that compliance to food safety standards is both expensive and beneficial. Actors in the Nile perch export supply chain obtained the highest gross revenues and net returns. They also incurred the highest operating costs when compared to those in other fisheries. For fishers/crews the average costs and benefits of compliance to food safety standards averaged at about Tshs 32,470 and 12,430/week/person respectively. For boat owners the costs and benefits averaged at Tshs 82,800 and 66,500/week/owner respectively.

Conclusions and recommendations

Production of lean and clean Nile perch fillets for export markets is expensive but beneficial. Besides the high costs of compliance to safety standards, Nile perch fishery has benefited many people in Tanzania - both artisanal and industrial based actors. But ensuring sustenance of these benefits seems to be one of the major challenges that face the industry. This requires that the capacity of the country to upgrade her standards conformity levels is enhanced and a mechanism is put in place to strike a balance between harvesting and growth of the fishery resources. This in turn calls for a need to strengthen the link between fishery research and policy-making (i.e. fishery resource management and harvesting decisions should be informed by empirical findings).

Food and Water – Ecosystem Services for a Nourished World

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Keywords: future study, integrated modelling, ecosystem services, human demand, green and blue water

The Alliance for Global Sustainability (AGS) is a coalition of leading universities comprised of Chalmers University of Technology, the Massachusetts Institute of Technology, the University of Tokyo and the Swiss Federal Institute of Technology. The AGS provide a platform for transdisciplin-ary research for sustainability. The safe, secure and robust provision of ecosystem services such as food and water are key issues that need to be addressed using this competence. A specific program has therefore been set up within the AGS in an attempt to identify feasible pathways into the near-term future, while maintaining a long-term perspective. The concept of "pathways" is used for approaching the complex and multidimensional problems of the future studies. This paper briefly describes the food and water program of the AGS, some of its key questions and explores some aspects of the pathways concept and its implications when applied to the challenge of providing food and water to a growing world population. Ensuring the secure supply of food and water is a pre-requisite for human well-being. Our program will identify development pathways for the socio-tech-nical systems which aim for a nourished world interlinked to the provisioning ecosystems. The pro-gram will provide a unique outlook, complementing the OECD/FAO work, for food and water in the 5 to 15 year near-term future, while considering long-term drivers as climate change, population growth and changes in demand caused by economic growth giving larger population groups and increased purchasing power. The heart of the program will be data and knowledge bases. The data and knowledge bases will reflect requirements of the AGS integrated model system, which consist of linked biophy-sical, economic, geographic and institutional models. These models of the complex and dynamic nature of food and water systems will provide a foundation for descriptions of the near term future, a future which we see as social-technical system development. Development paths will be tracked by combining stakeholder dialogue with the modelling results to provide a combined actor-modelling procedure. The procedure will be integrated into a form suitable for reflecting on possible interventions into socio-technical systems. Program supporting projects have been identified in two areas; i) security and human well-being, and ii) ecosystem services. The first area, security and human well-being, includes supporting projects within the risk management of food, safe, secure and sustainable food production, with a focus on Asia. The second area of ecosystem services includes supporting projects such as strategies to decrease land use, diets related to land-use requirements, innovation and decreased resource pressure for the water sector and the consumer perspective. The first set of key questions is related to a study of the links between human biological basic needs, socially and culturally determined demands and the multi-dimensionality of the ecosystem services, which through an agricultural production system (land, labour, capital, competence, crops, crop protection, trade, processing), is necessary for a fulfilment of the human demands. Another set of key questions is related to an assessment of the capacities of the ecosystem services to provide the demanded food and water, while a third set of questions is dealing with the ways to match human demands and available ecosystem services.

"Pathways" is here a metaphor. They are found in the landscape at particular positions due to irregularities and they are related to the passability of the terrain. The ease of following a pathway, compared

to traversing pathless land is a conspicuous aspect of pathways. It is obvious that there are places in the landscape where we want to be, therefore human preferences matters in the interaction between humans and nature. Within academic disciplines the concept of "pathways" has been approached in history (Mahoney 2000), and in sociology of technology (Hughes 1983; Bijker et al. 1987). In all instances the use of the metaphor tells us that it is easier to follow a path and that we cannot chose another point of departure than from where we are right now. "Pathways" is a way to approach the making of scenarios (Swart et al. 2004). There are many possible goals and therefore many possible pathways into the future. Sustainability science (Kates et al 2000) must therefore be a post-normal science (Funtowicz and Ravetz 1993) accepting multiple legitimate and parallel perspectives which poses challenges for future studies and emphasize the boundary work (Cash et al. 2003) when communicating between science and politics. The findings of the MA (Millennium Ecosystem Assessment 2005) indicate a need for transition. "Pathways" is about change and learning processes which is related to resilience and adaptive governance (Folke et al. 2005; Folke 2006). This will then rise some questions - who, what and how to learn? Who need to learn? It is easy to point out influential and powerful politicians, CEOs, journalists and academics - but also the ordinary citizen does possess power as consumer or voter. Restrictions on learning are seldom pointed out as a problem but the challenges ahead are probably also a matter of how to handle societal learning processes. What need to be learnt? Restrictions and possibilities together with ways to handle distribution and conflicts are high on the agenda and discovering and quantifying relationships between different sectors and perspectives are important challenges for "pathways" research. We think that integrated mediated modelling using participative scenario-making processes that open up the boundary work is what the pathways-concept should be about.

Turning the Tide on Water Waste: How Seattle Created a Popular Icon to Change Consumer Behavior

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Keywords: demand management, social marketing, customer values, conservation potential, behavior maintenance

The Imperative

American water consumers have an expectation of unlimited supply at modest cost. In a drought, they blame government and resent restrictions on use. The Seattle metropolitan area, with a population of three million, has a rainy climate, which makes people even more careless about water use.

In the early 1990s, two years of drought and a steep decline in river fisheries resources brought a hard dose of reality to the region. In fact, the local climate pattern of rainless summers, coupled with consumer expectations of well-watered lawns, was straining water supplies during the very months when river flow is essential to migrating fish.

Consumer Values

Political leaders and water managers recognized that simply criticizing wasteful behavior is futile. New values needed to be substituted, appealing to efficiency and an environmental ethic. Seattle implemented a social marketing campaign that celebrated the uniqueness of Pacific Northwest salmon runs and made "saving salmon" a motivator for conserving water.

It's been many decades since salmon fishing was a core element of the Seattle economy, and the city's newcomers are more likely to work in software or biotech or aeronautics. Still, the remnant runs of king salmon through the city's rivers tell a story of a heroic journey that has iconic power. Many regions facing water stress have similar potential aquatic or cultural icons.

Analysis and Market Transformation

Seattle undertook an econometric analysis of the potential for water efficiency. The Conservation Potential Assessment(CPA)identified 30 mgd of cost effective water savings to be achieved over the first ten years, and more by 2030. The result is a sequence of demand management measures – rebates for purchase of low-water-use appliances, subsidies for change-out of HVAC equipment in commercial buildings, industrial water audits and process retrofits, and the like. Each program is supported by publicity, praising the participants for "saving salmon."

Salmon-Friendly Tariffs

Water metering is now universal in the Seattle metropolitan area, and tiered rates are common in most service districts. In recognition of the strain on water supplies in the summer, Seattle set its June to September tariffs (for usage beyond lifeline amounts) significantly higher, and in El Nino years a punitive "third tier" rate is imposed on particularly wasteful customers. Politically, that high tariff is only possible because people connect it with "saving salmon." The media enjoy skewering well-known residents whose names appear on the third-tier "water hog" list.

Brown Lawns Save Salmon

The CPA identified summer landscape irrigation as Seattle's most wasteful water use. We decided to harness the creativity and market motivation of the region's landscape/nursery industry. How could they make money – and make beautiful gardens – using less summer water? The "salmon-friendly garden" theme is now sold though garden shows, DIY stores, garden advice columns and talk shows. Seattle hasn't needed to impose summer hosepipe bans because radio and TV weathercasters assist in giving water-saving advice to the public during dry periods to help "save salmon." For some consumers, brown lawns in summer are a badge of moral superiority, while others have substituted drought-tolerant plantings.

Mutually-Reinforcing Strategies

About a third of Seattle's water savings come from plumbing code efficiency improvements, a third from price signals, and a third from targeted conservation programs. The programs typically involve subsidies for water-saving hardware upgrades plus publicity to secure participation. The CPA assesses the levels of subsidy and publicity that will be required to produce target levels of water savings. For participating consumers, the reward is long-term savings on their water bills, as well as helping to save salmon.

Behavior Maintenance

Responsible consumer behavior is a pivotal demand-side asset. Maintaining those behaviors is as important as leak repair. For the long term, "behavior maintenance" requires well-crafted and flexible strategies. Consumer surveys and focused, well-funded media campaigns are now a part of every year's budget. Educational materials used in primary schools, "Salmon in the Classroom," bring the water-efficiency message home to every family. Annual community stream-restoration campaigns, enlisting scores of volunteers, broaden the ranks of consumers who understand the link between water conservation and "saving salmon."

Outcomes

The appeal to "save salmon" has reduced consumer water demand in Seattle. Total system water use is down 25% from highs in the 1980s. The program has leveled out the impact of growth on the city's water supplies and aquatic resources, bringing total consumption down to 1975 levels (120 mgd). Further, because programmatic savings are largely technology-based, savings are highly reliable. Looking forward, Seattle avoids developing a new water resource and has flexibility to adapt to climate change, while salmon have the water they need in Seattle's rivers.

Managing consumer demand for water in Jammu city of India: challenges and strategies

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Keywords: Managing Consumer Demand, Jammu City, Challenges, Opportunities, SWOT Analysis

The fresh water has a specific role to play in human health and development. It is a scarce resource, shared by all yet unequally distributed, being wastefully used by some but in too short supply for others, essential for life , when tainted, a source of many fatal diseases. Understanding the extent and causes of water problems is a pre-requite to solving them. The Jammu city, with a population of 1.12 million, is the second most populated city of the Jammu and Kashmir state of India. Despite considerable efforts made by the authorities for the supply of water for drinking and other domestic uses, huge gap remains between the supply and demand. According to a conservative estimate, the present daily demand of water in the city is about 325 million liters, against which the supply is around 240 million liters. The supply is further depleted by 15 to 25% due to distribution pipe leakages and dilapidated infrastructure. Of the total water supply, about 27.7% is through surface water and the rest from sub-surface i.e. from tube wells. The demand for water considerably increases during the summers when the temperature goes up to 45 0C. The water supply is further constrained by erratic electric supply and its low voltage as both surface and sub-surface water can only be supplied after lifting by pumps from the river Tawi and tube wells, respectively.

A SWOT (strengths, weaknesses, opportunities and threats) analysis of water demand and supply carried-out for Jammu city after detailed studies showed that weaknesses and threats outnumber the strengths and opportunities. The strengths are the availability of sufficient surface water from the Tawi river which is perennial in nature and relatively low supply costs. The weaknesses are depletion in groundwater recharge due to reduction in annual rainfall, erratic electric supply for lifting, spatial and temporal variation in ground water, consumer behaviour, dilapidated infrastructure, political instability, financial constraints to take up new projects, management constraints, faulty distribution system etc., while the threats are; climate change, mushrooming of unauthorized colonies, increase in migrants from other states of the country and from within the state, fast population growth rate, consumer attitude, extremely low pricing of water for judicious management of supply system and poor quality water. However, some solace can be found through available opportunities like sufficient surface water, reuse of waste water, enhancement in water pricing, rainwater harvesting, curbing water wastage, social awareness, judicious exploitation of groundwater, new government schemes and investments etc.

The main problem of facing the harmonious development and management of water supply in Jammu, apart from economic constraints, is the paucity of reliable data and lack of human and institutional capacity necessary for confronting the complex interactions of hydrological cycle with the societal needs, consumer behaviour, government policies, water consumption pattern and environment. There is justifiable concern over the adequacy of water supplies. Most opportunities for increasing water supplies in Jammu are financially and environmentally costly and current uses are depleting and contaminating the water supplies. There is need for optimization of water allocation under physical

and socio-economic constraints. The role of water as socio-economic and life -sustaining commodity should be reflected in demand management and implemented through water conservation and reuse, resource assessment and financial instruments. The delegation of water demand management to the appropriate level require educating and training water management staff at different levels ensuring that women participate equally. It is necessary to promote dynamic, interactive and multi-sectoral approaches to water resources management and, identification and protection of potential sources of fresh water supply, that integrates technological, socio-economic, environmental and human health considerations. Safe water supplies and environmental sanitation are the vital issues to be considered in future water supplies in Jammu. The reuse of waste water is necessary and the technologies now exist to upgrade this to meet the standards for domestic use and, so waste water recycling should be important source of water in future. If resistance from the consumers to use recycled water for drinking is there, it can be used for other domestic requirements. This would require treatment facilities for domestic sewage and industrial effluents outside the city.

The Asian Development Bank has provided a loan of Rupees 2200 million (US$ 45 million approx.) for improvement and upgradation of water generation and supply system in Jammu city which is likely to improve infrastructure, enhance water generation and reduce the deficit gap in water supply. Several other small and medium schemes have been undertaken by the state government to improve water supply in the city. But, above all, there is strong need to improve the consumer behaviour by making them aware of the need to judiciously use this scarce commodity. Equitable distribution of domestic water is necessary as, at present, some colonies in the city are getting enough water, even to waste, while others are reeling under its short supply.

The International Demand Management Framework – How Integrated Resource Planning Can Lead the Way in Determining and Curbing Demand

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Keywords: demand management, urban water, integrated resource planning, end use analysis, international

Presentation of the project/topic and analysis of the issues

Global population expansion in the coming decades will occur mostly in the developing world's urban areas. Such expansion will result in increasing demand on already pressured or non-existent water and sanitation services. This growth in water demand will vary from city to city and country to country predominantly due to varying demographic (population, housing type, occupancy ratios) and climatic influences but also as different water using technologies (i.e. toilets and washing machines) and consumer behaviours are adopted over time. Only by carefully considering how demographics, climate, technology and behaviour influence water demand forecasting for each region can consumer demand be carefully managed to ensure the community lives within the sustainable boundaries of the water resources available.

This paper presents an emerging international framework that can assist those planning and managing urban water systems on how to forecast water demand more accurately using end use analysis (EUA-1) and then develop a region specific strategy on how to manage that demand through both technology and behavioural measures and various instruments (economic, regulatory and educational). This framework can be applied at different scales within urban regions, for various climatic situations and to jurisdictions in developing and developed countries alike.

This framework aims to transfer a proven methodology "integrated resource planning" that has been applied in Australia and a number of other countries (Howe and White 2003) to other regions, particularly in the developing world and emerging economies. It is has been developed into a comprehensive set of guidelines in Australia and is now being developed for an international audience through the International Water Association (IWA) Specialist Group – 'Efficient Operation and Management' as Task Force 7 . The study, the International Demand Management Framework (IDMF-2) will enable urban water supply agencies and water resource managers to focus on service needs of water demand and how they might be reduced through demand management rather than supply-side options in isolation. It will also help agencies improve asset management and planning, reduce capital and operating costs of providing water and sanitation services and make more informed decisions based on the economic, social and environmental benefits of water service options from a whole of society perspective. Given the anticipated high costs of achieving the Millennium Development Goals (MDGs), these issues will become increasingly important in the developing country context.

Presentation of results/findings

This paper will show how integrated resource planning, which is the foundation of the IDMF process, has been extensively used in Australia and other countries, including in the Middle East and Asia.

It will also demonstrate through case study examples some of the significant benefits this approach has been able to produce in such countries in actual water savings. The paper will detail the process developed as part of the IWA Task Force No.7 and its potential application in other regions, including developing and emerging economies.

Conclusions and Recommendations

Given the significant increased demand for water and sanitation services expected in urban areas in developing countries and emerging economies in the coming decades, it will be essential to know how much water is being used now at a detailed sector and end use level and how this can be used to project water demand more accurately in future. The use of a flexible, integrated and cost-effective process for forecasting water demand and determining how to provide water services with demand management taking a central role will be essential if the MDGs are to be achieved. Water demand management still holds enormous potential. It provides 'new' water services at a lower cost to society compared to new freshwater supplies or reuse options. Further, this water service is provided at a lower resource use intensity i.e. it saves materials and energy required for treatment, distribution, use and collection (Mitchell et al, 2004). Today there are numerous proven examples of the application of demand management using an integrated resource planning approach. However there is still potential to improve the process in existing regions and extend it to new areas, particularly in the developing world. For these reasons, the development of the comprehensive set of guidelines, the IDMF, which is being developed iteratively by the IWA through extensive consultation with experts and potential users will play a vital role in improving water resource management over the coming years.

1. EUA involves the disaggregation of water demand into customer sectors and further into individual end uses (e.g. toilets, showers)

2. Refer to - http://www.ita.upv.es/iwaom/datosbda/Descargas/15.pdf

Workshop 9: Making Governance Systems Effective

Market-Based Water Governance in Transboundary River Basins: The Next Step?

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Keywords: Market-based water governance, Transboundary river basin, Water rights, Murray Darling River Basin, Colorado River Basin

In the discussions on water governance systems, economic instruments are increasingly recognized as essential tools. Although there are various policy options for taking into account the economic value of water resources, tradable water rights and water markets are ever more put forward as a model for water reform worldwide. What are the challenges for the establishment of market-based water governance in river basin shared by different jurisdictions? What types of inter-state water market systems have been developed and how effective are they?

This paper has a double objective. It will first look at the experiences of two Federal States in developing inter-state water market among their different jurisdictional entities. It will analyse the negotiations among the different jurisdictions and reform processes that were necessary for the introduction of market mechanisms. The paper will identify the different stages of the transition toward this new type of water governance systems. A first attempt to evaluate successes and weaknesses of this market-based water governance will be made although these experiences are very recent and still in the process of being developed and implemented.

The first case concerns the management of the Colorado River Basin among the Western States of the United States. The negotiations over a drought plan for the River Basin have led to interesting proposals and developments trying to integrate more flexibility into the Law of the River. After the creation of an Inter-state Water Bank by the State of Arizona and the issuance of a Federal Rule by the Department of the Interior on Interstate Storage and Release Agreement, the recent discussions among the riparian States and the Federal Government have changed direction. Another governance system based on Intentionally Created Surplus (ICS) – which might be potentially traded- is currently being tested.

This case is interesting because it identifies the challenges linked to the introduction of inter-state market-based mechanisms. In negotiating and designing the new institutional framework for water management in the River Basin, the decision makers have to answer to questions such as: How water rights are defined? What will be traded (in this case: Intentionally Unused Created Apportionment IUCA or Intentionally Created Surplus)? Who, where and how can they be traded? Etc.

The second case deals with the National Water Reform in Australia and more especially with the creation of an interstate water market in the Murray-Darling Basin. The context and decision-making procedures are very different from those in the Colorado Basin. The outcomes of the negotiations are also very different. The introduction of interstate trade among the riparian States of the Murray Darling Basin is supposed to be extended to the entire country. The scale of the proposed market goes much beyond the river basin level. The actors of the market are individual users whereas in

the former model, states were the main actors in the market. Finally, the Conference Of Australian Governments (COAG) is pushing for the harmonization of water legislations among the various States in order to bring homogeneity into the definition of water rights, environmental protection measures, water pricing policies and transfer rules. In order to facilitate interstate trade, different solutions were tested. The most recent discussions involved the choice between the 'tagged system' and the 'exchange rates system'. Thus, the paper will retrace the different steps in the development of market-based water governance among different jurisdictional entities and review and evaluate the different options negotiated and tested.

After having compared the successes and failures of the two models being currently developed in the Murray Darling Basin and the Colorado Basin, the author will turn to its second objective, which is to draw the conclusions from these federal experiences for the establishment of water market systems in transboundary river basins.

Contrary to the argument of some economists, international water markets are no easy solutions to disputes in transboundary river basins. They are long, demanding and complex processes.

As the examples of the Murray Darling Basin and the Colorado River Basin show the important initial step in the introduction of market mechanisms is the definition of the property regime of the shared water resources. A first difference between the Colorado and the Murray Darling Basin is precisely the difference of definition of property regime of the river water. The type of property regime expressed itself in the type of decision-making procedures and the governance principles adopted. To define water rights means to define who is legitimate to make decisions over the resources and what are the legitimate principles governing the management of the resources.

Thus the first prerequisite for the development of equitable and efficient inter-state market-based water governance is the well functioning of common decision-making procedures with the involvement of all the riparian States, transparency and data sharing. A second requirement is that each entity should first implement domestic water reform, conservation measures and local water markets. A third condition is the implementation of basin-wide water planning with measures such as caps on diversions from the basin and allocation for the environment. A fourth prerequisite is the harmonization of the definition of water rights and water policies among States. Finally, before thinking in terms of permanent water transfers across border, a preferable option would be the creation of inter-state drought water bank commonly managed and allowing only the temporal exchange of water rights in time of crisis.

Governance Reform for Stakeholder Participation in Nam Ngum River Basin Water Resource Management

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Keywords: Governance, participation, institutions, Lao, river

The Nam Ngum River is a major tributary of the Mekong River in Lao PDR. This is a rapidly developing basin, with one existing and four planned hydropower dams, existing and planned mines, forestry and shifting cultivation, existing and planned irrigation, flood control problems, fisheries and tourism activities and plans, and possible interbasin (international) transfer of water from the lower part of the river. At present the water resources of the basin are generally sufficient, but water quantity, quality and ecosystems could be stressed in the future as a result of development pressure.

Lao PDR has not had a well developed and coordinated system of water governance in the past. Major ministries are responsible for water resource development and services. Two small agencies, the Water Resources Coordination Committee (WRCC) and the Lao National Mekong Committee (LNMC), have carried out some water resource coordination activities but because of limited human, finanancial and legal capacity this has not yet been sufficient to meet the needs of the water sector. The same is true at the provincial and district level – inadequate capacity and the lack of a river basin institutional arrangement have prevented local governments from effectively coordinating water resource management.

The Government of Lao PDR is now taking steps to establish a more unified institutional structure in the water sector. At the national level a Water and Environment Agency is expected to be established under the Prime Minister's Office. This agency may include the WRCC and LNMC and possibly functions and resources transferred from elsewhere. At the basin level the Nam Ngum River is serving as a pilot basin for river basin planning, including basin-scale water resource planning and also sub-basin-scale watershed planning with a focus on land use and rural development needs.

The WRCC and the provinces which share the Nam Ngum Basin are expected to establish a Nam Ngum River Basin Committee (NNRBC). It is expected that this committee will include senior representatives from each of the basin provinces as well as representatives of key central level agencies as well as some district representatives. The NNRBC would be chaired on a rotational basis by a provincial Vice Governor. The general responsibilities of the committee would be to oversee basin water resource planning and monitor plan implementation, facilitate interprovincial communication and coordination on water resource management, promote water resource awareness and consultation with stakeholders, and to advise the Government on dispute resolution.

The WRCC and a number of other central and provincial agencies are cooperating on water resource planning in the Nam Ngum Basin. This integrated river basin planning involves the development of baseline information (basin profile), planning scenarios, analysis of development and management alternatives, as well as extensive consultation with stakeholders. Sectoral agencies such as hydropower, irrigation and others are participating for the first time in a coordinated approach to water resource management.

On the financial side, the Government has established an Environmental Protection Fund which can receive money from a variety of sources, including a share of revenue from major resource developers. Consideration is now being given to establishing a water resources "window" (sub-fund) which could serve to channel money to priority water resource management activities. Ideally these would be guided by such things as a national water resource strategy, river basin plans or other approved policies.

As decisions are made regarding the formation of the NNRBC, important water resource institutional issues come into focus. Can a river basin committee play and effective role as a coordinating and advisory body in the context of a rapidly developing river basin where high priority projects are being driven by a national development agenda and sectoral strategies? Should the committee have greater legal powers, such as responsibility for project approval or funding allocation? How can the various national planning processes be coordinated: basin planning, environmental impact assessment (including cummulative assessments) and national socioeconomic development planning? Will stakeholders (including local governments) see sufficient advantage in joint action to motivate them to be active participants in a river basin committee? And finally, how can water resource planning and management be financially supported to keep pace with the rapid development process?

Lao PDR is exploring, in its own way, how to answer these questions and work out an effective and practical approach to integrated water resource management and stakeholder participation at the river basin level. This presentation is a progress report on an evolving process. It concludes with a number lessons learned to date:

- Poor (fragmented) institutional arrangements will hamper IWRM implementation. A more coordinated and unified structure at both the central and basin (provincial) level is expected to lead to more positive results than in the past.

- With improved institutional arrangements it is possible to undertake coordinated, macro-planning for water resource management. There is increasing stakeholder interest in the development of a national water resource strategy and river basin plans.

- Good data and information management as well as technical tools and skills are needed for planning and operation of water resource management. Building this capacity will be a priority for the foreseeable future.

- International assistance and experience is appreciated, particularly where this experience is practical and relevant. Lessons from other countries must be adapted to local conditions and the current situation of the Lao water sector.

Challenge and Practice on Wastewater Water Reuse and Reclamation in Taiwan

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Keywords: wastewater water reuse, alternative water resources, risk assessment, reclaimed water criteria, municipal wastewater

Water resource background

In Taiwan, water resource development and management is very difficult due to congenital deficiency. Although the annual rainfall in Taiwan reaches 2500mm which is 2.5 times the world average, annual water resource is only 3900 m3/capita.yr which is poor and 12% of the world average (33,975 m3/capita.yr). Rainfall concentrates in the five months rainy season with an amount of 3/4 of annual rainfall. Rivers are short and steep in Taiwan with large runoff differences in wet and dry seasons. Discharges respond rapidly with rainfall intensity and flood flows. The peak discharge per unit drainage area in Taiwan is the largest in the world. For instance, the specific peak discharge of Choshui River, the longest river in Taiwan, is 450 times that of Yangtze River in China. These indicate that rainfall is so much, but water resource is deficient in Taiwan.

According to official prediction, the annual water demand in Taiwan approximately 18 billion m3 in 2006, includes 12 billion m3 for agriculture use, 3.6 billion m3 for municipal use, 3.0 billion m3 for industrial use and 1.5 billion m3 for conservation use. The prediction also indicates the annual water demand will reach approximately 20 billion m3 by 2021. However, the present water supply is only 18 billion m3 per year. This means that an additional 2 billion m3 have to be developed in the next 15 years. Because of difficulty of new freshwater resources, alternative water resources would be discreetly utilized. Alternative water resources include treated wastewater, desalinated seawater and rainwater. Because quality of treated municipal wastewater is acceptable and its quantity is stable and enough, municipal wastewater reclamation and reuse will become an important additional water resource. The purpose of this paper was to show the challenge and progress towards sustainability of wastewater water reuse and reclamation from various directions in Taiwan.

Integration between sewerage system construction and treated wastewater reuse development

Because of the lack of public sewerage system construction in Taiwan, the promotion of wastewater reuse has been insufficient. Nevertheless, it is convenient to plan new wastewater reclamation and reuse system. A scheme for wastewater reclamation and reuse shall be simultaneously given consideration with future public sewerage systems construction. According to Taiwan official statistical information, there are 24 public publicly owned treatment works in 2006. The sewerage treatment ratio is only approximately 13.07%. There will be 54 municipal wastewater treatment plants finished continually by 2011, then sewerage treatment ratio will reach the percentage to over 40%. There will be a great quantity of potential reclaimable wastewater. It is expectable that construction of these municipal wastewater treatment plants will consider simultaneously the applications and convenience of water reclamation. Before treatment plant construction, some factors were considered for treated water reuse, including plant location, advanced treatment level, reuse application, distribution system

for reclaimed water and user convenience. Predictably reclaimed water quantity will reach 600,000 CMD and ratio of reclaimed water to treated water will reach 14%. There are 36 of the 54 municipal wastewater treatment plants will be accomplished by private enterprises as Build-Operate-Transfer model (BOT). The treated water will reach 1,970,000 CMD for population of 5.6million. Some of the treated water will enter current water resources supply chain, and in order to balance sewerage construction cost, it will be traded between water suppliers. The government's responsibility and trade mechanism of reclaimed water right will be discussed in detail.

Challenge on Wastewater Water Reuse and Reclamation in Taiwan

Development of wastewater water reuse and reclamation in Taiwan confronts some challenges which are how to integrate assignment of government departments and works of private enterprises into a complete reuse system. The considered municipal wastewater reclamation and reuse plan is listed below:

1. In respect of market mechanism of reclaimed water resources

Development and utilization of reclaimed water shall move towards market economy. Trade mechanism of "take and supply" shall be established. If competition of reclaimed water resources with original water resources is inferior, the government shall partly subsidize or reduce taxes of water right.

2. In respect of compulsoriness of wastewater reuse and reclamation

Under low water price condition, wastewater reuse and reclamation need to be compulsory for a new development of industry and community. By way of an inspection of environmental impact assessment, the development should be requested to set up a reuse system of "take and self use".

3. In respect of Convenience and confidence for the user

User's doubts about wastewater reclamation and reuse include health risks, pipe corrosion by reclaimed water, the maintenance of reuse equipment and a distinguishable reuse system. Given public acceptability and safety risks in Taiwan, a reliable but not over severe reclaimed waster criteria shall be draw up. Some criteria have been drawn up but some not yet. In addition to water criteria, management regulations for the wastewater reclamation and reuse, including guidelines of architecture facilities, sewerage guidelines, need be modified in order to conveniently use the reclaimed water. Assessment of the rationality of reclaimed water criteria for various reuse categories in terms of health risks will be discussed in detail.

DSI's Water Sustainability Efforts on Water Resources in Turkey

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Keywords: water sustainability, water projects, water quality, floods and droughts, monitoring activities

Water Resources are one of the natural resources that heavily subject to overdraft for groundwater, excessive water use for surface water and in some cases environmental pollution. As it is seen in all over the world, these problems in some basins of Turkey have reached to important size. Thus, water shortages problems are raised and cost of water resulted from treatment and capacity increment needs is increase. The droughts and floods that are caused from climate change set off these problems more and started to affect all of our daily lives.

Although authorities try to harness the water resources in order to take precautions against droughts and floods, these efforts are likely to stay insufficient to avoid from these negative impacts and since people are mostly depended on climate conditions, these impacts can increase or decrease year by year. On the other hands, the studies are mostly focus on quality monitoring activities. In order to specify the effects of pollutant elements on water environment, parameters which define water quality must be measured properly. Through water quality measurements that are conducted regularly in a water source, it is possible to catch the pollution source, time and location besides the effects on water sources by natural ways and human intervention is determined.

State Hydraulic Works (DSI), in Turkey, has continued setting up Hydrometeorological network since its establishment. In present situation, DSI has 1117 river flow measurement, 1150 water quality monitoring, 120 lake water level, 115 snow level gauge and 452 meteorological stations and the number of these stations are envisaged to be increased more in future. From these stations, hydraulical and meteorological variables such as river flows, groundwater and lake water levels, sediment loads, water quality, amount of precipitation and evaporations are collected and monitored. These measurements form a database for planned projects of DSI in the future. Establishing a well monitoring network in Turkey and keeping a database at the centre which is easily accessible and quickly analyzable, is vital in order to define present water related problems, to provide optimum solutions for future studies and to give reliable information for decision makers. In this process, DSI is only responsible for monitoring activities, other actions are under the responsibility of Ministry of Environment and Forestry together with other related bodies.

In addition to this, DSI is in charge of planning, constructing and operating activities regarding all water projects in Turkey. As a public agency, DSI is responsible or four major tasks namely, irrigated agriculture enhancement, hydroelectric energy generation, water supply to large cities and flood prevention measures. In order to achieve the above-mentioned objectives, DSI primarily develops dam projects which are at the centre of the four objectives. Therefore, DSI is mainly known as a public agency developing dam projects. However, protection and effective use of water resources is a collective process that should include all related bodies apart from DSI including Ministry of Environment and Forestry, local authorities, municipalities and even water users.

Turkey tries to make her water and environmental legislation harmonize with European Union's (EU) legislation during the EU accession period. The Environmental Impact Assessment (EIA) has been in force in Turkey since 1993 with 3 amendments so far. Strategic Environment Assessment (SEA) Regulation drafted in April 2005 but not in force yet.

According to the planning studies made by 2030 in Turkey, 65% of water is needed for irrigation, 20% for industry and 15% for drinking water. Therefore, we need to develop our water resources in order to ensure sufficient and sustainable water supply and hydropower. Turkey has developed 36% of her hydropower potential in energy sector whereas 57% of her irrigation potential in agriculture sector. DSI aims to develop most of water resources by the year 2023 which is the 100th year of foundation of Turkish Republic.

After enactment of Renewable Energy Law and Electricity Market Law, private sector interest for hydropower plant construction (12 686 MW) in Turkey will become as big as the public sector investments. It means that, private sector will invest approximately

13 billion US Dollar in near future. Renewable energy will become distinct in the future as it's important today.

DSI is aware of the importance of water related issues and problems and the awareness and experience gained from a 52 years period, will be shared via the 5th World Water Forum that will be organized in 2009 in Istanbul by getting into close cooperation with World Water Community.

Goverance of Public Sector-Nonprofit Sector Coalitions: Social Learning and Negotiated Order Processes

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Keywords: Goverance , Social Learning, Negotiated Order, Core Group, Complexity Theory

[Abridged from the authors comprehensive papers: "Great Lakes Compact 2005: A Collective Action to Protect the Great Lakes-St. Lawrence River Basin By Building a Multi-Jurisdictional Government Regimen Based on Cooperative Horizontal Federalism: Overcoming Barriers to Collective Action Through Governance Leadership and Social Learning as Negotiated Order and Decision Making Processes"; and "Inter-Sector Decision Making: Governance Social Learning, Negotiated Order and Emergent Leadership as Adaptive Responses to System Complexity." www.case.edu/weatherhead/edm]

The five Great Lakes (Superior, Michigan, Huron, Erie and Ontario) and St. Lawrence River Basin hold twenty 20% of the World's fresh water supply and 96% of the fresh water in the United States. It is a vast, complex eco-system supporting 43 million people, industries and cities that are along and near its shorelines. The invasion of alien aquatic species, combined sewer-waste water overflows and 150 years of industrial dumping continue to threaten the water quality. And, now, the threat of significant diversions of water outside of the Great Lakes Basin have brought this critical and unique resource to the brink of ecological collapse (Kuehner & Koff 2005). It is a prisoner's dilemma: collective action to protect the Great Lakes-St. Lawrence River Basin is clearly needed. How do the relevant parties overcome their individual interest for the greater good and develop an effective collective action, when failing to do so will result in a classic Tragedy of the Commons (Hardin 1977)?

The stakes are high and the subject matter complex. Effective collective action to protect this unique and critical natural resource will not be easily achieved. To preserve and restore the Great Lakes will take a significant and effective large- scale collective action. The need for leadership, governance and decision-making capacities are needed on an unprecedented scale and within a limited time frame. The collective action must be multi-jurisdictional as between the eight Great Lake States and transnational as between those States and the United States Government on the one hand and Canada and her Provinces of Ontario and Quebec on the other. Failure means the destruction of an irreplaceable and vital resource. The need is for unprecedented cooperative multi-governmental efforts.

In December of 2005 the Council of Great Lakes Governors, Great Lakes Regional Collaboration and the Great Lakes-St. Lawrence Cities Initiative, along with the Premiers of Ontario and Quebec, Canada announced the signing of Compact and Sustainable Water Resource Agreements. These agreements craft an organizational structure and regimen for the governance and management of the Great Lakes St. Lawrence River Basin designed to prevent water diversions, promote water quality, direct restoration priorities and provide for ongoing study, monitoring and enforcement of regional water management standards. In short, the outcome of the collective action is the Compact 2005 and the companion Sustainable Water Resource Agreement (Appendices). The regimen will not be complete (enforceable as between the states), however, until the compact is approved by the eight Great Lake States, the US Congress and President. To obtain treaty status with Canada will require affirmation

by the Canadian national government.. Compact 2005 and the Sustainable Water Resource Agreements will start their ways through the various State Legislatures during 2006.
This paper explores the historical, political and social networks and legal complexities that marked the development of Compact 2005- unique in its scale and scope- and how the participants overcame barriers to collective action. A key proposition of this paper is that the prime motive for collective action and collaboration was the fear of water diversions outside of the Great Lakes St. Lawrence River Basin and that the barriers to collective action were overcome by that common fear. Most importantly, this study examines the key factors and processes of the collective action and how: (a) political leadership, (b) governance (organizational structure and functioning); (c) social learning and negotiated order as decision-making processes and (d) a historical dynamic collaborative community overcame the barriers to Great Lakes collective action.

Civil Society Participation in Decentralization – An Increasingly Popular Model for Water Resources Policy

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Keywords: water management, capacity building, water governance, water basin committees, Brazil

Emerging water issues in developing countries, such as Brazil, are synonymous of sanitation, pollution and water scarcity issues. So, the question is " How to face them?". Maybe this is the emerging issue. How to manage these issues efficiently and in a sustainable way? These ate the main issues that will be approached by this paper.

In 1997, the federal "Water Law" was approved as the outcome of a long negotiation process between different stakeholders involved in water resource management. Decentralization of the management of the Brazilian water resources has been ongoing for a decade. Federal law envisioned governance at three geographical levels. A national council oversees the national water agency and state water councils, while state level bureaucracy supervises the committees and agencies at catchment level, that is, the smallest territorial unit for decision making.

The growing commitment and concern with water resource's quality and availability, the increasing complexity involved in managing the various interests regarding water, added to the democratic transition of Brazilian society, are some of the historic factors which sparked such process. Up to this day, this new management system is still under construction, and therefore, presents different levels of maturity. It is based on some cornerstones that are common to both state and federal: the recognition of the water basin as a single management unit, the acknowledgement of the multiple uses of water, the definition of water as a property of social and economic value and the democratization of management through the participation of the civil society in the decision making spheres (Jacobi, 2004.

In Brazil, the participation of civil society in decentralization is becoming an increasingly popular model for water resources policy, aiming at achieving better results and sustainable management of water. In this way, a decentralizing, participative and integrated management is adopted as the main principle. The most important management instruments are: watershed plans, water-use licenses, water-use tariffs and information systems. The formula proposed for the management is a water resource public collegiate, with socio-technical negotiation through the Watershed Committees. The collegiate management tends to define a dynamics that allows different stakeholders to integrate and adjust their practices based on a socio-technical negotiation aiming at adjusting interests and proposals which are not always convergent and articulated towards a common objective.

The watershed committee is where the negotiation occurs. They deliberate on public policies and activities that can affect the quantity and quality of water. Its composition includes necessarily some measure of civil society participation: water users, mayors, organized civil society (NGOs) and on the other side government representatives. The collegiate management tends to define a dynamics that allows different stakeholders

to integrate and adjust their practices based on a socio-technical negotiation aiming at adjusting interests and proposals which are not always convergent and articulated towards a common objective.

The very first task of the watershed committees is to make a Watershed Plan that will be used to prioritize water investments.

The watershed committees have among their responsibilities to:

a) make a watershed diagnosis related to water quantity and quality and related issues;
b) make a Watershed Plan (reviewed every 4 years);
c) based on the Watershed Plan, prioritize water investments;
d) debate water related issues with the community;
e) resolve conflicts between water users;
f) define water–tariff policy.

They act as "watershed parliaments", defining the water policies for the watershed. The dynamics of the collegiate allows for greater transparency and permeability in the relationship between community, the private sector, and the state. It brings together those who are in fact interested in the process and creates a formal forum for participation, enhancing the possibilities of actions directed to the social and technical negotiation, combining territorial interests and technical needs.

Up to now, Brazil has 140 watershed committees in 24 states, actively involving approximately 7,000 people and entities (civil and public ones).

In 2006, the first National Water Resource Plan was launched through a participative methodology, with the participation of 6,000 people.

The reform of the water management systems in Sao Paulo has created 21 watershed committees involving approximately 2,000 people. Fourteen committees have a Watershed Plan. The basic directives: to guarantee of multiple uses of the water, with priority given to public supply in agreement with a watershed management plan; the charging for water use; and organization of decision making forums.

Now the water tariffs are implemented in two watershed committees, based on the priorities established by their Watershed Plans. At the very first steps of tariffs, it will only be charged industrial and urban activities, and agricultural activities will only be charged in 2010.

The paper will analyze outcomes in five water basins in the State of São Paulo linked to increased social credibility; increased participation and empowerment of the civil society; tapping local knowledge in management decisions; strengthening democracy and increased efficiency of investments.

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Climate Change and the Risk of Water-Related Disaster: Crafting Adaptive and Just Institutions in Thailand and The Philippines

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Keywords: water-related disaster, system of governance, institutional arrangements, Philippines, Thailand

Flood disaster is one of the most frequent and devastating natural disasters in Thailand and the Philippines and the changing climate regime compounds the existing challenges of managing water-related disaster in these countries. The anticipated sea level rises could have a major impact on flood risks in the coastal zone deltas in which many of the larger human settlements and key rice growing areas occur. Increases in the frequency or intensity of extreme precipitation events exacerbate risks of disastrous flooding both in upland watersheds and in lower floodplains.

The capacity of households, communities and nation-states to live or cope with floods and to adapt to changes in flood regimes depends on many factors. One of these factors that help shape differences in risk and vulnerability to floods and climate change as well as adaptive strategies is social institution. Social institutions, defined as clusters of rights, rules, and decision-making procedures that give rise to social practices, assign roles to participants in these practices, and govern interactions among occupants of those roles, defines what and who is to be at risk. Institutions and systems of governance that structure political, social, cultural and economic relations and transactions in a society shape and determine peoples' vulnerability. These socio-political and economic relations differentiate and influence resource allocation and people's access to resources, including capital, information and decision-making, which are crucial for survival and well being. The interplay of these institutions shapes the differences in vulnerability to floods and climate change. A good example is insurance, both the formal kinds provided by large firms in industrialized economies, and the various kinds social safety nets that may exist in traditional agricultural societies. Dysfunctional, perverse or unjust institutional arrangements may increase vulnerabilities to floods and risks of flood-related disasters.

The study focuses on the institutional capacities of the Philippine and Thai nation-states to manage floods and the risks of water-related disasters. The approach of the study was twofold. First, institutions created to deal with flood related disaster and how they have changed overtime were reviewed through reviewing documents and interviews. Second, research was carried out about practice and performance in recent flood events that caused loss of life, property and livelihood.

The study reveals several indications of improved institutional performance of the Thai and Philippine state. Institutional arrangements are important component to interventions in vulnerability and disaster reductions. There are indications of improved institutional performance of the government in the area of:

- Relief and emergency;

- Provisions for early warning systems as well as risk and vulnerability mapping;
- The creation of disaster committees at different levels;
- Initial efforts to involve the communities in flood prevention and mitigation; and
- Integration of disaster risk management in development programs at the national level.

The government and private sectors have been actively collaborating during emergency for mobilizing resources for relief and emergency assistance. The involvement of the private sectors and NGOs providing financial assistance for livelihood recovery and rehabilitation of the landscape through micro-finance and other schemes are emerging both in Thailand and the Philippines.

However, a number of institutional arrangements continue to undermine and impede the reduction of water-related disaster risks in Thailand and the Philippines. Marginalized groups are unlikely to benefit and may even be disadvantage by programs and policies aims at reducing risks of flood disaster due to:

- Corruption: relief and compensation programs
- Incomplete implementation of recovery and reconstruction programs
- Absence of the State in many areas in Thailand and the Philippines
- Highly Centralized Bureaucracy: State of Paralysis
- Decentralization efforts sans resources and power

There is an over emphasis on structural measures which again and again have shown to be more about redistributing risk in time and place rather than reducing risks. The self-serving belief that disaster management is a technical problem that calls for expert judgement that systematically excludes the interests of the most socially vulnerable groups continually permeates among the mindsets of water and water-related disaster risks managers.

The following are some mechanisms that might facilitate social mobilization in reducing water-related disaster risks:

- People's participation in district area planning, river-basin management, disaster preparedness plans and water-related disaster policies;
- Cross-scale coordination among agencies and stakeholders in the design, implementation and monitoring and evaluation of program and policies that help address the underlying causes of flood disaster risks;
- Framework for private sectors to help finance recovery and rehabilitation (insurance and micro finance schemes);
- Instituting monitoring and evaluation mechanisms in disaster risk management.

The Emergence of a Human Right to Water under International Law – Implications for Water Resources Governance

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Keywords: Human rights based approach, private sector, vital human needs, environmental protection, international law

In recent years there has been much debate on, and significant declaratory support for, the emergence in general international law of a right to water, or at least of a right of access to drinking water and sanitation. Recent developments supporting the existence of this right include the General Comment 15 on the Right to Water, adopted by the UN Committee on Economic, Social and Cultural Rights in 2002, and the resolution on Promotion of the realization of the right to drinking water and sanitation, adopted unanimously in 2004 by the UN Commission on Human Rights' Sub-Commission on the Promotion and Protection of Human Rights.

Views differ on the theoretical origins and normative implications of this purported right. Some scholars suggest that it was implicitly included in the International Covenant Economic, Social and Cultural Rights and it has also been linked to ancillary legal principles, such as the principle of non-discrimination. It remains quite unclear what the implications of this right might be for a wide range of water governance issues, including those of affordability of water, water privatisation, standards of service delivery, etc. Similarly, it is unclear what its impact might be in relation to practical application of the principle of 'equitable utilisation', the cardinal rule of international law, which accords special priority to the protection of 'vital human needs' and, arguably, to the environmental protection of shared freshwater resources.

Generally, this presentation sets out to appraise the merits and limitations of a human rights based approach to achieving more equitable freshwater resource management, including, for example, an analysis of its implications for the environmental protection of water resources and for private sector involvement in the provision of water services. Indeed, it is in the context of private sector investment in water services that the emerging human rights based approach to water resources governance has recently received seminal support from international dispute-settlement bodies.

Governance in the Context of Social, Climatic and other Change Processes: Responding to Emerging Challenges

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Current generations live in a world shaped by change; a world in which the basic assumptions on which local and global society are founded are subject to continual challenge. In many ways this is nothing new. Throughout human history, the presence of change has, perhaps, been the only consistent element. At the same time, the current depth and pace of change is unparalleled within human memory. Furthermore, much of the change is transformative. Rather than incremental alterations, many of the changes now occurring alter basic relationships within and between natural resource, environmental and social systems.

Broad patterns of change in key areas are familiar to many in the water resource community. As the 2007 IPCC report clearly documents, basic changes in climate systems are occurring. These changes will cascade at varying time scales through regional hydrologic systems and, equally importantly, through the knowledge and institutional systems we use to monitor, interpret and allocate water resources. Core probabilistic concepts – the 100 year flood, average annual rainfall, sedimentation rates, etc. – are founded on assumptions of climate stationarity that must now be recognized as incorrect. This, in turn, has implications for everything from infrastructure design to the nature of water rights and allocation systems.

Transformative change processes aren't, however, just limited to climate. Hydrologic systems are being fundamentally reshaped as drainage systems are altered and land uses evolve. Such direct changes in water resource systems are a product of equally great changes in social systems. Throughout human history, rural populations and livelihood systems have dominated urban ones. According to UN Habitat, half the world now lives in urban areas. Furthermore, globalized economic, transport and communication systems now penetrate deeply into once isolated "rural" areas. Both occupational and physical mobility have increased substantially. Where twenty years ago farmers in rural India had little daily interaction beyond their immediate village, now daily commute distances of 60 kilometers or more are common and rural livelihood systems contain many non-farm "urban" elements.

The above changes transform the governance needs and contexts in relation to water. Many local water management strategies – whether for domestic water supply, irrigation or watersheds – have been founded on assumptions regarding the presence of a geographically centered community with a degree of common interests in water management outcomes. At a higher scale, the focus on basins within the Integrated Water Resource Management (IWRM) paradigm assumed that the primary dynamics affecting water resource use and management options occurred as a result of interactions within basins. As populations become increasingly mobile and local economic systems increasingly affected by global dynamics, institutional mechanisms for governing water resources – from village level water-user committees up to basin water management organizations – are now facing multiple challenges. These challenges range from growing conflicts between urban and rural areas over limited water supplies to the fragmentation of institutions. There is a growing mismatch between the geographic and time scales at which hydrologic systems function and the scales at which economic

systems operate and humans most naturally appear to organize. Such change results in an ever shifting mosaic of water demands and uses with spontaneous mechanisms, such as informal water markets, occupy the growing space between both traditional and formal modern institutions for water management and service delivery.

What are the implications for water governance? Good governance is an outcome of systems that respond to change and surprise equitably, flexibly and effectively. In this presentation, I argue that this outcome depends heavily on the presence of checks and balances within society accompanied by enabling frameworks that, while recognizing basic principles of human organization, enable institutional evolution and flexibility. On a practical level I argue that this will necessitate far greater emphasis on:

1. The incorporation of informal water management and allocation mechanisms into more formalized strategies;
2. The development of frameworks that enable the formation of specialized but flexible water management organizations based on communities of interest and problem scales as well as geographical or hydrologic considerations;
3. Far greater focus on the role of indirect economic and other factors in determining water demand and use; and
4. Explicit recognition of the role pluralistic institutional environments can play in generating good governance outcomes within complex dynamic situations.

WWF Involvement for Improving Water Governance Issues in Mongolia

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Keywords: Mongolia, freshwater, WWF Mongolia, IWRM, IRBM

In this paper presented water governance challenges in Mongolia after collapsing socialistic system in early 1990s and WWF Mongolia's contribution for improving these problems and introducing an integrative and holistic approach since 2002.

At present, Mongolia's freshwater ecosystem is under increasing threats of degradation and resource depletion. Identifying and prioritizing the major issues and addressing their root causes will remain a major challenge due to the nature of the threats. The complexity and magnitude of the threats are subject to a combination of several factors, often with interdependent root causes.

1. Water Scarcity: Water shortage and scarcity is becoming inevitable with alarming numbers of dried-out rivers and lakes. UNDP (2005) commissioned a "Study on Economic and Ecological Vulnerability and Human Security for Mongolia", which pointed out water shortage as a major socio-economic problem that may soon create serious economic challenges throughout the country. Despite its limited and finite nature, the water has been subject to both natural and anthropogenic factors. Global climate change, which adversely impacts the natural dynamics of freshwater ecosystems, is one of leading natural factors. It causes water levels to rise in some areas due to glacier and permafrost melting. In other, arid areas, lower water tables are due to drought and loss of water retention capacity in riparian areas that have been heavily deforested. Increased permafrost melting advances further sedimentation in riverbeds, destroying habitat for aquatic and benthic life.

2. Water Pollution: Water quality has been decreasing with increasing pollution from a variety of sources, the majority of which are point-sources. This eases pollution-mitigation efforts by having a clear sense of the pollution originators and liability. A list of pollution point-sources includes:

   - Outdated and irresponsible mining technologies applying extensively heavy metals such as mercury and cyanide;
   - Chemicals from leather processing;
   - Agricultural practices such as overgrazing by livestock changing run-off conditions, damaging river banks and increasing nutrient content from livestock manures leading to eutrophication.
   - All these sources of pollution pose irreversible damage to the freshwater ecosystems of Mongolia.

3. Dwindling of Aquatic Resource: Mongolia is a mosaic of diverse ecosystems represented in a variety

of wild fauna and flora species endemic to the region. It is home to many endangered species such as the Hucho taimen fish (Hucho hucho) – the largest freshwater fish reaching up to 1.8 m long.

4. Disturbance of connectivity: Maintaining inter-linkage of ecosystem processes such as aquatic species migration is pivotal for healthy freshwater ecosystems. Despite natural factors of global climate change resulting in the increased frequency of flooding and melting of permafrost and glaciers, anthropogenic impacts (e.g. Hydropower dam construction) cause the greatest disturbance to ecosystem processes.

5. Weak Enabling Policy Framework and Management Capacity. Numerous national policy documents have been generated in line with global commitments on Sustainable Development and Millennium Development Goals. Nevertheless many of them do not evolve into practical actions and remain on paper only. Policies are generic in nature, advocating competing short term economic interests. In most cases they are centrally designed, with piece-meal approaches dominating due to a lack of inter-sectoral coordination and interactive dialogue of a broad range of stakeholders. Lack of a reliable database up to now has clearly hindered effective management processes based on solid scientific data, routine monitoring and evaluation processes.

For addressing these issues already in 2003, WWF Mongolia was recognized the necessity of introducing an Integrated River Basin Management (IRBM) approaches in Mongolia and organized a National Seminar on IRBM (24-25 September 2003) in close co-operation with the Ministry of Nature and Environment of Mongolia and other relevant authorities.

As a result of this seminar, the amendment and improvement of the then insufficient Water Law was suggested, which proved successful with the enactment of a new Water Law that was approved by the Mongolian Government in April 2004. This law requires suggests the implementation of major principles of IRBM. As a follow up of this new Water Law, a new government implementing agency - the "Water Authority"– was established under the Ministry of Nature and Environment in early 2005, which were made responsible for the water management nation-wide (www.mne.mn/water).

Another important effort that explored the opportunities and challenges for the Integrated River Basin Management (IRBM) is a study conducted by WWF Mongolia in 2004, resulting in the publication of Freshwater Systems of the Great Lakes Basin, Mongolia: Opportunities and Challenges in the Face of Climate Change. This report was a first attempt to compile and integrate information from a wide range of sources on the freshwater systems of the Mongolian Great Lakes Basin in western part of the country to facilitate the complex process of an IRBM, requiring people from different disciplines, research groups, and authorities to work together.

All these studies recognize the need for an integrative and holistic approach (IRBM) needed to manage water resources in Mongolia. However, due to constraints on human capacity and financial issues, effective implementation has only started recently, and there is a strong need to create exemplary projects to serve as a suitable blueprint for implementation on a national level. WWF Mongolia has been in close collaboration with the government authorities and full support of the Water Authority of Mongolia, is working towards to implement the IRBM approaches.

Lessons from Ecosystem Theory to Improve IWRM Effectiveness

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Keywords: ecosystem , theory, IWRM, social-ecological , systems

Ecosystem theory, our understanding of ecosystem development and dynamics, has evolved dramatically over the past century. Ecosystem theory has transformed with the growing realisation that ecosystems can not be understood through reductionism and rational thought (Zimmerman et al., 1998). They are now regarded as complex, chaotic systems that behave in a non-linear and unpredictable fashion. This complexity often takes the form of hierarchy and its dynamics (Wu and David, 2002). Gunderson and Holling (2002) describe ecosystems as a hierarchical set of adaptive renewal cycles with cross-scale interactions. This current understanding of ecosystems explicitly recognises that they are complex social-ecological systems (SES) where the separation between nature and humans is artificial, and where humans are considered as an integral and interdependent part of the ecosystem (Folke et al., 2002).

Complex social-ecological systems are:

- subject to powerful dependencies, contingencies and reciprocal feedbacks between social and ecological sub-systems.
- characterised by uncertainty across social, environmental, economic and political spectra, such that even when plausible explanations are developed, precise predictions cannot be made.
- characterised by probabilistic relationships between fuzzy identities leading to a range of possible outcomes, rather than deterministic relationships between clearly-defined objects that generate single, predictable outcomes.
- therefore best managed by adaptive learning processes, public participation and the integration of scientific knowledge not only across disciplines, but also across the lay-expert divide.

Recognising ecosystems as complex social-ecological systems has many implications in the way natural resources are / should be managed and the policy that underpins that management approach. This is particularly relevant in South Africa, where a situation of endemic water scarcity has occurred and the consequent "buffering capacity" of potential surplus flows is being lost. The current global discourse of water management is based on Integrated Water Resource Management (IWRM). This approach has its intellectual roots in the United Nations Conference on Environment and Development (UNCED) that was held in Mar del Plata in 1977. That event, which was a major turning point in our understanding of water resource management in the context of sustainability, led to the eventual recognition of the universality of the hydrological cycle, and saw the emergence of consensus around the need to manage water at the river basin level (Fox & le Marquand, 1977).

A key element to the emerging discourse of IWRM was the Dublin Principles which espoused a more holistic approach to management, with attempts being made not only to consider the interdependencies within natural systems, but also the way that economic and social systems affect the demands

placed on the resource base (ICWE, 1992). Both ecosystem theory and IWRM appear to be calling for the same thing – greater inclusively of the human element – the social sciences - into understanding ecosystem dynamics. The disjuncture however, between the two concepts, lies in IWRM defining the unit of management as the river basin. This delimitation of the management playing field is based solely on hydrological characteristics and takes no consideration of social, cultural, political or economic characteristics that shape water management. This does not agree with defining the ecosystem according to its social- ecological characteristics.

The boundaries of social-ecological systems are defined by the development of a conceptual model of the system, which is strongly based on stakeholder inputs. These inputs need to bound the problem and elicit information on the important issues in the SES and identify its major drivers (Walker et al., 2002). The requisite simplicity of complex SESs needs to be mapped in order to identify the critical pathways and nodes in the system such that it is resilient, facilitates adaptive co-management and achieves its objectives.

Utilising social-ecological systems as the unit of management, rather than the river basin, changes the complexion of water resources management to one that is stakeholder-driven and interdisciplinary. There are dissenting voices questioning the universal applicability of IWRM and a resurgence of interest in the whole discourse of IWRM, with leading scientists calling for a renewed analysis of the relevance of some of its core assumptions (Falkenmark, 1993; Gyawali et al., 2006). Using the latest ecosystem theory on social-ecological systems could provide some interesting nuances to the IWRM debate.

This is of strategic importance in South Africa where approximately 99% of the national water resource at a high assurance of supply has been allocated (NWRCS, 2004). This means that no buffering capacity exists and there is no room left to "get it wrong".

Improving the governability of water systems: the operational side of IWRM?

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Keywords: IWRM, governability, performance, separation resource-uses, regulation by objectives

The lack of epistemological foundations for the concept of IWRM has severely undermined its credibility. "Without a clear exposition of how science can inform IWRM, the research community is powerless to inform theory development, manage knowledge generation, or formulate prescriptive advice" (Jeffrey and Kabat, 2003). The temptation to "throw the IWRM baby with the bathwater" is therefore high and pragmatic "problem solving" approaches are more and more advocated and presented as better alternative to a costly and non effective IWRM paradigm for action.

The starting point of this paper is to take the critic of Jeffrey and Kabat seriously and explore if there would be a fruitful scientific path leading to reformulating the IWRM paradigm. The approach adopted calls for a blend of management and industrial economics science and draws on developments obtained in many spheres of the socio-economic life where public and private interests have to be conciliated for the larger benefits of society. Grounding the analysis of the IWRM concept in this field would allow a more solid migration from the theory to very practical questions of observability and governability of the water systems. This approach place a central focus on the interface between the "water resources management" and the "water uses management" and the coordination problems created by the radically different viewpoints carried by the managers operating on both sides of this interface. The thesis proposed is that the instrumentation of this interface is the key to realistically pursuing the objectives stated in the IWRM definition: social equity, economic efficiency and environmental sustainability.

The paper also clearly delineates what is concerning the "performance" of the water systems (in other words whether the above objectives are obtained or not) from the "characteristics of the management systems" embedded in these water systems. Policies, institutions and management instruments are presented as building blocks of such management systems able to confer or not desirable characteristics of observability and governability. Work on diagnostic tools for water management systems can therefore be initiated and cross analysis of performance and management characteristics paves the way for benchmarking and progress.

The paper proposes a framework presenting the key features of an operational IWRM approach, elements of diagnostic for action and draws illustrations from the work undertaken by the Economic Commission of the West African States to govern its water resources in an integrated manner. The main conceptual questions addressed in the paper are listed below with preliminary indications of the approach in view.

A) The overall policy framework introduced by "integrated management" refers to the creation of socio-economic value, in a sustainable manner, with the water resource (value often characterised as "3E" for Economic efficiency, Environmental sustainability and social Equity). Can we clarify

the duality between the "water production system" and the "water management system" in order to analyse the problem of management by objectives, including the important issue of the political construction of those objectives?

B) Can we propose a simple operational model of the "water production system" including by design the following important aspects?

- The explicit separation of the resource (mobilisation chain) from the uses (transformation chain)
- A clear representation of the interface between the mobilisation and the transformation chains including the various actors and goods and services derived from water transformation.
    - The founding analytical principle: Separating resource mobilisation from uses
    - Understanding the interface resources - uses

C) Can we propose a simple operational model of the "water management system" embedded in the entire production system (including both the mobilisation and transformation chains) in order to:

- Analyse the problem of instrumentation of the two basic management functions: (i) Constructing objectives and (ii) regulating the production system according to objectives
- Solve the specific internal coordination problem created by the separation of the internal production chains (mobilisation and transformation) within the context of overall objectives.
    - What are the building blocks of the management system? (When we put "Policies, institutions, instruments" in context; When we put the "Integration" of the water resource institutional regime in context)
    - What are the functions of the management model? (The key to governability: Overall, distributed and cross-regulation)
    - Can we propose functional characteristics of 3E governability?
    - From functional characteristics to building blocks of the management system: 3E governance

Corruption in Municipal Water and Sanitation Services

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Keywords: Corruption, Accountability, Water, Sanitation, Governance

Water and sanitation are central to the UN's Millennium Development Goal of eradicating extreme poverty in two respects, as the motor of local economic growth and by supporting sustainable livelihoods. Infrastructure services also have the potential to promote good governance through democratisation, decentralisation, greater public participation, civil harmony and a demand responsive approach to service delivery.

Corruption is the misuse of entrusted power for personal gain either at one's own instigation or in response to inducements. Corruption has been identified as one of the principle constraints to the delivery of sustainable services, with respect to petty corruption (the use of contacts or money to get new connections or better/ faster service), political rent seeking in the allocation of resources and contracts and the general misconduct of contractors, technical staff and employees. The effect of corruption on infrastructure can be gauged through both its direct impact (for example, increasing the cost of public services, lowering their quality and or restricting poor people's access to such essential services as water and sanitation. Corruption in services delivery often means that services are not effectively delivered, thus potential users have to do without or have to pay privately to obtain these services) and indirect impact (through diverting public resources away from social sectors and the poor, limiting development, and poverty reduction). The poor, in particular, are easy targets for extortion, bribery, double-standards and intimidation.

Corruption in municipal water and sanitation services has implications for governance relations. It has been demonstrated that corruption increases income inequality and poverty by reducing economic growth, the effectiveness of social spending and the formation of human capital. Furthermore, if people are denied access to basic services, because they cant afford to pay bribes, not only are the rights associated with citizenship violated and vulnerable people further endangered, but the role of local government is discredited.

The good governance agenda holds the potential for efficient public service and the participation of civil organisations in fostering more transparent, democratic and accountable governance. Public accountability is thought to improve public services, economic growth, good governance, and ensures that public resources are used more efficiently. Accountability arrangements for infrastructure provision may also improve the responsiveness of service providers, increase local ownership, reduce corruption; and improve cost recovery. Moreover, it is claimed that accountability arrangements induce government to respond to the local population by exposing them to the choice of the consumer in a direct way. Good governance holds the potential that the voices of the poorest and most vulnerable are heard in the decision-making processes.

This paper presents strategies which enable all citizens to combat corruption and to hold governments and service providers to account in the delivery of water and sanitation services, but that also develop their capacity to participate not only in monitoring and evaluating the quality of the services they receive, but also in the governance of their towns and cities. These strategies are derived from

real world experience; derived from a review of literature, desk-based case surveys and country case studies. These are not academic concepts but genuinely operational tools that can be used in practical situations.

This paper is based on a research project conducted by the WEDC Institute entitled 'Accountability Arrangements to Combat Corruption Using Partnerships'. The purpose of this project is to improve governance through the use of accountability arrangements to combat corruption in the delivery of infrastructure services in urban and rural contexts. The study is funded by Knowledge and Research for Engineering Sectors of the UK Government's Department for International Development.

CLEAR WATER: Transparency & Accountability in the Governance of Water

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Keywords: Governance, Concessions, Accountability, Transparency, Stewardship

Any discussion of "governance over water" stirs the emotions and prompts affiliation with one of two seemingly opposed positions: one favoring privatization, public-private partnerships ("PPPs"), profit-driven development, and trade-able commodities, and the other favoring public sector water management, collective ownership, and the non-commoditization of basic human essentials. The debate, however, should not be about "public" vs. "private." The discussion should be about transparent "efficient" public water services that are high quality and at the lowest cost. It is the Author's opinion that this requires strong, clear, and popular public policies, coordinated governance at the national, state and local levels, and public and private investment. Investment risk can be decreased if international standards are utilized, governance is transparent, and integrated water management systems are created that bridge national, state, regional, and local concerns over water.

The Author will provide a brief overview of best practices in Latin America and Africa, and will present a solution that stresses the importance of both the developed and developing world sharing in the task of funding and operating sustainable water and wastewater infrastructure. The Author recognizes that this has become increasingly impractical for government due to conflicting priorities, politics, shrinking budgets and insufficient resources. Privatization and the proper structuring of private sector participation ("PSP") in water may well be the answer; however, any effort to restructure the governance and deliverance of water must take into account that PSP is easily misunderstood and in many cases, objectionable for the wrong reasons. The trend towards PSP and privatization is strong, and the priority of governments and public agencies alike must be to educate and inform the relevant constituencies about the benefits and true risks. This education begins with the enactment of effective laws and regulations that balance public needs against the needs of private investors.

It is the Author's opinion that new policies and laws must be developed on a national scale to accommodate the needs of private investors and protect the public interest, including the environment. The first step in advancing a sustainable infrastructure is effective government communication that (i) promotes stakeholder participation, (ii) emphasizes transparency and accountability, (iii) stresses holistic integration of political, economic, social, cultural and environmental values, and (iv) emphasizes both the economics of water and the collective non-ownership of water. This is most effectively accomplished with a national legislated initiative that is implemented through state and local government.

The Author will discuss how an effective governance system begins with guidance from national and state governments for communities to create strong governance institutions that define common public policies, and regulators that govern independently of politics. As a policy maker, this coordinated government effort must set forth long term objectives for coverage and quality of service that contain clear guidelines on water service investments, financing, and subsidies. Regulators must be independent, must monitor compliance with legal and contractual obligations, set tariff levels, and

resolve conflicts among stakeholders in the community. In addition, and most importantly, the regulator must articulate and maintain a balance between independence and accountability. The regulator must function without political interference and remain answerable to its constituents. It is imperative that stakeholders participate in the decision making process, that an effective appeals process exist, that financial autonomy is balanced with financial accountability, and clearly specified accounting guidelines are in place. Any and all outsourcing must be transparent and subject to open bid; and all tariff regulation must be publicly accountable, and based on quality of service, fair allocations, productive efficiency, financial sustainability, social equity and administrative effectiveness. Lastly, regulatory leadership must be structured in a way that balances efficiency and prevents corruption. The incorporation of these elements in any governance model will greatly serve the national agenda.

In conclusion, it is the Author's opinion that infrastructure is weakest in the places least capable of meeting the financial requirements of investment partners and where strong regulators do not exist, lack credibility and independence, or exist in unstable legal jurisdictions. The World Bank and other multi-lateral agencies must continue in their efforts to accelerate water investments, to build infrastructure and promote sub-sovereign financing. They should also consider the benefits of PPP and stronger regulation that is based on new laws that clarify regulatory powers and provide sufficient legal rights for PSPs and secured lenders beginning from a national legal platform. An effective governance model must be founded on the recognition that a legal and fair allocation of risk and reward does not sacrifice the public interest. This requires public promotion and education on a national level, and a complex balancing of government interests and stakeholder interests.

Development of Joint Information Infrastructures and Services for the Transboundary Daugava/Zapadnaya Dvina and Nemunas/Neman River Basin Districts, the Baltic Sea Region (DatabasiN project)

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Keywords: GIS, environmental information, transboundary river basins, asymmetric access to information, trust

Administrative regions, such as counties, states and countries, are rarely the most appropriate for management of water related resources. Lakes, rivers and ground water cross and span our, from a water perspective, "artificial" administrative boundaries. Water management through drainage basins represents an alternative for our shared water resources, which in Europe lately has been championed by the EU Water Framework Directive. Drainage basins, or watersheds, represent the land areas where all the surface water flows into a single river. These basins can vary in size, and one large basin is made up of multiple smaller basins.

This project takes a transboundary and basin-wide approach at spatial information for the Daugava/Zapdnaya Dvina and Nemunas/Neman river basins. These rivers originate in Russia and Belarus and pass through Latvia and Lithuania, respectively, before reaching the Baltic Sea.

The overall aim of the project is to develop joint information infrastructures and services for these two river basins, and thereby reducing asymmetric access to pertinent environmental (spatial) information among the countries concerned. This is one way to minimise problems related to mistrust and increase effectiveness.

To enable management, and planning, a first step is to get an overview and assemble the available data and information, to support decision-making and assessment. In practice, this means assembling basin-wide map databases on existing data, primarily from national sources, as well as from global and regional datasets. National data are being harmonized to establish basin-wide layers. Furthermore, the data and information collated and harmonised will be made available, as much as copyright restrictions allow, through the Internet using WebGIS services.

The databases prepared through this project will assist planning and decision-making on such issues as:

- Characterisation of the river basins to support the River Basin Management Plan according to the EU Water Framework Directive
- Water quality issues: surface water quality monitoring data (point and non-point sources of pollution) and pollutants from industries, agriculture and urban waste water treatments plants
- Cooperation on transboundary protected areas
- Hydromorphological alterations: dams, hydropower plants, etc

Based on the goals and key water issues data can be defined. Several data layers are prioritised:

- International borders and administrative units
- Hydrological information
- Geological information
- Land use/land cover
- Soil information
- Elevation model
- Protected areas
- Hydrographical network
- Water monitoring network
- Water quality monitoring data
- Pollution points

Conclusions and recommendations

At its present stage the project confirms many of the known difficulties in developing joint GIS databases for transboundary river basins as noted elsewhere, but also demonstrates that if a pragmatic approach is being taken important steps towards the aim of the project can be taken. Further, it seems that the project outputs can positively contribute to a more genuine river basin approach for the River Basin Management Plans to be developed for the two River Basin Districts covered. Otherwise, it would be a risk that only the parts covered by the EU countries Latvia and Lithuania would be covered.

This project, managed by UNEP/GRID-Arendal, is set up to run in 2006 and 2007 and is funded by the Swedish Environmental Protection Agency. A team of Swedish experts is supporting the countries of Latvia, Lithuania, Belarus and Russia in the project development.

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