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The statistics in 1994 reveal that approx. 800 million people in rural areas and 300 million residents in urban settlements had no access to a safe water supply. As the rate of new service provision cannot adequately keep pace with the population growth especially in urban areas, this situation has hardly changed in the last 4 years. Hence, the unserved populations have to find their own ways and means to cover their daily water demands. Consequently, new water supply approaches and treatment processes for use at household level have to be developed to allow the poor to help themselves. SODIS is such a simple and low-cost water treatment process for unserved populations to treat their drinking water.

As reported in SODIS News No. 3, SODIS was introduced in demonstration projects at village level in 7 different developing countries, and the experience gained so far is encouraging. However, the introduction of SODIS to a limited number of demonstration villages will not change the water supply situation for the 1,100 million unserved population. Significant changes in the water supply coverage are only attained with large-scale dissemination programmes. Such programmes require, however, financial resources from external aid agencies and executing institutions, which are preferably provided by local NGOs.

A SODIS e-mail conference was initiated by SANDEC to raise the awareness of SODIS among the international donor agencies. The conference participants determined the potentials and limitations of the reviewed process and recommended additional studies and follow-up activities for the promotion of SODIS. The results of this conference are presented in a synthesis paper contained in this SODIS News and in an attached file on the homepage http://www.sodis.ch. This e-mail conference certainly enhanced the dissemination of SODIS at international level.

At national level, local lead agencies are preparing SODIS information material and establishing networks for the implementation of this new water treatment method. Since these activities require financial resources, SANDEC is grateful to the Swiss Agency for Development and Cooperation (SDC) for funding the development and dissemination of SODIS. Within this framework, cooperation agreements with three local lead agencies located in Indonesia, Togo and Bolivia were signed to support their promotional activities of SODIS.

In addition to these formal cooperation agreements, SANDEC is supporting numerous SODIS field testing activities of local organisations presenting this new water treatment method at workshops and conferences, preparing information material for target groups, and finally, implementing SODIS in ongoing projects. The present SODIS News describes some of these activities. Since these organisations face numerous and different problems, SANDEC is willing to provide its technical support and expertise in the field of SODIS.

To bring about changes in the water supply situation, the input of all water supply stakeholders is necessary. SANDEC is committed to contribute to this change by a sustained development and promotion of SODIS.

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Filling the Information Gap

SODIS conference synthesis paper signed by members international and national institutions

Demonstration projects in various developing countries revealed good socio-cultural acceptance of SODIS. However, it may not attract the required interest and lead to an information problem. For this reason, an international e-mail conference was held and a conference paper signed.

A field study programme carried out with the help of demonstration projects located in seven different developing countries (Colombia, Bolivia, Burkina Faso, Togo, Indonesia, Thailand and, China) revealed good socio-cultural acceptance and affordability of SODIS by the target population. At the beginning of this programme, a total of approximately 550 households participated in the SODIS demonstration projects. One year later, 1'260 households used SODIS. The final evaluation revealed that 84 % of the households will certainly continue to use SODIS after the formal end of the projects. Hence, SODIS is accepted at village level in the demonstration projects, however, for a large dissemination of this water treatment alternative general awareness and acceptance has to be achieved at national and international level (SODIS News No. 3).

Socio-cultural aspects, scientific evidence and control possibilities for adequate application might hinder large-scale dissemination and efficient use of SODIS. The water treatment method may, therefore, face the following limitations:

- Although SODIS is a very simple and not spectacular water treatment method, it is often difficult to inform people about the effects of UV-A radiation, temperature, and turbidity on the inactivation of harmful microorganisms. Such information is generally beyond the understanding of most the communities.
- The need to boil the water before it is consumed has been passed on for years by teachers to school children, and by health workers and medical personnel to the communities. All of a sudden, boiling is no longer necessary. Exposing the water to sunlight and heating it to 50 °C is sufficient to kill the harmful microorganisms. This message is difficult to understand not only by the target population, but also by the community responsible for public health.
- Common plastic bottles normally do not attract public interest. However, water treatment is generally declared as an important factor in maintaining a healthy life. Important things are usually handled with special care and equipment. SODIS application is not spectacular and may, therefore, not attract the same spontaneous interest as something excitingly new.

Information Need

Since SODIS is a modest technology, it may not attract the required interest and lead to an information problem. Most of the promising new approaches are currently being applied on a relatively small scale, often by NGOs. They are usually not regarded as serious engineering options by professional and scientific circles. Therefore, many new approaches have already been pioneered, however, they have not yet widely been applied or comprehensively enough to attain a significant breakthrough leading to more effective and sustainable solutions. The SODIS demonstration projects at village level have been accepted by the beneficiaries, however, acceptance at national and international level is required to enhance its dissemination in areas suitable for SODIS application. SODIS violates the general recommendation to boil unsafe water which has been propagated by public health officials for many years. These people are often unaware of the real thermo-sensitivity of microorganisms and tend to attribute too much importance to water quality. The behavioural changes, expected from the communities, cannot be sustained if policy makers and administrators do not support them. A clear understanding of the potential and limitations of SODIS is, therefore, required.

SODIS E-mail Conference

SANDEC (Water Supply and Sanitation in Developing Countries), a department of EAWAG (Swiss Federal Institute of Environmental Science and Technology) organised an international e-mail conference in order to create awareness among national and international agencies. Comprehensive information material (a background paper, technical notes and a video on SODIS) were sent to the workshop participants who reviewed and discussed this alternative water treatment option. The findings and recommendations of this conference are summarised in a synthesis paper (see following two pages). This paper is also available in Spanish and can be downloaded from our homepage: http://www.sodis.ch.

New approaches and strategies have to be applied for an effective promotion of SODIS. The development of national SODIS networks and the involvement of the private sector in dissemination activities are such unconventional new possibilities for the marketing of SODIS.

Solar Water Disinfection – a water treatment option for the year 2000 and beyond

Solar Water Disinfection (SODIS) is a simple technology using solar radiation to inactivate and destroy pathogenic microorganisms present in the water. The treatment basically consists in filling plastic bottles with water and exposing them to full sunlight for about five hours. The Department of Water and Sanitation in Developing Countries (SANDEC) at the Swiss Federal Institute for Environmental Science and Technology (EAWAG) in cooperation with numerous partners in developing countries has developed and field tested this water treatment option. The SODIS project has been substantially cofinanced by the Swiss Agency for Development and Cooperation (SDC). The participants of the International E-mail Conference organised by SANDEC reviewed and discussed SODIS as a potential water treatment process. To enhance dissemination and promotion of SODIS, they are endorsing the following statements:

The participants agree:

- SODIS is a simple water treatment process to improve the microbiological water quality for use as drinking water
- SODIS inactivates or destroys most pathogenic microorganisms present in the water through solar radiation and thermal treatment
- SODIS requires plastic bottles which are easy to handle and also convenient for storage and transportation of water
- SODIS application is simple and, therefore, ideal for use at household level
- SODIS reduces the risk of recontamination since the water is treated and stored in the same closed container until consumption
- SODIS does not require the addition of chemicals and, hence, does not affect the taste nor smell of water
- SODIS is a sustainable water treatment method as it makes use of locally available resources only
- SODIS is a low-cost technology since its investment costs are low and its running costs negligible
- SODIS is a reproducible water treatment approach requiring low capital investment costs and short construction periods
- SODIS demonstration projects have been well-accepted by the target population in seven developing countries
- SODIS is an environmentally sound technology, as it reduces the demand of firewood and charcoal, thereby, decreasing the rate of deforestation
- SODIS uses empty plastic bottles and, thus, enhances the recycling of solid waste.

The participants admit:

- SODIS does not improve the chemical water quality
- SODIS requires favorable climatic conditions; i.e., sunlight radiation and ambient temperatures preferably not under 500 W/m^2 and 20 °C
- SODIS should be applied to raw water of low turbidity, preferably with less than 30 NTU
- SODIS offers limited production capacity and, therefore, is used to treat only water for consumption; i.e., 1-3 liters of water per person and day
- SODIS is based on the use of adequate plastic bottles not always readily available to the target population
- SODIS could cause environmental problems if the plastic bottles have to be replaced too frequently
- SODIS has been tested for inactivation of bacteria and viruses, however, its efficiency in destroying parasites is still unknown
- SODIS improves the microbiological water quality, however, its impact on the health situation of the users has not been evaluated so far
- SODIS shifts the burden of treatment away from centralized systems to individual households where day-to-day behavior is often hardest to change
- SODIS, though a simple technology, requires adequate training of the users
- SODIS requires the acceptance of the users which is also influenced by their socio-cultural background
- SODIS, as an alternative process to water boiling, may not be readily accepted by public health authorities
- SODIS is not a spectacular water treatment process and may, therefore, not attract the necessary public interest required for its widespread dissemination

- ☐ SODIS has an excellent potential as a simple, inexpensive alternative for improving water quality. Nevertheless, additional research is still required before a wide dissemination and promotion of the technology can be undertaken.

The participants therefore recommend:

1. Additional studies should be conducted in order to:

- ☐ Test the durability and material properties of the plastic bottles in each country / region where SODIS will be implemented. These studies should investigate physical property changes of the plastic material (photoproducts) and their possible health risk to the consumer.

  Note: Comprehensive laboratory tests carried out by Swiss research institutions reveal that the photoproducts are formed on the outer surface of the plastic bottles and no substances hazardous to health are leached into the water. These research results will be published in an international journal. However, careful selection of the plastic bottles for SODIS use (PET and not PVC bottles), and determination of their durability by simple field tests have to be conducted at national level.

- ☐ Investigate the inactivation of parasites (e.g. Giardia and Cryptosporidium) by SODIS.

  Note: The Swiss Tropical Institute (STI) has, in cooperation with SANDEC, initiated laboratory tests to study the inactivation of Giardia and Cryptosporidium by SODIS. Additional research focusing on these or other organisms is welcome.

- ☐ Assess the impact of SODIS on users' health by epidemiological studies.

  Note: STI and SANDEC are planning to conduct health impact studies on ongoing SODIS demonstration projects in cooperation with local institutions.

2. Demonstration projects have to be initiated in order to:

- ☐ Study user interest, acceptance and affordability of SODIS under different socio-cultural, economic and environmental settings.

  Note: Local institutions should field-test SODIS on a pilot scale to assess the acceptance by the target population, and to develop approaches and material adequate for local dissemination of the water treatment method. External support agencies should support such pilot scale studies.

- ☐ Identify its niche in the rural and urban water sector.

  Note: In general, SODIS should be viewed as a complement to, rather than a systematic substitute for centralized water treatment. Possible applications of SODIS include the following situations:

  ⇒ where central treatment is inherently not viable (e.g. in rural areas and in very small towns where people are supplied by contaminated point sources or continue to use polluted surface water for human consumption),

  ⇒ *where central treatment exists but has become dysfunctional and cannot be rehabilitated quickly (e.g. countries suffering from severe economic crises/ civil war/ political unrest),*

  ⇒ *where central treatment does not yet exist.*

- ☐ Build up local expertise and raise awareness of SODIS amongst the different actors in the water supply sector.

  Note: Practical application of SODIS is important to acquire competence and to identify the advantages and constraints of this water treatment method. Local institutions are invited to take up this challenge, and funding agencies to support local initiatives.

3. SODIS requires widespread promotion and marketing in order to:

- ☐ Raise interest and awareness in the SODIS method at national and international level.

  Note: SODIS is not yet well-known and understood by policy makers. Once efficiency, acceptance and sustainability of SODIS has been proven in pilot projects, large-scale dissemination programs will have to be initiated to attract the necessary public attention for this technology.

- ☐ Gain international and national recognition and appropriate acceptance by development agencies and local governments.

  Note: SODIS has to be discussed and assessed by international leading agencies (e.g. WB/UNDP, WHO, UNICEF, etc.). After thorough review of this technology, recommendations on SODIS should be formulated. These recommendations will enhance its acceptance by local governments and guide them in the application of SODIS.

This Synthesis is endorsed by the following participants of the SODIS E-mail Conference:

Mr. Franz R. Drees, WB / UNDP, Washington, USA
Mr. Babar Kabir, WB / UNDP, Dhaka, Bangladesh
Mr. Abu Jafar Shamsuddin, WB / UNDP, Dhaka, Bangladesh
Mr. Adalid Arratia, WB / UNDP, RWSG/AN, La Paz, Bolivia
Mr. Eric Cole, WB / UNDP, RWSG/WA, Abidjan, Ivory Coast
Mr. José Hueb, WHO, Geneva, Switzerland
Mr. Han Heijnen, WHO, Dhaka, Bangladesh
Mr. Greg Keast, UNICEF, New York, USA
Mr. Arun Mudgal, UNICEF, New Delhi, India
Mr. Ian Curtis, DFID, London, England
Mr. Jo Smet, IRC, The Hague, The Netherlands
Mr. Armon Hartmann, SDC, Berne, Switzerland
Mr. Walter Meyer, SDC, Dhaka, Bangladesh
Mr. Ned Breslin, Mvula Trust, Braamfontein, South Africa
Mrs. Camille De Stoop, ENDA Ethiopia, Addis Ababa, Ethiopia
Mr. Carlos Dierolf, Universidad del Valle, Cali, Colombia
Mr. Olver Coronado, Programa de Aguas, Cochabamba, Bolivia
Mrs. Christina Aristanti, Yayasan Dian Desa, Yogyakarta, Indonesia

Martin Wegelin, Programm Officer Water Treatment,
EAWAG / SANDEC, Duebendorf, Switzerland, March 1999

SODIS helps reducing deforestation

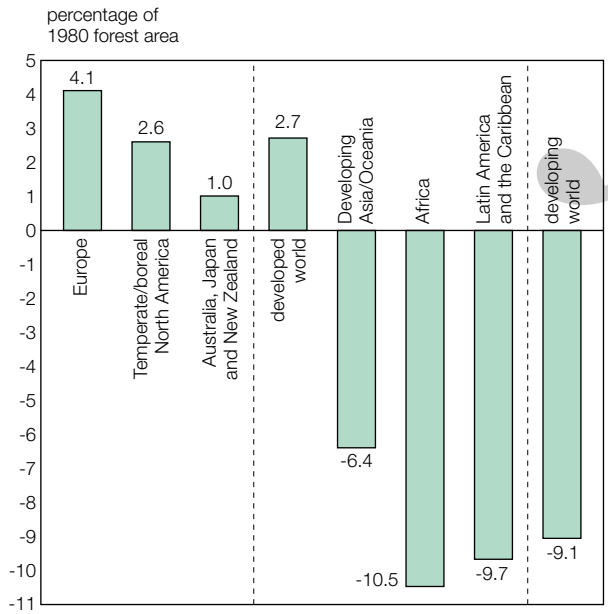
Annual forest area loss: Three times Switzerland

The extent of the world's forest decreased by some 180 million ha between 1980 and 1995, an area, which is about the size of Indonesia or Mexico. This represents an annual loss of 12 million ha, about three times the size of Switzerland. During the 15-year period, the developing world lost nearly 200 million ha of natural forest, mostly through clearing for agriculture. This was only partially compensated for by new forest plantations.

Developed countries: Increase of forest cover

Over the same period, forests in the developed world expanded slowly (by some 20 million ha) through afforestation and reforestation, including natural regrowth on land abandoned by agriculture. This increase more than compensated for the loss of forests in developed countries due mainly to urbanization and infrastrucutre development.

Comparison of 1980 and 1995 forest areas (in % of 1980 forest areas)



Situation in Asia and the Pacific

Forest cover in the temperate areas of the Asia-Pacific region has essentially remained constant In contrast, the region's tropical forests have declined substantially. In the tropical counttries of Asia, deforestation amounted to 3.9 million ha per year between 1980 and 1990. This represented the highest annual rate of deforestation (1.2 percent) among the tropical regions of the world. The estimated rate for 1990-95 is somewhat lower (1.1 percent).

The two major direct causes of forest loss in Asia and the Pacific are clearing for agriculture (including shifting cultivation) and excessive cutting of timber. Other important causes of forest destruction include fuelwood harvesting; mining, irrigation and hydroelectric projects; and urban expansion.

Forest degradation is also a serious problem in the region. Commercial harvesting has been more widespread and intensive in tropical Asia and the Pacific, than in any other tropical region. High population densities have also led to widespread forest degradation from fuelwood and fodder harvesting, cattle grazing, shifting cultivation, and timber harvesting for local construction.

Situation in Africa

Forests cover an area of 520 million ha, or about one-third of the land area of Africa. They consist of dry tropical forest located in the Sahel and in eastern and southern Africa; humid tropical forests in West and Central Africa, and various subtropical forests and woodland formations in North Africa and in the southern tip of the continent. Land-use changes, particularly over the last 20-30 years, have been largely responsible for the extent and condition of the forests today.

The dry tropical forests, including woodlands, savannah and steppe formations, are located in areas dominated by subsistence agriculture and rangelands which support large numbers of livestock. Pressure on these for-

ests due to agricultural expansion, and increased fuelwood collection and livestock grazing is heavy in many places. Drought and fire are major causes of *degradation*. The annual rate of deforestation in the region was estimated at 0.7 percent, with the highest rate (1.0 percent) in west moist Africa, and the lowest (0.2 percent) in non-tropical southern Africa. Afforestation efforts are unable to keep ahead the loss of natural forests.

Fuelwood and charcoal consumption [million m³] and annual growth rate

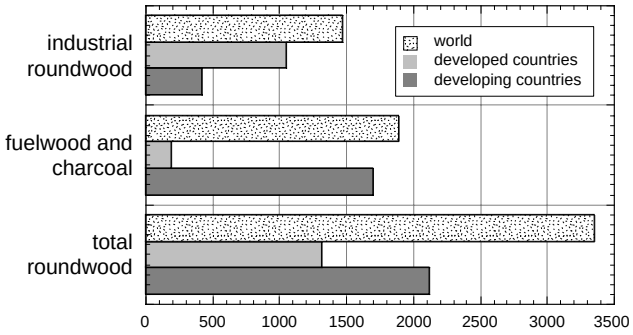
	1980	1990	1994	Rate [%]
Africa	330.5	443.8	502.2	3.03
Asia	675.1	816	878.2	1.90
South America	195.5	234.4	258	2.00
North/Central America	139	145.9	160.9	1.05
Europe	52.1	52.3	51.8	-0.04
Oceania	7.1	8.8	8.7	1.53
former USSR	78.9	81.1	30.6	-6.55
world	1478.1	1782.3	1890.4	1.77

Planting efforts in the dry areas of the region have been focused on meeting wood energy needs and controlling desertification. Dryland forest resources in the two Sahelian sub-regions continue to be exploited extensively to meet the energy needs of growing populatins. In spite of the tremendous efforts in the 1970s and 1980s by countries to increase fuelwood production and reduce consumption, the results were not as successful as had been hoped.

Situation in Latin America and the Caribbean

Almost all (95 percent) of the natural forests in the region are tropical (852 million ha), located in Central America, the Caribbean and tropical South America. The remaining resources, covering some 43 million ha, are found in temperate South America, mainly in Argentina, Chile and Uruguay.

Comparison of wood consumption in developed and developing countries



The natural *forest cover* continues to decrease in all countries due to: clearance for agriculture and stockfarming; construction of roads, dams and other infrastructure; and mining. A total of 5.3 million ha of forest was lost per year over the period 1990 to 1995. T highest average annual deofrestaion rate occured in Central America (2.2 percent) followed by the Caribbean (1.7 percent). Deforestation was lowest in the temperate countries of the region. Causes of *forest degradation* include fire, pest infestation and extraction of timber and fuelwood. Forest fires are a major cause of forest degradation, especially in the arid and semi arid zone. They usually arise in association with the clearing of land for agriculture.

Fuelwood: On big demand

In developing countries, minor attention is paid to forest condition, because reduction in forest area is the most striking aspect of forest change. Although the extent and degree of overharvesting of fuelwood and overgrazing are difficult to quantify, they are recognized as major causes of forest degradation in some developing countires, particularly in arid and semi-arid zones. Especially in Africa, fuelwood is on big demand and represents more than 85% of the total wood consumption in comparison to only 15% in developed countries. In total, slightly more than half of the wood volume in the world is used as fuelwood.

What can SODIS do?

In some regions of the developing countries, up to 50% of the fuelwood consumption is used for disinfecting water by boiling it. SODIS is an alternative method to boiling and eliminates almost all bacterias and viruses in drinking water, without depending on fuelwood or any other non-renewable resource. The method is designed for those areas where fuelwood is a scarce commodity and where economic growth has not yet introduced high-tech water purification systems. A widespread use of SODIS could therefore provide bottable water even for the poorest people in the world without aggravating the deforestation problem.

Reference:
The State of the World's Forests 1997 (SOFO 1997)
http://www.fao.org/WAICENT/FAOINFO/FORESTRY/SOFOTOC.htm

"Seeing is Believing"

SANDEC in cooperation with SDC (Swiss Agency for Cooperation and Development) is supporting the development of national SODIS networks in Indonesia, Togo and Bolivia. SANDEC's cooperation partners in these countries are acting as leading agencies and are preparing SODIS information material, initiating new projects and establishing networks to enhance information exchange. Independently, demonstration projects are in preparation or in progress also in other countries such as Bangladesh, Sri Lanka, Ethiopia, South Africa, Cameroon and, Ecuador in order to study efficiency and socio-cultural acceptance of the process. The following two chapters summarise the progress made in the preparation of the SODIS networks of Indonesia, Togo and Bolivia and report the experiences on SODIS received from various countries.

Yayasan Dian Desa: Dissemination and promotion in Indonesia

SANDEC's local partner in Indonesia, Yayasan Dian Desa (YDD) is acting as leading agency in the SODIS dissemination project of this country. The programme has the following objectives:

1. To develop a strong and active network on SODIS promotion and dissemination in Indonesia.
2. To strengthen the capability of participant organizations of the SODIS network in order to enable them to effectively disseminate the SODIS technology to the target communities. The strengthening process will include technical and social marketing aspects.
3. To promote the importance to use SODIS technology as an alternative drinking water treatment and the role of SODIS as an integral part component of sustainable, social, economic, and environmental development. This will be done among others through the integration of SODIS into existing water activities in Indonesia.
4. To assist the participant organizations in obtaining support from various sources for dissemination action in their respective locations.

Since early '99, YDD has carried out the following activities:

The first few months were dedicated to the development of support materials for the dissemination of SODIS such as leaflets, posters, manual, and comic book.

In addition, however, besides directly doing some social marketing of SODIS to different institutions, promotion of SODIS was also carried out through exhibition, workshops, meetings. etc.

Special efforts were made to develop the national SODIS Network with the following activities:

Irian Jaya Province

Contact was made with YPMD, a leading NGO working in the Irian Jaya Province. Although there has been no definite plan yet, YPMD has stated interest to disseminate SODIS in their area. They really think that SODIS will provide a very useful alternative to the people of Irian Jaya where the majority still live under very primitive and poor conditions. They have been provided with the workshop proceedings and SODIS leaflet.

Bandung Area

A contact was made to the Department of Health of West Java, Boromeus Hospital, and Doctors' Association of West Java regarding SODIS. There has been a good response from those institutions. In April 1999, a workshop was held in order to introduce the idea of SODIS to field staff of NGOs implementing water supply project and to officials of governmental institutions. The one day workshop ended up with the enthusiasm of the participants to try and disseminate SODIS in their projects. The government health local department also gave a good support to the adoption of SODIS. In addition, most of the participants also recommended that a further study related to the decrease of diarrhoea incidence by the SODIS intervention should be conducted. The St. Borromeus Hospital in cooperation with the local health authorities and the Swiss Tropical Institute are therefore planning to carry out such a health impact study next year once SODIS has been introduced to Bandung area.

East Timor Province

The meeting and discussion resulted in the agreement that a dissemination project should be held in East Timor province. It is also planned that prior to the project implementation, a one-day workshop will be held in Dili, the capital of East Timor.

A further step was the writing of a proposal. The proposal was submitted to UNICEF-East Timor. Although basically there has been a positive response from UNICEF-East Timor, no agreement has been signed.

It should be noted, however, that we are all not sure what is going to happen with East Timor politically, and this means it will also affect our planning program there.East Nusa Tenggara

Since September 1998, there has been a good progress in the networking activities conducted in East Nusa Tenggara.

In October 1998, Yayasan Dian Desa participated in an exhibition conducted by the local government. It was referred to as a Development Exhibition. The small booth of Yayasan Dian Desa exposing SODIS was quite of interest to many. The best thing was the interest of the Governor himself and right away he supported that SODIS be disseminated in East Nusa Tenggara Province. Yayasan Dian Desa who had submitted a proposal to UNICEF of East Nusa Tenggara for SODIS dissemination project through schools in NTT comprising four districts, later added three more districts, and UNICEF was also willing to support the three additional districts. The agreement was already signed and preparation was started. The dissemination in each district is planned to be started with a one-day training workshop on SODIS for the teachers and health officers of the respective districts as part of the dissemination and networking formation in the localities.

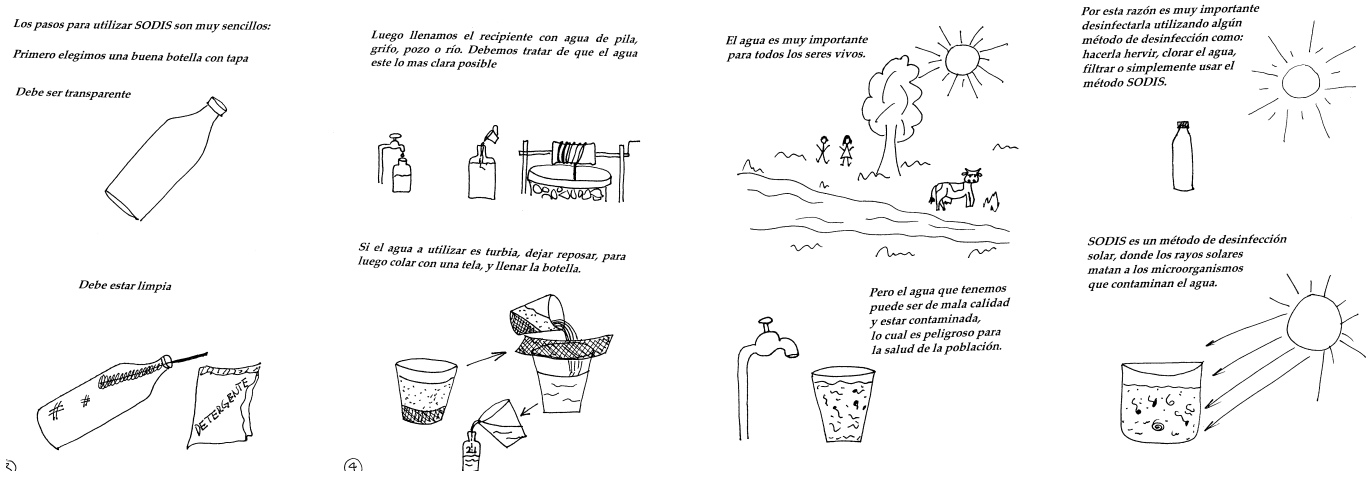
CREPA: Preparing SODIS dissemination in Togo

CREPA-Togo has carried out a feasibility study in order to assess the potential and constraints for a SODIS dissemination project in Togo. In a intermediate phase it is planned to field tests SODIS in selected 20 villages located in the 5 Regions of Togo. Socio-cultural acceptance of SODIS by the different ethnic groups, willingness to pay for the water treatment method and a SODIS plastic bottle supply scheme will be studied among other aspects during this intermediate phase.

Survey in 500 households carried out

A survey covering a total of 500 households (25 households per village) was carried out by specially trained interviewers to assess the water treatment need and the interest in SODIS of the target population. Presently, approx. 45 % of the population are supplied by

Woman in Togo capturing water, naturally filtered by the sandbed. This method efficiently reduced turbidity, but does only partly eliminate the pathogens.



untreated surface water and hence, the need for water treatment seems to be apparent. However, water treatment might be avoided in certain areas by the development of alternative water sources such as shallow wells and drilled boreholes. Nevertheless, the interviewed population is interested in water quality improvement since the people already apply ingenious water treatment methods (see photo above).

Plastic bottles in Togo are not very easy to find

Unfortunately, plastic bottles of adequate quality are not easily available in Togo. They are imported as Coca-Cola and Fanta soft drink bottles from Nigeria. CREPA-Togo is now assessing different options (e.g. importation of empty bottles from neighbouring countries, modification of mineral bottles produced locally, start of a local PET bottle production) in order to achieve a sufficient procurement of SODIS bottles.

Based on the results of the feasibility study, CREPA-Togo intends to elaborate a detailed project proposal to be submitted to potential external support agencies. Contacts with UNICEF are already established. SODIS dissemination projects should be initiated towards the end of '99 provided the SODIS bottle supply and the financement of the projects are secured. Once the SODIS projects have taken off, it is planned to carry out a SODIS efficacy study in cooperation with the Swiss Tropical Institute in order to assess the health impact of SODIS on the respective users.

Programa de Aguas: SODIS Information Material for Bolivia

SODIS dissemination is also an information problem in Bolivia. Therefore, Programa de Aguas (PdA) in Cochabamba as SANDEC's local partner has developed different information material to address various groups of people. Informative leaflets referring to basic health aspects and introducing SODIS are produced for the executives of the communities, training documents prepared for field staff, folders (see also Fig. X) presenting the SODIS process printed for the users of the treatment method and a poster as well as a video will be used to address the large public.

All this information material on SODIS will be introduced by workshops to be held in the 9 Departments of Bolivia. Field staff from implementing agencies from governmental and non-governmental institutions are invited to attend these workshops. Furthermore, PdA as leading agency of the SODIS project in Bolivia is supposed to prepare a detailed project proposal for a large-scale dissemination of the water treatment method in this country.

Experience from Sri Lanka

J. P. Padmasiri, Chemist, NWSDB, Peradeniya, Sri Lanka

In early 80 's, I was roaming through the rural communities in Sri Lanka as a young, less experienced development worker to assist the rural folks to solve their water & sanitation problem which was among of their major burning issues. Spring fed gravity systems and the shallow wells were the only technical options which was offered to the villagers from the project as we believed those are the last long technologies (expression of "sustainability" wasn't existing at that time!). All the structures of the gravity water schemes were constructed by the stone masonry and the shallow wells were constructed by using concrete rings.

As a custom or rather a practice we were used to construct the reservoirs buried in the soil and only the entrance to the tanks were exposed. Similarly all most all the shallow wells were either covered on top and a handpump was fixed or else there was a opening on the cover slab so that people can draw water by using a bucket and rope. We were always insisted on covered structures and the maximum precautions were taken against contamination as the project was very much concerned on the quality of the drinking water. But very often, in most of the projects there was always someone, a villager who would approach me politely and say they do not like the covered structures as they had serious doubts about the quality of the water in covered structures since stored water is not exposed to the sunlight. As a person who hails from a rural village, I knew that in rural communities of Sri Lanka, they feel comfortable (or traditionally believe) to fetch water from the open wells which are located in sunlit places. No one of them had a scientifically proved theory but surprisingly was it their "basic instinct" which convinced them that the sunlight can kill pathogens? Or was it a something complete different reason, I do not know yet.

Fig. 1: Coliform counts of samples, tested at the laboratory of National Water Supply & Drainage Board, Sri Lanka. (TC: Total coliforms F.C.: Faecal coliforms)

Date	Air temp. variation °C	Bottle temp. at the end of the day	Bottle No.	Initial T.C.	Initial F.C.	Final T.C.	Final F.C.
21 Dec	28.1 - 31.1 °C	44 °C	1G	1600	800	8	0
			2G	560	80	0	0
			3G	320	64	0	0
			1P	900	12	14	0
			2P	240	0	20	0
			3P	160	12	12	8
22 Dec	29.2 - 30.8 °C	49 °C	1G	8	0	4	0
			2G	0	0	0	0
			3G	0	0	0	0
			1P	14	0	0	0
			2P	20	0	10	0
			3P	12	8	0	0
23 Dec	31.1 - 33.1 °C	52 °C	4G	100	0	20	0
			5G	320	32	0	0
			6G	640	240	0	0
			4P	120	4	32	0
			5P	140	0	0	0
			6P	900	40	0	0

However, I used to convince them explaining the rate of probability of contamination and the algael growth in un-covered structures, in addition to the better taste which derives from the coolness of the water in covered (against the sunlight) reservoirs. They trusted me since they thought (most likely) "this guy is an expert in his job and he knows better than us", the usual acceptance or the humble respect from a Sri Lankan villager. Did I know (or even do I) better than them or have I misled them in certain elements? The question was well answered in early 90's when I heard about SODIS for the very first time and met Martin Wegelin of SANDEC in a latter year.

In Sri Lanka, there are many rural and even peri-urban communities who do not have access to safe drinking water due to many number of reasons which are commonly known in many developing countries. There are substantial investments and serious attempts by various agencies in order to find solutions to this burning problem but the sustainability in water supply & sanitation is yet a distant goal. Insufficient funds for operation and maintenance and the weak & intermittent management structures at community level will not be simple issues which can be dealt with overnight. Whilst working towards this long term achievements, it's also worthwhile to look for alternative strategies which can positively contribute towards the same objective. In Sri Lankan context SODIS will be such an alternative which is effective, practical and simple enough to be applied by individuals or households. However, SODIS technology itself will not be "the solution" but it could be "a solution" to improve the quality of drinking water. For an instance, in an any given community in Sri Lanka, raw water (stream or irrigation) could be treated by an efficient, effective roughing filter at community level and later SODIS could be applied at household level which will definitely minimize the burden on issues like O&M and the community management compared

with other treatment technologies.

COSI Foundation, which is an active organisation in the water and sanitation sector has already identified the need and the necessity of dissemination of SODIS technology in Sri Lanka. In near future, COSI expects to try out SODIS in selected 80 communities with the help of CBOs/NGOs as research partners who are working in various geographical areas where SODIS will have a higher degree of demand. During the one year research period, it is expected to study the socio-cultural, technical, economical, environmental aspects related to SODIS which may facilitate the dissemination of SODIS later throughout the island. Recently, as a trial, SODIS has technically tested at the laboratory of National Water Supply & Drainage Board at Peradeniya which gave successful results (see Fig. 1).

SODIS Test: Down to zero

A set of glass bottles and a set of plastic bottles with a capacity of 750 ml were taken for the trials. One half of each bottle was painted in black to preserve the heat falling on to the bottle. The bottles were filled with rain water and kept in sunlight for six hours with the clear side facing the sun. At the end of the each day all the samples were subjected to micro biological examination. Rain water was selected for these trials because its micro biological quality is somewhat similar to that of ordinary shallow wells. The first set of samples disinfected by sunlight on 21st December 98 were further subjected to solar disinfection on the next day.

The results clearly showed that faecal coliform counts could be brought down to zero level in both glass and plastic bottles, thus indicating SODIS as a sucessful method to do the disinfection of water in many communities in Sri Lanka. To which extent the Sri lankan communities are going accept SODIS is yet to be researched.

Experience in Ethiopia

Desalegn Eyobe, Desalegn News Agency, Addis Ababa.

Half the world cooks daily meals over fires. For one out of every three people in the world wood is becoming scarce and cooking is difficult. In recent years wood shortages in many developing countries have added hardships to already burdened families, particularly in Eastern and Southern Africa. The annual wood consumption for cooking in most parts of the world is about 3 tons per family of six people.

The World Health Organization says 40,000 children die from water borne-diseases each day. About 80% of the hospital cases in Ethiopia are related to water borne and/or water related diseases. Families are less able to heat/pasteurize their water and milk to reduce water borne diseases, the major killers of children.

Ethiopia is a country with a per capital income being one of the lowest in the world. For too many, fuel is too scarce to even heat water to kill germs. Two of the world's pressing problems- growing scarcities of cooking fuels and the sourage of water-borne diseases can be helped with solar water treatment. Solar energy easily pasteurize water. Ethiopia is a thirteen months of sunshine country. The main ingredient of solar water treatment is sunshine, which is free.

FORUM FOR ENVIRONMENT was established in June 1997 with an aim to create links between all those who are concerned with the Environment in Ethiopia. With these respect the FORUM held a half day meeting on SODIS. It was organized with the aim to create awareness on different options and give basics about the SODIS technology. Before the meeting, four well-water samples had been analysed in around Addis Ababa. Two of raw water and two of the same water after 5 hours exposure to the sun in plastic bottles. The results were convincing. One of the sample was so infected with pathogens, that it had not been possible to make a count of the pathogens. The Number of pathogens after the SODIS treatment was nil.

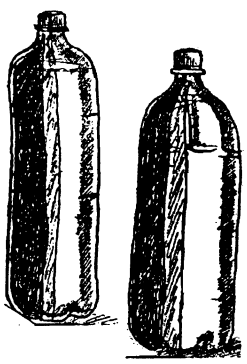
The presentation was followed by questions and discussions, which helped to see SODIS from different directions. All in all, participants felt the technique should be promoted in Ethiopia but a proper package has to be prepared, including wider test results using different types of bottles and clean instructions, in a language understandable by any layman, on how to use the technique.

Mail from and to Somalia

Dear Mr. Wegelin,
I have read your article in a recent Waterlines on SODIS and earlier this month I had to go to Somalia for a mission with SAWA-Netherlands a dutch foundation. My job was to look for viable, approrpiate ways to improve the waterquality for rural areas. People there are nomadic and catch (scarce) rainwater in groundtanks, thus it becomes very contaminated. One of the only options there was to do something with SODIS, because it is very hot and plastic jerrycans are available. I did some tests with black jerrycans (10 liter) in a wind free location for 4 - 5 hours and found after testing with Del Aqua kit that almost all faecal coliforms were gone (couple of times we had measurements from > 2500 FC / 100 ml initially down to < 50 or a couple of times even 0. This is a bit contrary to what you are saying in your articles (I have also copies from your earlier publications). You mention that UV-A radiation is required to get 99.99% reduction. Or it should be pasteurized in 70 degrees Celcius. I have a feeling from the few experiments we have done that 2 hours above 50 degrees also kills (almost) all Faecal coliforms. ALso a question was raised that even when the FC are killed, what about other pathogens..? From reading other publications I gathered that FC are almost the most resistent, meaning that Vibrio Cholera, Shigella, Ascaris, etc should also be removed. Did you do any more tests since the Waterlines article? Maybe we cold keep in touch with each other on this facinating subject.

Yours sincerely
Foort Bustraan

Dear Mr. Bustraan,
Thank you for your letter which reveals very interesting information. Your tests jerry cans of 10 liters volume demonstrate the temperature effects on the inactivation of microorganisms. Due sunlight radiation the water temperature rose to more than 50 0C and was kept above this level for more than 2 hours. You observed a substantial inactivation of Faecal coliforms in your tests. This is in agreement with the literature (see also Table X which was already published in SODIS News No. 1). As you can see, also Vibrio Cholera, Shigella and Ascaris eggs are destroyed when exposed to a water temperature of 45 - 57 °C for one hour. The Table also indicates that longer exposure times reduce the necessary temperature for 100 % destruction. The Swiss Tropical Institute (STI) has embarked on a research to study the inactivation of Giardia cysts and Cryptosporidium oocysts by SODIS. Storage (time), light (UV-A irradiation) and energy (heat) can be used individually or in combination to improve the microbiological quality of drinking water. SODIS makes use of all three processes which are enhanced by synergies. By these physical water treatment processes, the microbiological quality is always improved. Hence, any storage, sunlight exposure or water heating will have a positive effect and produce a safe or at least improved water quality.



I look forward to hearing from you again.
With kind regards. Martin Wegelin

A Village in Cameroon

Chris Hochstrasser, SIL, Yaoundé

The village (Mekomba) is situated near the town of Mfou, at about 30 km from Yaoundé. We probably encountered the worst conditions to introduce a new water treatment method. We had actually analysed their water two years ago since a drinking water protection programme was supposed to be introduced in the region. However, this programme was finally never implemented. We presented them with a more simple treatment method. However, the water in the village had always been consumed untreated since the population was under the impression that it was clean. We, therefore, confronted them with an unexpected request. Furthermore, it was the rainy season and the sky was cloudy.

We visited the village three times. On our first visit, we informed the villagers about their water quality and taught them how to use the SODIS bags. Thanks to the presence of their health officer, we received a warm welcome in spite of our long absence. We gave the participants of this meeting about ten SODIS bags or one bag per household and told them to use them the next day.

Two days later, we returned to the village and asked the persons who had been given the bags how they had used them. They had perfectly followed our instructions. We also sampled water from their bags to analyse it.

On our third visit, we brought Petri dishes to demonstrate the change in water quality before and after SODIS treatment. We taught the villagers how to reuse PET bottles and left them a few bottles, including a can of water-resistant black paint and a brush.

It can conclusively be stated that the treatment system and its use had been well understood by the villagers. However, the conditions for its acceptance in a village where drinking water had never been treated are rather unfavourable a priori. We plan to return to the village in April to find out whether the bottles are still used!

As regards SODIS, the questions most frequently asked referred to the possibility of using containers holding more than 1.5 litres and its costs rather than the boiling of water (this question was always asked by the men and never by the women). The only question we couldn't answer referred to the possibility of producing a SODIS bottle by tying a black cloth around one of its sides. We told the villagers that we would consult the researchers about this question.

A continuing education course for persons in charge of dispensaries was held during our stay at Mfou. Dr Mangas from the Mfou hospital asked us to present the SODIS technology at this course. The participants understood and seemed interested in the treatment method, however, we don't know whether they will implement it. Just after the course we were informed that a member of the Ministry of Health was also present. He came to ask us a few questions and seemed interested, but again, we are not sure if and how he will make use of the information received.

SODIS in Ecuador

Brigitte Hintermann, Guayaquil, Ecuador

After a day of frustrating meetings in Berne, I came to meet Martin Wegelin in the train. This was in August 1998 when I first heard of SODIS. We decided that I would disseminate the SODIS method during my stay in Ecuador.

As graduate nurse specialised in tropical medicine, I had already worked for a year with the Ecuadorian Health Service in 1994/1995. Although my second mission to Ecuador was to be entirely devoted to my new profession of midwife, I was highly motivated to take the necessary SODIS documents to South America. The SODIS leaflet is now also available in Spanish.

Within the frame of an International Nursing Congress at the University Católica Santiago de Guayaquil, I was invited to give a lecture on "New Alternatives in Primary Health Care" in mid-November 1998. It was clear that the topic was going to be SODIS!

Preceding the congress I took the opportunity to present SODIS in the media. Two articles on the SODIS method appeared in the newspapers, one in Guayaquil's largest daily paper "El Universo" (Guayaquil, the largest city in Ecuador, 2.5 million inhabitants).

I also presented SODIS at a local TV station which transmitted it live in a morning show. Two weeks later I was asked by the University Católica de Ibarra to hold SODIS lectures in the North of Ecuador at the University of Ibarra, Otavalo, San Gabriel and Tulcan. My presentation varied depending on the age of the pupils and students attending the lectures. The Spanish video on SODIS produced by EAWAG is an important audiovisual aid in disseminating information. Unfortunately, I am not in a position to check whether the disseminated information has also led to its practical application. Unluckily, copying of the leaflet was regarded as too expensive by the board of the nurse's training school. Moreover, the list of prospective users also got lost.

Since I have been in Guayaquil I drink tap water every day which I previously expose to the sun in blacked PET bottles. The SODIS methods works as I have never been ill. You have to apply this method yourself before you can recommend it.

SODIS in South Africa

Edward D. Breslin and Erik Harvey, The Mvula Trust, South Africa

The Mvula Trust is a South African NGO which concentrates on rural water supply and environmental sanitation development. In recent months, the Trust has effectively introduced SODIS at a number of project sites throughout the country. This has been done through a "revisiting initiative" designed to evaluate projects for sustainability and develop strategies to overcome problems identified at local level.

SODIS and the "Revisiting Initiative"

The Mvula Trust is currently managing a national programme to re-evaluate existing water projects for sustainability. The "revisiting initiative" is being conducted in partnership with the Australian Agency for International Development (AusAID) and the South African Department of Water Affairs and Forestry (DWAF). A total of 78 projects will be evaluated by the end of April 1999.

The evaluations focus on issues of operation and maintenance (O&M), cost recovery/affordability, communication, water for production, and health. Plans of action are developed at project site to address sustainability problems which become apparent during the evaluations.

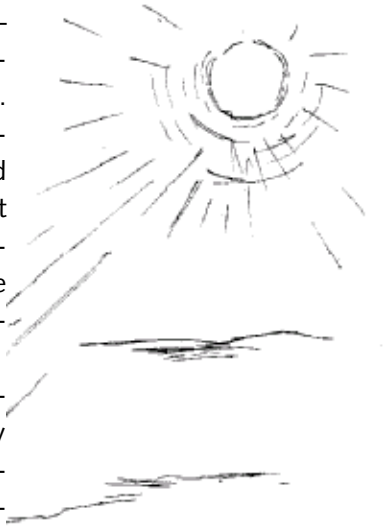
One of the more disturbing issues to emerge from the evaluations is the high levels of fecal contamination of water in existing project sites. The reasons for this are complex, but are primarily related to poor O&M at project level. To illustrate, in one project site in the Northern Cape, the project was specifically designed to address issues of water quality. The purification plant is poorly managed, and the economic conditions in the area mean that the District Council's capacity to sustain the purification plant are suspect.

The evaluations are clearly suggesting that the potential beneficial health impact of improved water supply is being threatened by poor water quality at project site.

To address this problem, the evaluators are introducing the concept of SODIS through a participatory process known as PHAST (Participatory Hygiene And Sanitation Transformation). The overall methodology, known as SARAR, was originally developed by Lyra Srinivasan, together with Ron Sawyer and Jake Pfohl, and adapted specifically to the water supply and environmental sanitation sector through PROWWESS and the PHAST initiative.

The approach is designed to promote health/hygiene, sanitation and community management of water supply and sanitation facilities. PHAST is an adaptation of the SARAR methodology of participatory learning, which builds on people's innate ability to address and resolve their own problems. The methodology aims to empower communities to manage their water supply and to control sanitation-related diseases.

Discussions on what can be done about poor water quality at project site are initiated using PHAST. Community members explore a range of treatment options – including boiling and chlorinating water – that are commonly considered at local level. SODIS is introduced using the picture depicted below, usually without any explanation. Participants rapidly figure out how solar disinfection works.



Community members discuss what they believe are the advantages and disadvantages of each option. Boiling, for instance, is often considered time consuming, costly (in terms of fuel) and somewhat difficult to manage. Chlorination, with a local product called Jik (household bleach), is also expensive and leaves a bad taste in the mouth (especially if too much Jik is used). SODIS is often a new concept but people readily claim that it would not cost them anything. But does "SODIS water" taste alright? And, isn't "SODIS water" hot?

Participants are asked if they want to test these assumptions through a SODIS experiment. A 2 liter plastic coke bottle is filled with water that had been tested as "contaminated" the previous day. The plastic bottle is kept in the sun for 24 hours, and then tested again. After a further 24 hours (when the water quality tests can be analyzed by villagers), community members see that the water is clean as the test results show that contamination has been eliminated.

Participants are then asked to taste the water. Community members involved in the test indicate that the water "tastes fine". The issue of "hot water" is resolved by storing the water in a cool place overnight.

SODIS uptake and foreseen obstacles

In a number of project sites, SODIS is now being used by many households as a means to improve water quality. The Mvula Trust will, in the near future, try to quantify the uptake at a number of these villages, but observations at community level suggest that the SODIS experiments have had an impact on household water management.

There are, nevertheless, a number of factors which will threaten the spread of SODIS in South Africa. First, 2 liter plastic bottles are not as accessible nationwide as many would hope. Moreover, households do complain that they need bigger containers so that larger amounts of water can be disinfected by the sun. The most common water collection bucket is 25 liters, but many of these plastic containers are PVC rather than PET containers. In isolated villages in KwaZulu/Natal, where PET containers are readily available, then the issue of volume is not such a problem (see picture below of child fetching water from a stream to conduct a SODIS experiment).

In other areas, like Mpumalanga and the Northern Province, this is a bigger problem as supplies of PET containers is somewhat limited.

Another problem encountered is that community members claim that they should not have to be concerned with water treatment. Many argue that the water from new taps should be treated if new supplies of water have been provided through a donor or government scheme. People in the cities get clean water from their taps, so why should rural people be treated any differently?

The size of a community may also present obstacles. The history of water supply in rural South Africa has left many communities disillusioned and apathetic. It is more difficult for community structures to effect change in such communities, especially larger communities. Recommendations from future participatory evaluations will provide the scope for more in-depth interventions in such communities.

Addressing these legitimate worries at field sites throughout the country remains a critical challenge for the Trust.

Promoting SODIS in South Africa

The Mvula Trust is involved in a number of initiatives that should help promote the spread of SODIS in South Africa.

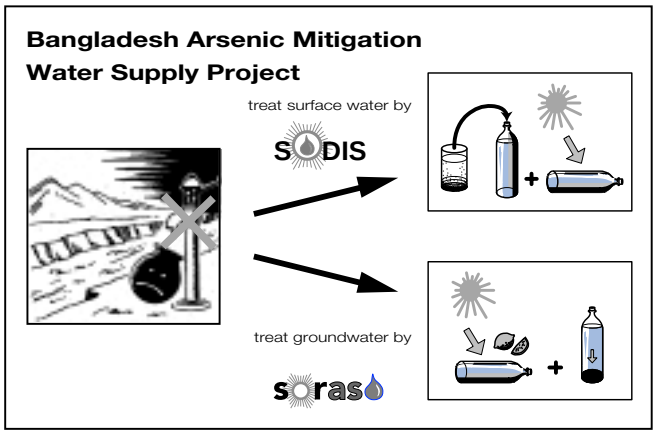
First, the Radmaste Center at the University of the Witwatersrand (Johannesburg), is actively involved in the development of the field-based water quality testing programme outlined above. A central part of this programme is SODIS.

Second, the Mvula Trust, Danida, the Department of Water Affairs and Forestry (KZN) and Glover Development Engineers have been running a child-to-child programme in rural KwaZulu/Natal centered around water quality issues. The children in the participating villages are promoting SODIS as a cost-effective, simple way to treat water effectively.

Finally, SODIS will be a key section in a forthcoming manual for field workers involved in health, water supply and sanitation. The manual, being produced by Soul City in South Africa, will highlight low-cost, effective ways to address water- and sanitation-related health problems in communities that will continue to rely on unprotected sources of water supply for the foreseeable future. SODIS will be presented as an important option in these communities trying to find ways to improve water quality at household and community level.

Will plastic bottles help to mitigate the arsenic problem in Bangladesh?

By tradition, pond water has been a major raw water source for the rural population in Bangladesh. In order to supply a source of water free from bacteria and virus, the use of groundwater has rapidly expanded since the 1970s. At present, about 95 % of the rural population are drinking groundwater. However, skin diseases and cancer have been recently reported and in the following, in numerous wells in various parts of the country high levels of arsenic have been discovered. This serious threat to the health of over 50 million people through consumption of arsenic-rich well water in Bangladesh calls for immediate action on various levels. The development and use of alternative raw water sources such as surface water (e.g. from ponds, lagoons or rivers) and rainwater are proposed. However, surface water is exposed to



pollution and, therefore, generally requires treatment. SODIS is a simple method used at household level to improve the microbiological quality of drinking water. SODIS has been field tested in various developing countries for its socio-cultural acceptance and affordability.

Another option to respond to the Arsenic problem is the development of low-cost and simple arsenic removal methods appropriate and affordable for household use. Currently existing small-scale arsenic removal procedures require chemicals that are either not easily available and/or affect water taste and odor. With major financial support of the Swiss Agency for Development and Cooperation (SDC), EAWAG is in progress to develop a simple solar oxidation and removal of arsenic (SORAS) method that uses irradiation of water with sunlight in PET- or other UV-A transparent bottles to reduce arsenic levels from >500 mg/L to levels below 50 mg/L.

SDC initiated and funds the WATSAN Partnership Project (WPP) in the project area of Rajshahi and Chapai Nawabganj districts with the aims to

- improve user's sustainable access and use of affordable water and sanitation
- build on experience learned in the project toward an incremental integration into the nationwide Bangladesh Arsenic Mitigation Water Supply Project (BAMWSP)

SODIS as well as SORAS are being field tested within WPP. For SODIS, this treatment method is introduced to 15 villages by the Partner NGOs (PNGO) under the lead of CARE and with the assistance of Yayasan Dian Desa, Yogyakarta in Indonesia acting as a consultant to the project. EAWAG has a backstopping mandate for this project and considers to carry out a SODIS Health Study in cooperation with the Swiss Tropical Institute (STI). Implementation of SODIS at village level started in March '99 and it is planned to run the field study over period of one year.

The target population is interested in SODIS as the water treatment method helps to reduce the demand on firewood which is often scarce in the project area. Quite often the women use cow dung as energy source for cooking. However, a successful application of SODIS mainly depends on the users' acceptance to return to unsafe and polluted surface water sources. Pond water is often turbid and, therefore, requires the separation of the suspended solids and algae by sedimentation possibly supported by flocculation using alum sulfate or Moringa oleifera seeds. Furthermore, the groundwater wells equipped with a handpump and usually located within the owner's compound are nearer to the users than the ponds proposed as alternative water source. The ongoing field studies in Bangladesh will reveal whether SODIS will be accepted by the Arsenic affected population or whether SORAS will efficiently reduce the Arsenic concentration found in the groundwater.

Information exchange remains an important issue in the development and promotion of new technologies. SODIS has gained worldwide momentum and different actors are gaining their own experience with this fascinating water treatment process. The practical knowledge acquired in different projects may prevent other field staff from making the same mistakes or may allow the same approach to be successfully applied elsewhere. SODIS News plans to play an important role in this information exchange. We, therefore, invite all our readers to use this communication platform which may in future be replaced by a mail box on the Internet. The electronic information exchange will certainly be faster and more interactive.

Hence, new approaches for the dissemination of information will be announced electronically. However, SANDEC intends to also keep on using the traditional communication channels. We plan to prepare a SODIS Manual containing information collected during the different phases of the SODIS project; i.e., results obtained in the laboratory, field tests and in the demonstration projects, including the practical experience gained in the implementation of SODIS. Furthermore, SODIS will be presented at forthcoming events such as the 9th Stockholm Water Symposium in Sweden or the 25th WEDC Conference in Ethiopia.

The idea of using solar energy to improve the microbiological quality of the water is very attractive and fascinating. Development of the technology was simple compared to the task of convincing people about the potential of this water treatment process. A change of perceptions and attitudes takes time - SANDEC will continue to work on these changes.