

# COMMUNITY WATER SUPPLY AND SANITATION

WHO  
DEPARTMENT OF WATER, SANITATION AND HEALTH  
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## WATER SUPPLY, SANITATION AND HEALTH IN RURAL AREAS

REPORT OF THE SECOND CONSULTATION OF  
THE WHO WORKING GROUP ON  
WATER, SANITATION AND HEALTH  
GENEVA, 9-11 APRIL 1991



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The report contains the project summaries prepared by the WHO Working Group on Water, Sanitation and Health, following two consultations on drinking water, sanitation and health in rural areas (Geneva, 27-28 June 1990 and 9-11 April 1991). The report of the first consultation (document WHO/CWS/90.12) contains an analysis of the present situation and recommendations to improve water supply and sanitation services for the villages and the dispersed populations of developing countries, which are dispersed populations of developing countries, which are often at high risk in respect of health. The present report gives the results of the second consultation and summarizes the projects formulated in accordance with the conclusions of the Working Group.

L. Laugeri, WHO/CWS, Secretary of the Consultation and of the Working Group.

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**WATER SUPPLY, SANITATION AND HEALTH  
IN RURAL AREAS**

**(WHO Consultation, Geneva, 9-11 April 1991)**

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**WATER SUPPLY, SANITATION AND HEALTH****IN RURAL AREAS****(WHO Consultation, Geneva, 9-11 April 1991)****LIST OF ABBREVIATIONS**

|                   |   |
|-------------------|---|
| Al                | Aluminium   |
| AFRO              | Regional Office for Africa  |
| CAEP              | Comité d'Adduction d'Eau Potable - Drinking Water Committee   |
| CEC               | Commission of European Communities  |
| Cl O <sup>-</sup> | Hypochlorite ion  |
| CREPA             | Centre Régional pour l'Eau Potable et l'Assainissement à Faible Coût<br>Regional Center for Low-Cost Drinking Water Supply and Sanitation |
| CTP               | Tri-soda Chlorinated Phosphate  |
| CWS               | Community Water Supply and Sanitation   |
| DESA              | Direction de l'Education pour la Santé et l'Assainissement<br>Direction for Health Education and Sanitation                               |
| DPS               | Directions Provinciales de la Santé - Provincial Directions of Health   |
| EAST              | Eau Agriculture et Santé en Milieu Tropical - Drinking Water<br>Agriculture and Health in Tropical Areas                                  |
| EBAM              | Ministère de l'Education de Base et de l'Alphabétisation des Masses   |
| EEC               | European Economic Community   |
| EIER              | Ecole Inter-Etats d'Ingénieurs de l'Equipement Rural  |
| EMRO              | Regional Office for the Eastern Mediterranean   |
| EPFL              | Ecole Polytechnique Fédérale de Lausanne  |
| ETSHER            | Ecole Inter-Etats des Techniciens Supérieurs de l'Equipement Rural  |
| FCFA              | CFA Francs  |
| Fe                | Iron  |
| FF                | French Francs   |
| IDB               | Inter-American Development Bank   |
| IGE               | Institut de Génie de l'Environnement<br>Institut of Environmental Engineering   |
| IRCWD             | International Reference Center for Waste Disposal   |
| m                 | Metre   |
| NGO's             | Non-governmental Organizations  |
| ONEA              | Office National de l'Eau et de l'Assainissement - National Water and<br>Sanitation Authority  |
| ONEP              | Office National de l'Eau Potable - National Water Supply Authority  |
| ONPF              | Office National des Puits et Forages - Office National for Wells and<br>Boreholes   |
| PEP               | Poste d'Eau Potable - Drinking Water Supply Post  |
| POCHEP            | Poste ou Projet Communautaire d'Hygiène et d'Eau Potable - Community<br>Hygiene and Drinking Water Project or Post                        |
| t                 | Ton   |
| SAS               | (Ministère de la) Santé et de l'Action Sociale  |
| ug                | Millionth of gramme   |
| UNDP              | United Nations Development Programme  |
| UNICEF            | Unicef Nations Children's Fund  |
| WHO               | World Health Organization   |
| WSS               | Water Supply and Sanitation   |



## INTRODUCTION

### The Consultation

A second informal consultation was held at the Headquarters of the World Health Organization (WHO), in Geneva, from 9 to 11 April 1991, on the public health aspects of rural water supply and sanitation (WSS). The Working Group on Water Sanitation and Health, which had been constituted at the time of the previous consultation (Geneva, 27 and 28 June 1990), had 35 members, including Mr M. Azili, engineer in charge of the national plan for rural water supply at the Ministry of Public Works in Morocco, Chairman.

The Group also included other national managers of rural WSS projects (in Haiti and Morocco), managers of non-governmental organizations (NGOs) which support similar projects in other countries (Burkina Faso and other Sahelian countries), technical advisers from bilateral, multi-lateral and international technical and financial support agencies (Commission of European Communities CEC, UNDP, UNICEF, Germany, Netherlands, Switzerland), representatives of private interests in the water supply and sanitation sector (consulting engineers, chemical industry), and a representative of the International Reference Center for Waste Disposal. The membership of the Working Group, including the participants of the first and second consultations, is in Annex I. The breakdown into study teams of the members of the second consultation, and a list of participants from the Secretariat, are in Annex II. On the whole, about 40 persons take part in the activities of the Working Group.

The Consultation was opened by Dr M. Jancloes, Manager, Office of International Cooperation of the World Health Organization, who welcomed the members and recalled the objective of the second consultation, which consisted in the formulation of projects:

- to promote the implementation of appropriate technology;
- to develop support programmes, especially in hygiene education;
- to propose development plans for the coverage of needs;
- to facilitate sustainable developments;
- to mobilize the resources of the various parties involved.

Dr Jancloes gave a broad explanation of some aspects of the general policy of WHO with respect to the countries which are in greatest need of its intervention, and within these countries, the poorest regions which were the subject of the present consultation. In these countries and regions, local

resources were limited, and all efforts had to be made towards optimum utilization. This required that the priorities be defined by the countries themselves, in order to determine the orientation of external resources made available.

These resources were often plentiful, but generally poorly utilized, as a result of lack of rigorous follow-up of the development plans, lack of consultation with external support agencies and amongst these agencies, and because the economic crisis of these countries or regions, which justified the need for international cooperation, upset the priorities in favor of activities with short-term benefits, rather than programmes which show benefits only in the long term.

Water remained however, a priority sector, particularly in Sahelian countries which were part of the subject of the present consultation. The problem of water is technically complex, but even more difficult to solve if socio-cultural aspects are taken into account; if they are not, a sector is being developed without an optimum use of its resources, and without meeting the real needs. Like the right to health, the right to water is stronger than economic reasoning, which is rendered complex and uncertain by the multiplicity of parameters.

The Chairman of the consultation confirmed and developed some of these considerations, especially with respect to the differences in perception of priorities between populations on the one hand, planners on the other hand. He emphasized the role of water supply and sanitation as elements of the structure of development, and the need to ensure that local projects are integrated in a nationwide sector programme.

In this context, the manager of the community hygiene and drinking water project (POCHEP) in Haiti, emphasized the merit of institutionalizing such projects, in order to ensure the continuity of action, to facilitate decentralization, and to avoid short-lived multiple vertical programmes.

In Morocco, the responsibility for the construction or management of a number of small centers had been given to a national institution, the national water supply authority (ONEP). Considerable advantages had resulted, especially with respect to cost-containment and cost recovery. Thus in the regional project of the Ziz Valley, in the south-east of the country, service was extended to a large region at unit costs from 20 to 60 dollars per head; these figures were ten times lower than in the case of a large integrated rural development project which had been undertaken a few years back in the Fez region.

Water quality, another important aspect of the consultation, was discussed during the opening debate, particularly by representatives of the Association EAST, Eau potable, Assainissement et Santé en Milieu Rural (Drinking Water Supply, Sanitation and Health in Rural Areas) and of the International Reference Center for Waste Disposal.



These various points were discussed in more detail during subsequent meetings, with presentations on the use of chlorine (Annex III) and iodine (Annex IV) and on slow sand filtration (Annex V).

An important part of the discussions was on water-borne diseases, especially diarrhoeal diseases, dracunculosis, and schistosomiasis which was the subject of the presentation of a film (Kichocho, Tanzania, Schistosomiasis on Pemba Island - Annex VI). Finally, Dr Monjour and Dr Empereur Bissonnet, from Association EAST, summarized the presentation which they had made during the first consultation on the present situation of WSS in rural areas (Annex VII).

### **The Commissions**

The Working Group divided itself into three commissions in order to discuss the contents of a number of projects which had been prepared prior to the consultation, and to improve the formulation of these projects. For their final presentation, the Secretariat recommended the adoption of a uniform outline:

- description (title, scope, agglomerations, population, water points, sanitation facilities);
- justification (from the sector to the project) and objectives (from the project to the sector);
- executing agencies (resources, constraints);
- beneficiaries (users, owners);
- motivations (resources, constraints);
- duration (phases);
- costs (local, foreign exchange, voluntary contributions);
- financing plan (implementation);
- expected benefits (project, sector).

The conclusions and recommendations of the commissions were presented and discussed in a plenary session, in the presence of Dr D.B. Warner, Manager, CWS, who also made the closing speech of the consultation. The result of the work was presented in the form of projects, which were subsequently finalized by the rapporteurs, and which are summarized and presented hereafter.

### **The Projects**

Nine main projects were retained, costing about US\$ 5 million in total, of which US\$ 1 million for the health education components. Five of these projects, amounting in total to US\$ 2.2 million, of which US\$ 0.4 million

for health education, are of direct relevance to population groups in Burkina Faso, Mali and Rwanda, totalling about 300 000 people. The indirect effect cannot be estimated with any accuracy at this stage, but the total population benefitting from the projects would probably be more than 1 million inhabitants, which would indicate a satisfactory ratio of cost efficiency (about US\$ 2 per inhabitant directly served or sensitized).

The four other projects are not formulated as a mix of water sanitation health actions to improve the situation of target populations, but were nevertheless discussed during the consultation, because they are of considerable interest with respect to needs coverage extension, research, planning and promotion.

The epidemiological considerations which have lead to these proposals are essentially related:

- to the high prevalence of diarrhoeal diseases in the areas of the projects, and to the interest of expanding on-going programmes, especially in Haïti, in the Sahel and in Rwanda;
- to the objective of eradication of dracunculosis in 1995 in Africa south of the Sahara, subsequently confirmed by resolution WHA 44.5 of the 44th World Health Assembly (May 1991);
- to the felt need of better linkages between horizontal programmes for the development of water and sanitation infrastructure and vertical programmes for the control of important endemic diseases such as goiter, schistosomiasis, malaria and dracunculosis;
- to the well known limitation of the benefits of water supply and sanitation in the absence of quality control, surveillance, health education and promotion of community involvement.

With regards to physical and chemical characteristics, the consultation has taken into account the current insufficiency of resources to treat water for drinking purposes (for instance in Rwanda), the lack of iodine in landlocked countries (for instance a large part of the Sahel), and numerous defects in environmental management, as in Haïti where land erosion can lead to the gradual drying up of water sources. The main projects which were formulated, are designed to improve quality, especially by chlorination, as well as health education, surveillance and impact evaluation. Other projects concern the protection of sources or the improvement of the quality of water from wells. The iodization projects are more specific and are the subject of other studies.

With regard to human and financial resources, the projects have been formulated on the basis of community involvement, particularly with respect to hygiene education at school. To various degrees, the projects require the intervention of external teams, but essentially they rely on the energy and the resources of the countries, the communities, the individuals.

PROJECT FORMULATION

| PROJECT  | COUNTRY         | LOCAL or<br>EXTERNAL<br>AGENCY | 000 US\$<br>TOTAL<br>COST | 000 US\$<br>HEALTH<br>EDUCATION | 000 h<br>POPUL.<br>GROUP |
|--|-----------------|--------------------------------|---------------------------|---------------------------------|--------------------------|
| <b>A/WATER-SANITATION-HEALTH</b>   |                 |                                |                           |                                 |                          |
| 1. Water quality impro.<br>and hygiene educ.                                   | Rwanda          | MINISANTE<br>UNICEF            | 185                       | 31                              | dispersed<br>80          |
| 2. Treatment and health<br>impact of drinking<br>water                         | Burkina<br>Faso | GOVT. EAST<br>EAU VIVE         | 700                       | 100                             | villages<br>14           |
| 3. Water sanit and health<br>educ. in 500 villages                             | Mali            | GOVT.<br>CREPA                 | 600                       | 160                             | villages<br>150          |
| 4. Water sanit. and health<br>in 37 primary schools                            | Burkina<br>Faso | GOVT.<br>CREPA                 | 400                       | 60                              | schools<br>28            |
| 5. Intersec. dev. in<br>schools in Bazega prov.                                | Burkina<br>Faso | GOVT.<br>EAST                  | 400                       | 85                              | schools<br>30            |
| Sub-total A  |                 |                                | 2 285                     | 436                             | 302                      |
| <b>B/OTHER PROJECTS</b>  |                 |                                |                           |                                 |                          |
| 6. Protection of 138<br>sources used by POCHEP                                 | Haïti           | POCHEP<br>BID                  | 1 245                     | 138                             | villages                 |
| 7. Research on the<br>promotion of hygiene<br>and sanitation                   | Mali            | MINISANTE<br>WHO/UNDP          | 1 570                     | 206                             | villages                 |
| 8. Planning and<br>formulation by<br>countries of health<br>education projects | Africa          | GOVTs.<br>WHO/AFRO             | 135                       | 135                             | rural                    |
| 9. Pilot study of the<br>qualitative improv.<br>of water from lined<br>wells.  | Sahel           | GOVTs.<br>EAST                 | 55                        | 6                               | villages                 |
| Sub-total B  |                 |                                | 3 005                     | 485                             |                          |
| GRAND TOTAL  |                 |                                | 5 290                     | 921                             |                          |

**PROJECT 1**  
**RWANDA**  
**Water Quality Improvement**  
**and**  
**Health Education**

**Definition, Location, Description**

This is a pilot project for the improvement of the quality of drinking water through chlorination and for hygiene education in rural areas in the Republic of Rwanda. The pilot zones are located in four administrative regions (prefectures): Gisenyi, Butare, Kigali and Byumba. The pilot project includes:

- A. Chlorination of gravity water supply systems selected in four communes of the prefectures of Kigali, Butare and Gisenyi;
- B. Chlorination of rainwater collection systems in six communes of the prefectures of Kigali and Byumba;
- C. Chlorination of recipients of drinking water by the population, in eleven communes of the prefectures of Butare, Byumba and Kigali;
- D. Hygiene education and social mobilization in the three pilot projects A, B and C above.

The rural population of Rwanda is generally dispersed. Water flows freely from the springs, which represent more than 75% of available water sources. Water is collected by jerry cans, and nearly all of these recipients are polluted. The project consists, on a pilot scale, in the treatment of water from gravity supplies and from rainwater collection tanks, where such facilities exist, and everywhere else in the disinfection of recipients: 3.6 million people (more than half the population) use 17 000 improved springs for their water supply. Considerable efforts are currently undertaken to improve drinking water and sanitation, with the support of health education campaigns.

**Justification and Objectives**

Together with malnutrition, the diseases transmitted by water and excreta are among the main causes of morbidity and mortality in Rwanda, especially among children, whose mortality rate is one of the highest in the world. The Government of Rwanda and UNICEF have undertaken a large programme of equipment of water points, information on the importance of sanitation, latrine construction and health education, especially in primary schools.

However, Rwanda remains one of the countries of the world where the quantities of water consumed are the lowest (from 8 to 12 lcd). Besides, this water is dangerously polluted by fecal matters, despite the large number of latrines which have been installed. Finally the population is still largely unaware of the health risk associated with lack of hygiene. The objectives of the project are to introduce the disinfection by chlorine of water and its recipients in rural areas, and to promote health education for the public at large and for some target groups such as pupils and teachers, essentially in order to reduce the incidence of diarrhoeal diseases. Calcium hypochlorite is imported in Rwanda, and a recent study of the National University of Rwanda and of the Ministry of Health recommends the introduction of chlorination, particularly in gravity supplies.

The specific objectives consist in the procurement of products for chlorination, the training of health agents, officials of the communes and private volunteers in order to operate the chlorinated water facilities, the mobilization of the community, the health education of the users, and the transfer of treatment responsibilities to the communes, the users and the private sector.

### **Institutional Framework**

The project will be executed by the Government of Rwanda (Ministry of Health) and UNICEF, with technical support from WHO (especially in health education), from the NGO EAST (especially treatment) and from the WHO Working Group on Water Sanitation and Health. The central and communal authorities will pay the salaries of the civil servants. The population will provide the labour and the local materials.

### **Duration, Cost, Beneficiaries**

The duration of the project will be two years (1992-1993), and its total cost will be US\$ 185 000 in foreign exchange. The funds requested are broken down as follows (in US\$):

|                                |                |  |
|--------------------------------|----------------|--|
| - materials and equipment      | 50 300         | A. 57 400 (page 6)                             |
| - human resources              | 51 500         | B. 19 100                                      |
| - facilitation and training    | 50 200         | C. <u>108 500</u>                              |
| - transport and distribution   | 13 500         |  |
| - studies, laboratory controls | 19 500         | Total 185 000                                  |
|                                |                | <hr/>  |
|                                | <u>185 000</u> | (including component D<br>costing US\$ 31 000) |

The estimated number of beneficiaries is 81 000, of which 24 000 for activity A, 5 000 for activity B and 52 000 for activity C. This population as a whole would benefit from activity D.

**PROJECT 2**  
**BURKINA FASO**  
**Water Treatment**  
**and**  
**Health Impact Evaluation**

**Definition, Location, Description**

This is the continuation of an on-going project, and its extension to the provinces of Boulkiemde and Bazega (rural sub-sector, sedentary villages, Mossi groups, soudano-sahelian climate, water supply by wells, bore holes and surface water, few sanitation facilities).

The study will include 7 treatment processes, each of which will be implemented in four villages: 2 in the Boulkiemde province and 2 in the Bazega province. The project as a whole will concern 28 villages. The health impact study will be carried out in six primary school classes, grouping about 180 pupils.

**Justification and Objectives**

The contamination of drinking water by fecal matters is responsible for at least half of the infectious diseases which are prevalent in the rural populations of developing countries, especially in Africa. From 20 to 30 million fatal cases - including 6 million children less than 5 years old - are registered each year as a result of infectious diarrhoeas. In order to improve this serious situation, the quality of water points should be increased and the quality of water consumed should be improved. This project will use several methods to improve the quality of water, starting from existing water points.

The studies of the bacteriological quality of water show that fecal pollution occurs nearly always during transportation and storage of water, and that water which is safe for drinking at its source is generally unsafe when it is consumed in the household.

The first approach of the project therefore consists in finding the ways to supply drinking water for consumption. The proposals will take into account the specificity of rural areas, especially the dispersed water points and agglomerations, and the low incomes.

The documentation on water treatment in rural areas, and the data on the health impact of drinking water, are quite limited; research on these subjects will constitute the second approach of the project.

In the short-term (4 years), the project has two main objectives:

- comparison between several drinking water treatment processes:
  - . a model of treatment by the family, in the household,
  - . six models of collective treatment by the village, near the water points or in the center of the agglomeration
- evaluation of the health impact which can be related to the consumption of drinking water.

The implementation of this project will be supported by preventive health actions: education, equipment and protection of water points, sanitation.

In the long-term, the results and references of the project could be used in the definition and promotion of a few simple water treatment and sanitation measures, which - together with health education - would be widely disseminated and applied in rural areas, and therefore could contribute to the improvement of human health.

### **Institutional Framework**

After consultation and concertation, the project will be implemented by the population, which will contribute to the cost of constructing and operating the facilities, and the administrative and technical services of:

- . the Ministry of Health and Social Action, particularly the Direction for Health Education and Sanitation (DESA), and the Provincial Directions of Health (DPS).
- . the Ministry of Water, and the authorities under it: ONPF (National Authority for Wells and Bore Holes) and ONEA (National Water and Sanitation Authority)
- . the Ministry of National Education, particularly the Provincial Directions of Education and the teachers.
- the technical and financial support agencies:
  - . EAST for health oriented technical support;
  - . EAU VIVE, for support in water engineering and in the mobilization of funds;
  - . WHO, for its capacity to coordinate, disseminate information, its assistance in fund raising, and its technical support, especially in health education;
  - . any other interested structure or agency.

The action is proposed by the NGOs EAST and EAU VIVE, and is a follow-up of the studies already conducted by EAST since 1985 on water pollution sources and disinfection methods; these studies have been implemented since 1988 by the water supply programme in the schools of the province of Boulkiemde.

The funds will be managed by the two NGOs, with the objective of continuing the project under the management of national structures (population, administrative and technical services, artisans, and enterprises of the private sector).

### Duration, Costs, Beneficiaries

The project will start in January 1992 for a duration of 4 years; there will be two evaluations, one at the end of the second year, and one at the end of the project.

As much as possible, the project will utilize the numerous local qualifications in training, production and follow-up. The planned activities will be implemented with disinfection techniques which are well known and widely used throughout the world. By making these techniques more accessible, integrating them in all water supply programmes, and supporting and promoting training and health education, the project should facilitate the access to water supply, and improve the health of the population.

The total cost of the project for four years is 4 218 000 FF (US\$ 700 000), including 4 106 000 FF to be financed by foreign agencies, and 112 000 FF of local participation (from the population). The budget is as follows:

|   |   | FF               |     |
|---|---|------------------|-----|
| - | Water treatment                                 | 340 000          | 8%  |
|   | . equipment                                     | 226 000          |     |
|   | . operation                                     | 24 000           |     |
|   | . analyses and quality control                  | 90 000           |     |
| - | Equipment of water points and sanitation        | 582 000          | 14% |
| - | Training and promotion                          | 2 372 000        | 56% |
| - | Health impact study                             | 407 600          | 10% |
| - | Evaluation                                      | 100 000          | 2%  |
| - | Miscellaneous                                   | 184 400          | 4%  |
| - | Administrative and management overhead expenses | 232 000          | 6%  |
|   | Total:  | <u>4 218 000</u> | FF  |

The project will benefit some 14 000 persons, living in 28 villages.



## **PROJECT 3**

### **MALI**

#### **Water Supply, Sanitation and Health in 500 Villages**

##### **Definition, Location, Description**

The objective of this project is to extend the coverage of water needs in the rural areas of the south (Bougouni, Yanfolida, Kolomdieba), and west (Kita Bafoulabé, Kéniéba), regions of Mali. This country has undertaken a large programme in order to meet its drinking water supply needs, but the coverage rate remains very low. Numerous boreholes with hand pumps have been abandoned because of the unpleasant results of the use of the water which they supply, which is strongly ironised and causes spots on clothes, smells, tastes of metal etc. The population goes back to the traditional sources, although they often represent a hazard to health.

The Malian authorities have requested the Regional Center for Drinking Water Supply and Sanitation (CREPA) in Ouagadougou to solve this problem. CREPA has successfully implemented two iron removal pilot plants, which have been in operation for nearly one year, with a decrease of dissolved iron content by 75 to 90%. The objective of this project is the large scale implementation of the pilot type solutions which have been adopted.

According to an initial evaluation, there are 500 abandoned boreholes in the southern and western regions of Mali. The population to be served varies from 100 to 500 inhabitants per village, and amounts in total to about 150 000 inhabitants. The objective of the project is not limited to the rehabilitation of these 500 abandoned boreholes, but it also includes the reactivation of the local water committees, the health education of the population, the construction of pilot improved latrines, and the training of workers.

##### **Justification and Objectives**

The improvement of health and welfare of the population is one of the priority objectives of the numerous financing agencies which have supported the construction of water supply facilities in Mali. However, some important water - sanitation - health aspects have been neglected, especially health education, utilization and maintenance of facilities, and environmental sanitation.

At relatively low cost, 500 boreholes could be reactivated to supply a large population with drinking water. A broad approach to the water and sanitation problems is proposed in the framework of these rehabilitation works.

The objectives are as follows:

- health education: the project will include activities undertaken with a view to improving the information and motivation of the population, and its hygiene education, in order to ensure people's participation in the construction, maintenance and operation of the works. A special effort would be made to improve sanitary conditions around the water points and in the land plots;
- construction of 500 iron removal units: each borehole will receive 1 unit of one of the two models which have been tried, according to the quality of the water which it supplies;
- training of local workers: the specialized workers from CREPA working on the project will be assisted by local workers available in the villages; CREPA's mission will be to train these village workers for the construction and current maintenance of the facilities;
- construction of 1 000 improved latrines: the project includes the construction of 2 improved latrines in each village at the same time as the iron removal units are built; the beneficiaries of the latrines will dig the pits and build the superstructure; the stabs and the pipes will be provided by the project.

#### **Institutional Framework and Implementation**

- identification and planning phase: jointly conducted by engineers from CREPA and from the National Department of Hydraulic Works, in order to inform the responsible persons of all the villages about the projected activities, to carry out qualitative analyses of the water, and to prepare a schedule of works to be undertaken;
- pilot phase: the promotion and participation methods will be tested in 30 villages, as well as the health education equipment, the prefabricated iron removal units, and the training of workers and technicians;
- implementation phase: following the evaluation of the pilot phase, the implementation phase will be planned and executed with much larger resources, in order to meet the needs in the shortest possible time;
- resources of the executing agency: the national branch of CREPA, represented by the National Direction of Hygiene and Sanitation and by the National Direction of Hydraulic Works, will make their structures and qualified personnel available to the project; in Ouagadougou CREPA has trainers, engineers and technicians which will participate in the two first phases of the project;
- the programme will be defined by CREPA in agreement with the Ministries represented in the national branch. The Institute of Environmental Engineering (IGE) of the Ecole Polytechnique Fédérale de Lausanne, which is associated with CREPA, can participate in the project according to the needs;

- resources of the beneficiaries: each integrated village action will only be undertaken with the full agreement and the active participation of the water committees. An important contribution will be requested in the form of materials and labours.

### Duration, Costs, Beneficiaries

#### Duration:

- identification and planning phase : 2 to 3 months
- pilot phase : 12 to 18 months
- implementation phase : 2 to 3 years

Millions FCFA

#### Costs:

|  |           |            |
|--|-----------|------------|
| - identification phase:                                |           |            |
| personnel, analysis, travel                            |           | 12         |
| - pilot phase:   |           |            |
| construction of 30 iron removal units and 60 latrines: | 5         |            |
| supervision and training of workers:                   | 5         |            |
| health education:                                      | 3         |            |
| miscellaneous and CREPA's management overheads:        | <u>2</u>  |            |
| TOTAL pilot phase                                      |           | 15         |
| - implementation phase:                                |           |            |
| construction of 470 units and 470 latrines:            | 66        |            |
| supervision and training of workers:                   | 23        |            |
| health education:                                      | 47        |            |
| miscellaneous and CREPA's management overheads:        | <u>16</u> |            |
| TOTAL implementation phase                             |           | <u>152</u> |
| - TOTAL project:                                       |           | 179        |

The total cost is about 180 million FCFA, for an estimated population of 150 000 inhabitants. The cost is therefore 1200 FCFA per inhabitant.

#### Expected benefits:

- the project is an integration of several activities: training in public health, drinking water, sanitation, training of workers, reactivation of the village committees. It can be expected to result in the improvement of the health of the population and of the general sanitary conditions of the villages concerned. The construction of pilot latrines should promote a longer term action, with the support of the National Direction of Hygiene and Sanitation.

**PROJECT 4****BURKINA FASO****Water, Sanitation and Health in 37 Primary Schools****Definition, Location, Description**

The objective of this project is to extend coverage in the provinces of Bulkiemde, Kadiogo et Youbritenga, in rural and semi-urban areas. In 1990, the Regional Center for Low Cost Water Supply and Sanitation (CREPA), in cooperation with the Association Ingénieurs du Monde of Ecole Polytechnique Fédérale de Lausanne (EPFL) built 2 blocks of 9 ventilated latrines for the school of Tanghin Taamila, which has more than 1000 pupils, in the suburbs of Ouagadougou. Following this construction, 37 primary schools located in villages and peri-urban squatter districts made a formal request to CREPA in Ouagadougou in order to improve their health status. These schools generally do not have adequate water supply and excreta disposal facilities. Each pupil, coming sometimes from more than 5 km away, must bring the water which he will need for the day. The schools have from 250 to 1000 pupils each, aged between 5 and 14. Following these requests, the project has been widened in order to include health education and the training of local workers as complementary aspects which will be indispensable in the long term.

**Justification and Objectives**

Any development project has as one of its fundamental tasks the improvement of the health and welfare of the population. One of the ways to reach this objective is to work with school children. Health education and information on problems of disease transmission, as well as operation and maintenance of the facilities, can be combined with local construction requiring community contribution in the form of sand, gravel or stones, and this has the effect of involving the entire community around each school. In order to be more effective, the project will concentrate on three provinces around the capital city, where population densities are the highest.

The objectives are as follows:

- health education: learning through information exchanges and lessons, with projections, role playing and visits of facilities, for teachers, pupils and parents;
- construction of facilities: 45 blocks of 6 ventilated piped latrines, 10 boreholes equipped with hand pumps and 25 rain water tanks;
- training of workers: to encourage the families, the communities and other schools to construct improved latrines with the help of qualified workers;

- sectoral development: the objectives of the CREPA are to promote low cost technology in the field of water supply and sanitation, to support pilot projects and applied research, and to coordinate the efforts undertaken in each country.

### **Institutional Framework and Project Organization**

The project will be executed by the national branch of CREPA, in which the ministries of water and sanitation, health and social action and environment are represented, together with the institutions which are directly linked to CREPA, EIER, ETSHER, CIEH. The Institut du Génie de l'Environnement (IGE) of Ecole Polytechnique Fédérale de Lausanne, an institution associated to CREPA, can participate in the project as needed.

The ministries concerned and CREPA will rely on local contractors for the work requiring heavy equipment (boreholes). CREPA has also the organization required to monitor the quality of the water supplied.

A programme will start in a school only after the teachers, the parents or the village or district committee have made the commitment to participate actively in the works and in the health education actions. At the level of villages and suburban districts, each one of the 37 actions is already locally engaged, and has been the subject of a request; the communities are therefore responsible and actively involved.

### **Duration, Costs, Beneficiaries**

The project will last from 18 to 24 months following the agreement in principle on its financing. Longer term follow up is planned in the framework of the activities of the national branches of CREPA, in order to evaluate the impact. The operation and maintenance of the facilities will require only limited additional expenditures, besides the routine cleaning work done by the users.

| Costs  | CFAF Million |
|--|--------------|
| technical personnel, workers' training         | 20           |
| health education, sensitization                | 18           |
| construction of latrines, tanks, boreholes     | 65           |
| contingencies and CREPA's management overheads | <u>10</u>    |
| Total  | 113          |

The total cost of CFAF 113 million (at January 1991 prices) or US\$ 400 000, amounts to US\$ 14 per child. The local population deriving direct benefits from the project is about 28, 000 children. Numerous other persons will derive indirect benefits from the promotional and health education activities.

## PROJECT 5

### BURKINA FASO

#### Intersectoral Development in Schools

#### Bazega Province

##### Institutional Framework

- In Ouagadougou Ministry of Health and Social Action (SAS)  
Ministry of Basic Education (EBAM)  
Direction of Education for Health and Sanitation
- In Kombissiri Provincial Direction S.A.S.  
Provincial Direction E.B.A.M.
- at local level (first year):
  - . 90 teachers from 30 rural primary schools (directors and teachers)
  - . 5400 pupils and their parents
  - . 15 community health agents and nurses

##### Justification and Objectives

Province of Bazega (Capital Kombissiri) in Burkina Faso. Rural area with dry climate. Main ethnical groups: Gourounsi and Mossi, farmers, sedentary, animists.

Lack of health care centers and absence of sanitation infrastructures. High levels of morbidity and mortality due to infectious diseases, most of which have their origin in the fecal pollution of drinking water and the lack of hygiene. 90% of the population is illiterate, 30% of the children go to schools; there are 80 primary schools and 20 training centers for young farmers (CFJA) all of which are under-equipped. Traditional monoculture cereals (millet); some market gardening. Self-sufficiency is difficult to attain with respect to food. The food diet is not varied. Malnutrition is frequent and affects 30% of the newborn.

The objectives are to improve the health and to promote the self development of rural populations, to disseminate in simple form the fundamental notions of preventive medicine and to train local managers and promote the development of self-operated and self-financed structures.

In September 1988, EAST started the project "Water Supply Facilities in Schools" which concerns the rural establishments of the bordering province of

Boulkiemde (150 schools and CFJA: 15 000 children). The project initially focussed on health education, water supply and sanitation; its scope was widened to cover other sectors, especially agriculture, school medicine and interchanges with French schools. The feasibility of the programme is the result of a strong engagement of the teachers and of the parents of the pupils. It is now envisaged to undertake this project in Bazega. The objective is to work during 5 years in all the rural schools of the province, which represent a target population of 19 000 children from 7 to 15 years old. The project corresponds to the National Burkina Bé policy in primary health care, basic education and farmers' self-promotion. It is conceived and implemented by EAST in cooperation with the national administration.

### Phasing and Costs

During the first year, the project concerns 30 schools in the vicinity of Kombissiri. The team is constituted by 1 expatriate medical officer (specialising in Public Health and Tropical Medicine), 1 Burkina Bé training specialist, recruited and trained by EAST, and assisted by 1 health agent from the DPSAS of Bazega.

- training of teachers and health education of pupils: at the beginning of the school year, all the teachers attend a training session. For each class, there are three health education workshops per year;
- water supply and sanitation: a drinking water supply post (PEP) is distributed in all the classes. The chlorination (javellisation) method is described and implemented in front of the children, who are responsible - under the authority of their teacher - for the maintenance, the filling and the daily treatment of their PEP. A four-seat latrine, with double ventilated dry pits is built in the school yard. The parents are requested to participate. The sanitary protection of the hydraulic works utilized by the school is constructed, also with community participation. It can be a drain, a pit, a wall or a paved area;
- agricultural production: an agricultural zone is created near the schools which have enough water during the dry season. A field of cereal plants is available to the pupils, with the support of the village authorities;
- school hygiene: each school receives a pharmacy kit containing the drugs and equipment which are indispensable for first aid care. The teachers diagnose and treat common diseases; the more serious or doubtful cases are referred to the dispensary or the hospital;
- inter-school training arrangements and other activities.

Following years: the zone of influence of the project will expand rapidly in order to cover the entire province within 3 years (37 additional schools during the second year, and 55 during the third year). During the last two years, the structures are consolidated, and EAST withdraws its support, which is replaced by complete local management.

The total cost is FF 2 400 000.

|                                       |            |
|---------------------------------------|------------|
| For the first year of the project     | 600 000 FF |
| Financed by Ministry of Cooperation   | 100 000 FF |
| Total-Afrique                         | 50 000 FF  |
| EAST                                  | 50 000 FF  |
| Syndicat des Eaux de l'Ile de France  | 100 000 FF |
| The additional funds needed amount to | 300 000 FF |

## PROJECT 6

### HAITI

#### Protection of 138 Springs equipped by POCHEP \*

##### Background

In 1980, the Haitian Government signed with the Inter-American Development Bank (IDB) and the European Economic Community (EEC) a loan agreement in which the Ministry of Public Health and Population became responsible for the management of a water supply project developed with the sole objective of improving the water supply of rural populations.

This project constituted one of the main activities of the Ministry in its programme to control diarrhoea, responsible for 20% of infant mortality in the country, especially in the target area. 68 drinking water supply systems were built, and in 1986, a second loan from the Inter-American Development Bank provided for the construction by the Ministry of Public Health and Population of 70 additional water supply systems. At the same time, a Continuous Maintenance Service was created to manage the systems constructed by the Construction Unit. The second phase of the project is currently being implemented.

The Haitian Government has made an important investment in this project, which to date represents an expenditure of close to 17.4 million dollars (US\$ 17 400 000).

##### Justification and Objectives

The Continuous Maintenance Division of the POCHEP project, during the implementation of its programme, has shown the considerable decrease of the yield of the equipped sources and of those which will be equipped in the near future. The Construction Unit has been immediately alerted, since the cost effectiveness of the projected investment can be considerably affected. Obviously, the main reason for this situation is the deforestation of Haiti, especially of the catchment areas of the springs equipped by the project. If this issue is to be addressed scientifically, this means finding and accepting any

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\* POCHEP= Communal installation for hygiene and drinking water supply



solution of soil conservation and afforestation, through a case by case study of the hydrogeological development and the boundaries of the catchment areas of each source equipped or to be equipped by POCHEP.

The objective of this project is to increase the water infiltration in the catchment areas of the springs through soil conservation works and through the production of fruit trees and other trees.

In order to reach this objective, it is important to know the variations in the water yield, and the geological conditions for each of the springs, in order to show their behaviour and their production. For each spring, the depletion curve, the age of water at the source, the infiltration area, the time of response to rain, the volume of water stored and the projected yield can be determined. This information will be used in defining the boundaries of the catchment area, in calculating its size, and in determining the ways and means to protect the spring.

### **Description**

The methodology proposed for each source includes:

#### **1. Study of the field location**

It consists in:

- the determination of the geological origin and the mapping of the geological conditions;
- the evaluation of the physical catchment area;
- the determination of an immediate protection perimeter; and
- the determination of a close protection perimeter.

2. Equipment of the spring - at this level, the spring will be visited in order to check if the catchment has been adequately built, and to provide additional protection as necessary. At the same time, the project will provide for the installation of:

- a downspout with measurement scales;
- immediate protection perimeter with wire netting and locker;
- a water point outside of the catchment area in order to forbid access to the source.

At this stage, it will also be necessary to designate an observer for the reading of the scale.

#### **3. Monitoring of the spring**

In order to monitor the spring, a series of activities will be undertaken:

- measurement of the water level everyday;
- record the rainfall in the zone, which necessitates the installation of gauges;
- take samples and characteristics for a number of measurements;
- take the temperature.

The data collected will be treated through HYDROM, in POCHEP, and the following can be obtained:

- depletion curve (projected yield, stored volume);
- rain - yield correlation;
- physical and bacteriological qualities of water.

This information will contribute to the determination of the water balance and the determination of the areas to be treated.

#### 4. Health education and impact evaluation

These aspects will be considered separately, in the framework of the POCHEP project as a whole, which has a public health component of essential importance.

#### **Expected Benefits**

- A. For each one of the springs, a permanent infrastructure will be created, which will allow the Drinking Water Committee (CAEP) to improve the management of the resource, by early forecast of the yields, water quality checks, intake monitoring, and physical protection of the environment of the spring.
- B. For POCHEP, reliable yield data will be provided, and the project will monitor yield trends for each source. The maintenance and promotion services will be able to convince each water committee of the importance of periodic rationing in the framework of overall system management.
- C. This information, once obtained, will show the limits of each catchment area, with its geological and rainwater characteristics. The soil conservation pattern and the type of afforestation required for each catchment area can thus be determined, in order to maximize outputs from project investment.

**Personnel, Equipment, Duration and Costs**

The project personnel will include national consultants (2) and technicians (4) in hydrogeology, observers (136), drivers, masons and a limited administration.

The equipment will include vehicles, rainwater gauges, scaled down spouts (136), and office furniture and supplies. The duration of the project will be two years.

The costs of the project will be as follows (in US\$):

|  |                  |              |                  |
|--|------------------|--------------|------------------|
| 1. Analyses for the completion of data:                          |                  |              |                  |
| - chemical analyses  | 552 u x \$ 20    | = \$         | 11 040           |
| - bacteriological analyses                                       | 552 u x \$ 20    | = \$         | 11 040           |
| - isotopic analyses + freight                                    |                  |              | 3 000            |
| - contingencies  |                  |              | <u>5 016</u>     |
|  | sub-Total        | \$           | <u>30 096</u>    |
| 2. Construction of wire fences and rehabilitation of catchments: |                  |              |                  |
| - lump sum amount per spring                                     | 138 u x \$ 4 000 | = \$         | 552 000          |
| contingencies  |                  |              | <u>55 200</u>    |
|  | sub-Total        | \$           | <u>607 200</u>   |
| 3. Personnel expenditures  |                  |              |                  |
| Item   | No.              | Salary/month | Salary/24 months |
| Local expert (in charge)   | 1                | \$ 3 000     | \$ 72 000        |
| Local expert (assistant)   | 1                | 2 000        | 48 000           |
| Technician (hydrogeology)  | 4                | 800          | 76 800           |
| Computer Specialist  | 1                | 500          | 12 000           |
| Secretary  | 1                | 500          | 12 000           |
| Mason (foreman)  | 4                | 500          | 48 000           |
| Driver   | 2                | 300          | 14 400           |
| Observer   | 138              | 20           | 66 240           |
| Perdiem  |                  |              | 18 000           |
| Contingencies  |                  |              | <u>36 744</u>    |
|  | sub-Total        | \$           | <u>404 184</u>   |
| 4. Vehicles (including repairs)                                  |                  |              | 112 000          |
| 5. Fuel  |                  |              | 30 000           |
| 6. Hydrology equipment   |                  |              | <u>60 000</u>    |
|  | GRAND TOTAL      | \$           | <u>1 243 480</u> |

## PROJECT 7

### MALI

#### Promotion of Hygiene and Sanitation

##### Description and Location

This research project on Promotion of Hygiene and Sanitation in rural areas will take place between 1992 and 1995.

Mali, a continental Sahelian country, has an area of 1.24 million km<sup>2</sup> and a population of 7.6 million inhabitants, 84.4% of which live in rural areas. Mali is among the poorest countries in the region and in the world. Infant mortality ranges from 125 to 200 per 1000, life expectancy is 46 years for men and 48 years for women, water supply is available to 45% of the urban population and less than 19% of the rural population, sanitation facilities are available only to a few, and are particularly scarce in rural areas, less than 16% of children go to school (1986), and the literacy rate for women is less than 5%.

##### Justification and Objectives

Water supply and sanitation are essential elements of any action to protect the environment, improve health and combat poverty. High morbidity and mortality rates are often directly linked to the lack of these services. The persons affected by water - and filthborne diseases are essentially among the less privileged population groups, and include a large number of women and children.

Studies of the Hygiene Laboratory have shown that all the sources of water (wells, surface water) were polluted; even water from boreholes, which is safe at the source, is also polluted during transport and storage. Other studies have shown the low coverage rate in terms of latrines, and the ignorance of populations with respect to elementary action to be taken in order to protect their welfare.

The specific objectives of the project are as follows:

- a. Data collection on the rate of coverage of safe water supply and sanitation, how the facilities are used, what level of knowledge people have in environmental hygiene, and traditional practices which may be favorable or unfavorable to the promotion of hygiene.

b. Treatment of data:

- problems which are familiar to the population, both in terms of causes and solutions, will be the subject of the implementation of this programme;
- real hygiene issues, however not perceived by populations which therefore are unaware of the solutions, will be the subject of an education component, with the objective of stimulating the perception of the problem, leading to the identification of causes, and motivating people to find a solution.

c. The programme will include a construction component for each agglomeration; the facilities to be constructed will be adapted to the environment. Ten latrines will be constructed, including 1 in a school and 1 in a health center; 10 composting pits will be installed; 4 water points will be equipped, including 1 in a school and 1 in a health center; a "women literacy" component will be included in the project, as well as a component of education for the rational utilization of the works.

d. Evaluation of the activation of the participatory structures of the rural communities engaged in the implementation of the primary health care policy. These structures consist of political organizations, agricultural groups or projects, local administration and health mid-management personnel.

### **Implementation**

Ten villages will be selected in each of the administrative regions of the country. A team composed of 1 sanitary engineer, 1 sociologist, 1 community development technician and several public health technicians will be in charge of the preparation of the questionnaire. The study will take place under the supervision of the sanitary engineer, with the support of the local public health mid-management personnel. The study will last for two months. The report will give an account of the current situation and provide guidance for the selection of the facilities.

Ten latrines and ten solid waste compost pits will be constructed as models in each village. Two sanitation areas will be prepared around modern wells or boreholes corresponding to the quality criteria accepted in the country. For villages which do not have adequate well or borehole installations, the project will build the water supply installation with the help of the population.

Health education will be undertaken on a permanent basis, and focussed on the promotion of hygiene and the protection of the environment. A literacy programme will be implemented. The health education programme will also concern the utilization and maintenance of the facilities.

The programme will include interim annual evaluations, and a final evaluation which will take place at the end of the fourth year. The main indicators to be used include the percentages of households equipped with latrines, and the percentages of project beneficiaries who are aware of the transmission of disease by water and excreta, and of the linkages between environmental sanitation and health.

### **Institutional Framework**

1. Government of Mali (Ministry of Public Health and Social Affairs):
  - Personnel of the central team, except the consultant;
  - Officers;
  - Local labour for implementation of the activities;
  - Funding of part of the works by the benefitting populations.
2. WHO and other international and national agencies:
  - WHO technical and financial support;
  - UNDP/UNICEF technical and financial support;
  - Support of the UN Volunteers;
  - Other institutions: technical and financial support in relation with their interest for the project.

### **Cost of the Project**

|                                 |                     |
|---------------------------------|---------------------|
| National contribution           | 180 600 \$          |
| External contribution requested | <u>1 250 000 \$</u> |
| Total                           | 1 430 600 \$        |
| Contingencies 13%               | <u>185 978 \$</u>   |
| Grand Total                     | 1 616 578 \$        |

404 144 500 FCFA

to be spent equally over 4 years, and broken down in 1/3 personnel expenditures, 1/3 supplies for construction and equipment, 1/6 for the training budget and 1/6 miscellaneous.

### **Note**

This proposal has been formulated as a preliminary project by the Division of Hygiene and Sanitation of the National Directorate of Public Health Ministry of Public Health and Social Affairs, Republic of Mali. It is therefore subject to change prior to its presentation in final form.

**PROJECT 8**  
**AFRICA**  
**Planning and Formulation**  
**of**  
**Health Education Projects**

**Background**

Several projects concerning the health education component of drinking water supply and sanitation have been formulated in detail in 1990. Some of them have been financed in part, and their objectives, as well as the methods to be used for their implementation, should now be defined with accuracy. The following projects have been submitted to the evaluation of a special Commission of the Working Group on Water Sanitation and Health:

|  |                              |
|--|------------------------------|
| - Promotion of hygiene education in schools                        |                              |
| - Study and preparation of a programme                             | US\$ 25 000 (1)              |
| - Inter-country seminars (9 of the least developed countries)      | US\$ 70 000 (2)              |
| - Water Sanitation and Health planning (rural areas)               | US\$ 65 000 (3)              |
| - Promotion of health education at schools                         | US\$ 255 000 (4)             |
| - Health education, water and sanitation in the poorer rural areas | <u>US\$ 250 000 (5)</u>      |
| TOTAL  | <u>US\$ 665 000</u><br>===== |

**Recommendations of the Commission**

The objective of Project 1 should be the establishment of methods for the formulation of health education projects adapted to each country. The project requires a sanitary engineer specialized in public health and a training expert, for 6 weeks each. They will collect the largest possible number of reports on existing health education projects, especially those which seem the most difficult, as well as existing studies concerning such projects. The projects EAST (Burkina Faso), POCHEP (Haiti), UNICEF (Nepal, Uganda), SIDA/UNICEF (SWATCH - India) and WHO (EMRO) should receive special attention. The study should show some key elements of success or failure, which will be used for the elaboration of draft planning guidelines, to be used directly in some countries, as well as in the framework of Project 2.

Project 2 requires the preparation of project documents by countries, on the basis of the guidelines of Project 1. These documents should be finalized at the level of the sub-regions, and presented at a donors meeting at regional level. These activities can reflect the lessons learned in the context of the EAST project, but other projects should be studied, especially those which have to various degrees succeeded in making effective changes in hygiene behavior, with resources and methods different from those used by EAST. The emphasis should be placed on training methods, rather than equipment, and the issue of participation should be dealt with in great detail.

Project 3 is an extension of Projects 1 and 2 at inter-regional level and should make use of the conclusions of these projects.

Project 4 should be used for the organization of health education workshops in countries of various regions.

Project 5 consists a series of activities which the commission recommends to limit to the following issues:

- appropriate sanitation technologies for less privileged rural areas;
- involvement of the users in planning, follow-up and evaluation;
- integration of health education and sanitation in schools;
- operation and maintenance of water supply and sanitation systems;
- development of information systems for Central America.

#### **Note**

Some funds have been made available by the Swedish International Development Agency and are currently being allocated to some of the above mentioned projects, as well as some WHO funds. A large part of Projects 3 and 4, and some components of Project 5 are still to be submitted to potential donors for funding.

Some of the recommendations of the Commission are already being implemented especially those concerning the promotion of hygiene education at school. The funds of Project (1) have thus been allocated in priority to the health education component of other projects, in order to obtain the information which will be used in the formulation of a project to prepare planning guidelines for rural areas.

The amount of U\$ 135 000 in the project formulation table of page 5 of this report represents the health education component only. The other components (U\$ 530 000) have not been mentioned in the table in order to avoid any overlapping with other projects.



## PROJECT 9

### SAHEL

#### Measures to Improve the Quality of Drinking Water from Lined Wells

##### Background

Numerous "modern" water points have been created in the rural areas of Africa in order to improve - qualitatively and quantitatively - the supply of water to the local populations.

Among these water points, the lined wells are wells with large diameters (1.2 to 1.8m), and of an average depth of 25 to 30m. Their walls are concrete cylinders in which flows turbid or opalescent, rarely clear, water, which comes from the shallow aquifers. The yield of these aquifers varies according to the meteorological conditions (rainfall and evaporation).

The basic equipment of these modern wells is rudimentary. The higher element of the well, if it is above the surface of the soil, constitutes the curb stone of the well, which is generally open, and surrounded by a circular concrete slab of about 1m radius, which is supposed to stop the infiltrations of polluted surface water. Water is extracted with equipment which is stored on the ground. The water which is lost during withdrawal, as well as the rainwater, are not drained, and a slough is thus formed near the water point, contaminated by the cattle which comes there to drink.

##### Justification and Objectives

15% of the lined wells are contaminated by fecal matters; the average pollution rate is 10 fecal coliforms in 100ml of water. The reasons for the contamination of this water are:

- the pollution of the environment;
- the lack of sanitary protection of the facility;
- the bad habits of the users.

Besides, it has been observed that water, after having been drawn, is subjected to gradual fecal pollution during its transportation, its storage and its consumption in the household. It has been shown that the chemical disinfection of water, especially by chlorination, maintains the good quality of water until it is consumed.

In order to provide drinking water supplies to the villages which use lined wells, some measures are required in terms of health education of the population, sanitary protection of the wells and of the environment, and chemical water treatment. Sanitary protection of the wells and chemical treatment of the water are the two objectives of the present pilot project, which would be undertaken for a duration of 6 months, in 1992.

### **Description**

Sanitary protection of hydraulic works - remote protection perimeter. All fecal pollution sources - latrines, refuse, cattle farms, traditional wells - will be kept distant from the water point in order to avoid the contamination of the aquifer. A distance of 30m is usually enough.

Immediate protection perimeter - it includes a watertight concrete slab around the curbstone, with a circular drain which collects the lost water and evacuate it towards a pit or a watering trough

- a wall, 1m high

Maximum watertightness - this prevents the external pollution to penetrate in the well, at all levels, and it requires:

- cement joints (for infiltration water);
- concrete curbstone (surface and rainwater);
- concrete slab, sealed on the curbstone, closing the opening of the well (air and animal pollutions).

Protected water drawing systems - the systems facilitate the drawing of water, and it avoids the introduction of water in dirty recipients. Several systems can be recommended (pulley, etc.).

### **Chlorination of Water from Wells**

The disinfection of water directly in the well requires the immersion of a chlorinating pot or the daily introduction of chlorine. As compared to the individual treatment (in the household, in the storage recipient), the collective treatment of well water has the advantage of protecting the entire rural community from water-borne fecal pollutions by reducing the individual constraints.

### **Equipment and Methods (for 10 modern lined wells)**

Rehabilitation of the elements:

- water tightness: cement joint;

- protection: verification and repair of the concrete curbstone, the concrete coverage slab, the immediate protection area, elimination of all nearby sources of fecal pollution;
- water withdrawal system with pulley - 5 wells; with winlass - 5 wells.

### **Chlorination**

- Test A - daily evaluation of chlorine  
daily evaluation of the bacteriological quality of the water (during one month);
- Test B - chlorination of well water by Javel water

Promotion of village participation

There will be two groups of facilitators

- The health education agents (physicians + public health workers), they teach public health and hygiene:
  - . distinction between clear and turbid water;
  - . presentation of films of pathogenic agents in water;
  - . indication of the usual pollution agents;
  - . maintenance of the equipment;
  - . standardization of chlorination methods.
- The pupils in the schools
  - . they are made responsible, and they chlorinate the water daily;
  - . they are already the promoters of safe water supplies in their families;
  - . they wish to establish advisory and surveillance groups.

### **Expected Benefits and Costs**

The objective of the pilot study is to standardize the methods to be promoted in order to obtain drinking water from wells. On the basis of a vast programme of health education at school (Boulkiemde province - Burkina Faso) and knowing the bacterial contamination of lined wells is relatively limited, it seems feasible to ensure a daily supply of safe water.

The provisional budget is FF 323 300 (US\$ 55 000), including 125 000 investment costs and 198 300 operational costs (of which about 36 000 is for health education).

**WATER, SANITATION, HEALTH**  
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**ANNEXES**

ANNEXE I

WORKING GROUP

ON WATER - SANITATION - HEALTH

LIST OF MEMBERS

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| Mr | H.     | SPRUIJT            | Officer in Charge, CWS, UNICEF, UNICEF, Rwanda               |
| Mr | P.     | STEVENS            | Sté Gle pour l'Industrie, Switzerland                        |
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| Mr | M.     | WEGELIN            | Progr. Officer, IRCWD, Switzerland                           |
| Mr | L.     | LAUGERI            | WHO/CWS, Secretary   |

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**ANNEXE II**

**LIST OF PARTICIPANTS BY COMMISSIONS AND SECRETARIAT**

**Commission I - Study and Pilot Projects**

|    |      |              |
|----|------|--------------|
| M. | M.   | AZILI        |
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| M. | C.   | HOUDUS       |
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**Commission II - Extension of Coverage**

|     |        |                    |
|-----|--------|--------------------|
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| Mme | G.     | MATHURIN           |
| M.  | H.D.   | SPRUIJT            |
| M.  | H.P.J. | VAN SCHAIK         |
| M.  | B.     | VERHILLE           |
| M.  | M.T.   | WAITE              |

**Commission III - Health Education**

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| M. | M. | AZILI      |
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| M. | Y. | GLEMAREC   |
| M. | D. | GUBLER     |
| Dr | R. | HEINMULLER |
| Dr | A. | SEIM       |
| M. | M. | WEGELIN    |

**Secretariat**

|    |        |   |
|----|--------|---|
| Dr | D.     | BENBOUZID, WHO/NUT (Nutrition)                |
| Dr | R.     | BOS, WHO/CWS                                  |
| M. | J.     | HUEB, WHO/CWS                                 |
| Dr | M.     | JANCLOES, WHO/ICO (International Cooperation) |
| Dr | L.     | MONJOUR, President EAST                       |
| Dr | K.E.   | MOTT, WHO/SCH (Schistosomiasis)               |
| Dr | A.G.   | PRADILLA, WHO/NUT (Nutrition)                 |
| Dr | A.M.E. | PROST, WHO/PDM (Programmes)                   |
| Dr | P.J.A. | RANQUE, WHO/FIL (Filariasis)                  |
| Dr | H.     | REJEB, WHO/FHE (Family Health)                |
| Dr | D.B.   | WARNER, WHO/CWS                               |

|      |    |   |
|------|----|---|
| Mlle | F. | SIGALOTTI, Secretary, CWS                   |
| M.   | L. | LAUGERI, CWS, Secretary of the Consultation |

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**ANNEXE III**

**Chlorination \***

**by Bernard Verhille**

**Treatment Requirements for Potable Water Supplies**

The sequence of steps is as follows: screening (to eliminate the largest solids), settling - clarification (elimination of mud from water) and various chemical treatments:

- destruction of toxic chemical products,
- flocculation (chemical products accelerate the settling of the more resistant suspended solids - Al or Fe salts, polyelectrolytes);
- major disinfection with chlorine or ozone;
- remanent disinfection with chlorine.

Various combinations of these techniques are used according to the nature of the water, which can be obtained from a spring, naturally filtrated by soil, or a running surface water (a river), or a static body of surface water, like a pond. The major disinfection, in some cases when it is done without efficient flocculation, can result in the creation of toxic molecules (organic polyhalogénures with chlorine, peroxydes and aldehydes with ozone).

The remanent disinfection is due to the  $Cl O^-$  ion; this process is called chlorination. The major disinfection should be applied to all cases, except for a well controlled borehole water. When the process of chlorination is used for major disinfection, subsequent remanent chlorination is not required.

**Chlorine in the Economy**

More than half of the turnover of chemical industries in some countries (among the most industrialized) is linked to chlorine. This is made as co-product of soda, and with it it constitutes an essential basis of the world chemical industry.

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\* Presentation on the Industrial Environment of Water Treatment by Chlorination  
- Sté des Produits Chimiques d'Harbonnières - April 1991

The largest chlorine/soda plans produce 1 million tons of chlorine per year, the smaller ones can produce a few hundred tons per year only. A minimum feasible unit should produce 1000 to 2000 t/year. The mineral products concerned are essentially:

- soda for textiles and detergents;
- hydrochloric acid for cotton;
- iron chlorine for flocculation;
- liquid chlorine;
- sodium hypochlorite;
- bleaching powder (calcium chlorine).

The production of chlorine and soda is always the start of a basic chemical industry. A few countries of the developing world have this type of industries, for instance in the North of the African Continent Algeria, Egypt, Lybia or Morocco.

### Action and Effects of Chlorine

Chlorine acts in water in the form of the hypochlorite ion  $\text{Cl O}^-$ . This ion can be brought by various products:

- gaz chlorine;
- sodium hypochlorite (bleaching solution);
- calcium hypochlorite in the form of bleaching powder of HTH;
- sodium isochlorocyanurate;
- tri-soda chlorinated phosphate (CTP).

When a certain concentration of this ion is dissolved in water, as it is a very active oxydating agent, it will:

- destruct the organic molecules which are sensitive to its action, fats, dies, etc.;
- store itself in the suspended nitrates and produced chloramines;
- if there is an excess of free chlorine, the  $\text{Cl O}^-$  ion penetrates in the living cells, destroys some of their elements, and makes these cells burst.

The function of destruction of some organic molecules is used in the bleaching and disinfecting functions for the viruses. The capacity to penetrate in the cell and to make it burst is used in the disinfecting function for bacteria and parasites.

By contrast with these two positive uses of a very active ion, there is the natural degradation of the solution, and in the case of turbid waters, the formation of chloramines.

These are at the origin of the "smell of chlorine" which is often referred to. The chlorine stored in these suspended matters has negative effects, because:

- chloramines have very little disinfecting power (about 10 times less than the  $\text{Cl O}^-$  ion);



- the smell of chlorine (in drinking water as well as in swimming pools) is generally objected to by the public.

It is important to know that if there are chloramines, and therefore if there is a "smell of chlorine", there is in fact no free chlorine present. If the chlorine content of water containing chloramines is increased a breaking point is reached, where the suspended matters are saturated; at that time, all the chloramines free their chlorine, and the "smell of chlorine" disappears.

With respect to the conservation of the solution of sodium hypochlorite, it should be noted that the degradation of this product will vary with its quality, its concentration, the quality of the recipient, and the climatic conditions. For identical concentrations, the degradation of the product is much more rapid at high temperatures. A ill-adapted recipient can also cause a very rapid degradation of the product.

It seems that in tropical climates, like in Brazil for agua sanitaria, the concentration should be about 25 g/l (8 chlorometric degrees). It would be interesting to standardize this concentration for all countries as an intermediate product for the protection of potable water in rural areas.

With respect to the time of degradation of the product, and in order to monitor the quality of the product and of the recipient, it will interesting to use an indicator (in France, the loss of 1/6 of the Javel water at 15°C, 3 months for an initial concentration of 150 g/l, 48<sup>0</sup>Chl). In tropical countries, a possible indicator could be the time of loss of 1/6 of the product at 25 g/l at 30°C.

The degradation occurs as the result of an initial loss called "oxygen", followed by a continuous loss called "chlorate", it is important to separate the two phases, while maintaining the product in the storage recipient during the degradation test.

Finally, the stability of the hypochlorite depends on a minimum content of free soda, of the order of 0,4% for a product at 150 g/l; the product should not be in an acid medium; the ventilation of the product destroys the free soda in the form of sodium carbonate. An excessive content of free soda makes the solution dangerous to handle. Free soda is particularly difficult to dose.

## Conclusions

The hypochlorite ion is essential for the remanent disinfection after flocculation of drinking water. Its use should be normalized at the level of 25 g/l, among the products used by the public health authorities. The production can be integrated in basic industrial development as in Morocco (Mohammedia plant) or be undertaken with very limited investment by private "javeliers", as in Burkina Faso.

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**ANNEXE IV**

**Iodization \***

**by A. Blanchard**  
**and C.P. Pusineri**

**The Health of Children in the World\*\***

The following objectives are included in the list adopted by the World Summit for Children of 30/09/90 in New York:

- in general: access of all families to safe water supply and sanitation;
- nutrition: nearly total elimination of the affections resulting from lack of vitamine A and iodine.

**Effects of Iodine Deficiency**

Several hundred million people have an insufficient supply of iodine. The high prevalence areas are: Africa (essentially landlocked countries), Latin America and Asia (in its center, especially in China).

The pathological consequences are extremely serious:

- during pregnancy: spontaneous abortion, premature delivery, foetal death, foetal brain development disorders;
- in children: mental retardation, abnormal psychomotor development, growth disorders, muscular disorders, paralysis, language and hearing disorders, cretinism;
- in adults: goitre, adynamia, cretinism, low productivity.

\* "L'Eau Nouvelle Source d'Iode - Rhodiffuse Iode " (Water New Source of Iodine), and "Troubles dus à la Carence en Iode" (Affections resulting from Lack of Iodine) - Rhône-Poulenc Rover, 1990.

\*\* United Nations Children Fund (UNICEF), 1990.

All these consequences have an impact on the economic life, as most of the people affected are virtually excluded from the active community.

There are many ways of providing humans with iodine, like the iodization of salt, intramuscular injection of iodized oil, or oral absorption of iodized oil. These methods are not fully satisfactory, because they require costly resources and they are difficult to implement in practice; besides, usually only a minority of people in developing countries can benefit from these improvements.

### **Problem Definition**

Endemic goitre, evidenced by the enlargement of the thyroid gland, was until recently considered to be only a secondary problem with no repercussions on general health. Advances in medical sciences have completely modified our perception of this issue to the extent that the reduction of iodine deficiency disorders has now become a priority for the international authorities.

Certain countries are privileged by particular dietary customs or a specific geographical situation enabling them to effectively combat iodine deficiencies. These advantages are not the same everywhere. The natural soil iodine content, leached away during glaciation or erosion, affects the diet of the populations. It is therefore difficult for people in such geochemical contexts to escape from iodine deficiency disorders. Regular and sustained attention is required for the prevention and control of deficiencies.

For the correct treatment of these disorders, a medical infrastructure is usually required, the first concern of which is to detect symptoms. Treatment must then be ensured within the framework of locally available means. What solution can be proposed? What industrial perspectives may be put forward to ideally answer this problem affecting more than 800 million people, a figure which was confirmed by the last United Nations coordination report? The irreversible nature of iodine deficiency in children has led the international authorities to consider this health problem as a world-wide priority, and the scientific community has decided to address it as a matter of urgency.

### **Proposed Solution**

The main feature of the proposed solution consists in a system which ensures the programmed release of iodine through silicone polymeres which can release continuously during one year in wells and boreholes or any other water point or water tank. This system provides for continuous treatment of the people who suffer from iodine deficiency, by using the most universal, physiological medium, water.

The notion of biological acceptability is fundamental, and therefore silicone polymeres have been selected, because they are biotolerated. Their physical, chemical and biological properties correspond to the objective. The source of iodine selected is sodium iodine, which is an iodine salt of high quality which is widely available.

The prototype has the following characteristics:

- a daily iodine supply of 50 to 200 ug/l per person for a consumption estimated at about 2 liters of water per day;
- for a borehole yield of 600 l/hour;
- for an average operation of 12 h/day.

The parameters affecting the diffusion of the iodine salt are:

- the distribution of the iodine salt;
- the type of iodine salt;
- the type of silicone elastomere;
- the degree of cross leaking of the silicone;
- the initial percentage of iodine salt;
- the surface area/volume ratio of the matrix.

The diffusion process is as follows: the diffusion of water through the matrix towards the hydrophylic salt, continuously transports and releases the iodine by induced osmosis. The osmotic pressure gradually breaks the matrix network leading to the new osmotic contact and so on. The system (physiological system) consists in a polyethylene module containing N "matrices" (cylinders) which are silicone polymeres imprisoning a defined proportion (30%) of sodium iodine, and which have the surface/volume ratio selected to allow for utilization during one year.

Mali has been selected for field testing of the experimental data, because it is a landlocked African country, with more than 2 million cases of chronic lack of iodine (source - WHO). The geographical area selected is in the North West of Bamako, with goitre affecting 42% to 64% of men and 58% to 83% of women.

The study started in December 1988 on the diffusion of iodine in water under daily conditions of use in African countries, to demonstrate the correlation between the supply of iodine in water and urinary excretion, to check the acceptability among the population of a device inserted into a borehole and to follow-up with surveillance of chemical and goitre indices.

The experiment was carried out in three villages sufficiently far apart to prevent any zone effect; a control village was used as a control group during three months; water was supplied from a borehole. The programme was conducted in full agreement with local authorities and mores, with controls by water assays twice per month, assay of urine every three months, and permanent clinical follow up.

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**ANNEXE V**

**Rural Water Supply Treatment \***

**by M. Wegelin**

The slide sound show presented at the consultation concerns essentially water treatment processes applicable to turbid surface water. Groundwater, which should be given preference when it is available, is usually free from contamination, and therefore needs little or no treatment. The most difficult component to operate and maintain in a water supply system is water treatment. Therefore, the use of surface water should only be opted for after careful consideration of the other alternatives.

The main objective of any water treatment is the removal or destruction of the microorganisms affecting the health of the consumers.

Slow sand filtration and chlorination are treatment processes primarily used for the separation and oxydation of microorganisms. Slow sand filters improve the bacteriological water quality on the basis of natural, physical and biochemical treatment processes. They make maximum use of local resources, they hardly require mechanical equipment and do not depend on chemicals; their operation is easy and reliable. However, slow sand filters perform well only with water of low turbidity. The same applies to chlorination, which is often applied as final treatment step to destroy the microorganisms and provide a safety barrier against the subsequent microbiological pollution of the water. Chlorination requires careful dosage of the chemicals.

\* Abstracts from the slide sound show of the World Bank sub-module 4-5-b presently under production (International Reference Centre for Waste Disposal, UNDP World Bank Project, 1991).

Most flowing surface waters are turbid, especially during the raining season. High turbidity surface water should be treated in two stages:

- to reduce the turbidity by the removal of the solids from the water;
- to remove or destroy the microorganisms remaining in the pretreated water, by slow sand filtration or chlorination.

Flocculation and sedimentation are used as a first treatment step to remove the fine solid matter, in large municipal water treatment plants. The following constraints apply more specifically to the rural areas:

- water treatment requires chemicals, which are often imported and difficult to transport and store in the quantity required;
- chemical water treatment requires dosing equipment; the doses should be adapted to rural water quality, or the installation may be damaged;
- chemical water treatment requires skilled personnel, which is difficult to find in rural areas, for monitoring of the water quality, adjustment of the doses, maintenance and repair.

These constraints are especially serious in the frequent case of management of the facilities by the community, alternative treatment processes must be used, based on physical and biological, rather than chemical properties, by analogy with the natural treatment of ground water, which undergoes efficient natural purification processes.

Floating matters are removed by sedimentation tanks, roughling filters and various other filters installed next to the catchment; where the hydraulic head is sufficient, dynamic filters can be installed in river beds.

The removal of suspended solids is usually followed by treatment to improve the bacteriological quality of water, by slow sand filtration and chlorination.

Generally, rural water supply treatment presents a challenge for all people involved, especially in the case of high turbidity surface water. Our main counterpart is nature itself, which provides the best model for the production of a clean and bacteriologically safe water.

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**ANNEXE VI**

**Control of Morbidity due to Schistosomiasis (*S. haematobium*)  
in the Island of Pemba (Tanzania) \***

**by K. Mott**

The WHO film entitled "Kichocho" (schistosomiasis in Swahili) illustrates, from the view point of a child affected by the disease, the main steps taken in order to reduce its incidence and control its progress. The action takes place in Pemba (Tanzania), a small island of the Indian Ocean with 280 000 inhabitants. According to a 1975 estimate, *S. haematobium* concerns 60% of this population, and the morbidity rate of persons affected is 10%.

Two health agents have helped the inhabitants of Pemba to combat schistosomiasis, by explaining to the community the mode of transmission of the disease from one person to the other, and how to react by adopting hygiene habits, using latrines, digging wells and treating those who have the disease. The effective involvement of the population of Pemba in the schistosomiasis control programme has resulted in a reduction of the presence of blood in urines (indicator of prevalence of schistosomiasis) from 55% in 1986 to 10% in 1988 among children of 5 to 9 years of age.

Previously, the large scale use of drugs had required the participation of qualified personnel for diagnosis (with microscope) and costly logistic resources. These activities were independent from the system of health care constituted by the dispensaries and the village health agents. The objectives of the programme were defined in term of elimination of morbidity due to *S. haematobium* by using primary health care in order to strenghten the existing system and create a framework for the future control of other endemic diseases.

Besides the action of the health personnel in diagnosis and treatment, the communities were encouraged to change their habits, especially with respect to water and sanitation. The schools played an important role. The film "Kichocho" includes a sequence of construction of wells by the local population on its own initiative. The programme thus illustrates the complementarity of efforts of the health personnel and the involvement of the community, in both preventive and curative actions.

\* Abstracts from the WHO film "Kichocho" and from an article on the control of schistosomiasis in the Island o Pemba (Savioli et al. Trop. Med. Parasit. 40(189)189-194).

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**ANNEXE VII**

**Present Situation of WSS in Rural Areas \***

**by L. Laugeri et L. Monjour**

The extension of drinking water supply services to the less privileged, and the provision to all rural dwellers of adequate sanitation, are constantly hampered by the constraint of dispersed habitat. For these objectives to be fulfilled, a number of steps should be taken to improve the quality of services, as reflected in the characteristics of the water which is supplied to the consumers. The conditions of wastewater disposal in the environment, and of access to adequate drinking water supply and sanitation facilities, should also be improved. The purpose is therefore to optimize the quality and accessibility of existing goods and services, which are indispensable to life and health, rather than create and distribute a new product.

In order to cover the needs of one thousand million persons who are still without safe water, and of the many more who are deprived of adequate sanitation, WSS activities should be decentralized. In view of the strong tendency of water agencies to remain centralized, it will often be difficult to develop efficiently their regional and local branches. Decentralization will rely on community development rather than on "deconcentration". Where it is feasible to develop branches, these should coordinate their resources and efforts with those of other sectors which are more easily decentralized, for example public health or other sectors such as education or agriculture.

Because water supply and sanitation are integral parts of primary health care, and are essential to the success of health programmes, the cooperation of water supply and sanitation and health workers is required at village level. In villages, qualified public health workers are generally easier to find than teams specialized in the operation and maintenance of infrastructure works; the deconcentration of these teams is often not feasible beyond regional level.

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\* Abstracts from the Report of the First Consultation of the WHO Working Group on Water, Sanitation and Health, Geneva, 27-28 June 1990 (Document WHO/CWS/90.12)



To-day, while more than 1000 million people are still without water, the beneficiaries of the service continue to be affected by qualitative and quantitative defects of WSS facilities. In Sahelian Africa, for instance:

- the number of improved ("modern") water points, particularly boreholes, is not sufficient to cover the needs: only 20% of the inhabitants use them throughout the year for their water supply. This low percentage is essentially the result of a low number of boreholes per inhabitant (less than 1/1000 or 1/2000 on average): most rural dwellers do not have access to a borehole. The relative lack of interest results from the lack of information of the beneficiaries on the health benefits of the new services, and the difficulties of maintenance of the pumps which have been installed;
- although the water abstracted from boreholes is safe to drink in more than 90% of the cases, it is generally subject to fecal contamination during its distribution. Even if it comes from a "modern" protected water point, the water which is consumed in the village houses is not very different, in terms of microbiological quality, from that which was drunk before the rural water supply improvement programmes were implemented. This situation is the result of the permanent pollution of the environment by fecal matters, and the behaviour of consumers who remain unaware of the fundamental rules of hygiene. The impact of water supply programmes is therefore considerably reduced, because health education and sanitation have not been included in these programmes.

Besides Sahelian Africa, in many other regions of developing countries, much progress has been made with regard to the quality of water supply and to a lesser extent to sanitation. The improvement of the health situation remains however less than expected. On a global basis, the low quality of drinking water supply, and of sanitation services, results in high mortality, perhaps of the order of 20 million persons per year by the prevalence of bacterial, viral and parasitary infections. In the absence of adequate sanitation, water also plays a role in the transmission of schistosomiasis, amebiasis, filariasis and other diseases which affect nearly one billion people. Besides, from 50 to 80 million people are still infected by the Guinea worm. Waterborne infections are particularly serious among malnourished children. Worldwide, water used for drinking purposes is at origin of the death of 6 million children per year.

As antibacterial and antiparasite drugs are costly, active treatment of infectious gastro-enteritis is difficult in tropical countries. The only solutions are preventive, and include in particular the disinfection of water for human consumption.

For further information, write to:  
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**Community Water Supply and**  
**Sanitation, EHE/CWS**  
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