

# **CRS EXPERINCE ON WATER SUPPLY AND SANITATION**

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## **1. INTRODUCTION AND BACKGROUND**

### **1.1. GENERAL**

Water is a precious natural resource, vital for life, development and the environment. It can be a matter of life and death, depending on how it occurs and how it is managed.

However, when too much or too little, it can bring destruction, misery or death. Irrespective of how it occurs, if properly managed, it can be an instrument for economic survival and development. It can be an instrument for poverty reduction, lifting people out of the degradation of having to live without access to safe water and sanitation to meet human needs and without access to adequate water to meet livestock needs.

However, when inadequate in quantity and quality, it can rather serve as a limiting factor in poverty reduction and overall national development, resulting in poor health and low productivity, food insecurity and constrained economic development. It is therefore imperative that the linkages between water development initiatives and the initiatives in the agriculture, food energy, health, education and decentralized governance sectors clearly understood and carefully managed in order to benefit from the inherent synergies and to minimize or avoid negative cross-sectoral impacts.

It is on this basis that water is one of the most essential substances for the sustenance of life. It is generally recognized that fresh water is the most important natural resource in all socio-economic development endeavors and indispensable input for environmental Management. It is an important component of every type of environment including desert, where life is found. Successful management of environment, therefore, can never be achieved in isolation from appropriate management of water resources. Because it is a product of environment, and visa-versa as it comes as rain from the environment goes through land, which is the major component of the human environment (Tewolde, 2000) and ends up in sea or in the Land. Managing water is thus intimately linked with managing the environment – all terrestrial aquatic and atmospheric resources including human welfare.

Based on the bond between water resources and environment, integrated water resources management is gaining paramount importance in worldwide. In pursue of integrated solutions, it is well observed that decision makers and planners tend to be oriented towards the management of water while preserving the environment through appropriate legal tools and sustainable actions of development.

Integrated management of water resources entails coordinated development of water, land and related resources to maximize socio-economic benefits and preserve the sustainability of ecosystems. Being viewed as comprising an ecological system of interdependent components, the water system interacts with land; environment and others related political and economic systems. The whole process should be directed towards the foreseeable assessment of water needs, sources, the causes of water related problems, and possible systems to optimize the utility and equitability among stakeholders throughout the water system management.

It is worth mentioning that although implementing water resources in an integrated manner is very important, its management action is complex. The complexity also defers from place-to-place and time-to-time because the integration entails needs and equitable distribution of water for all domestic utilization and agricultural and industrial use together with the need for ecosystem management. These require coordination, harmonization and temporal availability constraints and situational pressure. Effective coordination and integration between the water system and other systems require efficient decision and controlling mechanisms that are based on knowledge of water acquisitions, development and efficient allocation to different socio-economic and ecosystems management activities. The need for such connection in the water system is due to the fact that water has economic, ecological, social, cultural and religious value.

It is always stated and often quoted that “Ethiopia is water tower of East Africa”. The reason for this might be connected to the fact that Ethiopia has 12 major river basins/valleys, 11 Lakes, 9 saline lakes, 4 crater lakes and over 12 major swamps. The total mean annual flow from all the 12 river basins is estimated to be 123.25 Bm<sup>3</sup>. Based on this information, it is always stated and often quoted that “Ethiopia is Water Tower of East Africa”.

The country can only be water tower in terms of receiving ample of water and donating it to neighboring countries but not in terms of ample of water resources that is readily available for use. This is because, most of the major rivers have created deep gorge in the country and the water they contain passes to neighboring countries, thus constraining development and utilization of the water resources in the country. In addition, uneven spatial and temporal distribution of the available water resources have either demands huge investment to develop and extend to the water scarce areas or constrained the utility at required time and place. This is again due to the fact that most perennial springs and streams exist only in the highlands comprising just over 40% of the country’s geographic areas where as there is hardly any surface run-off and perennial springs and streams in areas below 1500 m.a.s<sup>1</sup>. that comprises over 55% of the country. Even the country’s estimated 2.6 Bm<sup>3</sup> ground water, which fairly distributed in the lowlands could not be appropriately developed and utilized because of financial and capacity problems. Such failures in developing and utilizing the country’s water resources and mismanagement to the sparsely available water have already been reflected as a root cause for overall environmental degradation.

## **1.2 WATER SUPPLY & SANIATION COVERAGE**

In general it is estimated that less than 20% of the rural population has access to potable water, with fewer than 7% having access to adequate sanitation facilities ( Tables 1). Given the fact that 85% of Ethiopia's population lives in the rural areas, these low access rates contribute to high water-borne and fecal-borne disease rates throughout the country. In fact, diarrhea is the second leading cause of mortality and morbidity in children  $\leq 5$  in Ethiopia. The causes for these low access rates to potable water and sanitation facilities include complex hydro geological conditions, lack of resources and conducive environment to develop the appropriate infrastructure, environmental degradation, and poor personal hygiene practices. The effects, once again, are mostly felt by children, whose development is retarded by poor utilization related to diarrheal diseases, and women, who must spend many hours every day collecting water from distant water points and are thus unable to properly care for their young children. CRS/ET's DAP mid-term evaluation stressed the need to alleviate water scarcity by concluding that "[it] is a problem of such severity that it, in effect, cancels out all other evidence of progress toward food security at the household level."

Over the past several decades, a number of development organizations including CRS/ET have spent millions of dollars to construct new potable water points. Unfortunately, due to insufficient involvement of the beneficiary communities, a large percentage of these water points were poorly maintained and have since fallen into disrepair and are not functional today. Those which are functional are often used by households who do not have access to sanitation facilities and do not practice improved hygienic and sanitary behaviors. Thus, any health benefit gained from the developed water source has been lost, as poor sanitation conditions result in continued high rates of diarrheal diseases. This important point was emphasized in the study on potable water, supported by USAID and USAID/CRS training work shop on multiple uses of water and sanitation ( march 17-22/2003 ) held at Dir-Dawa. Thus, it is essential that any organization involved in water and sanitation interventions begin to understand that "potable water resource development" does not refer only to the development of water points, but also to the development of sanitation facilities and promotion of improved hygienic/sanitary behaviors at the household level.

Based on recent strategic planning assessments, CRS/ET has identified increased rural access to potable water and sanitation services as one of its priority objectives for the coming five years. CRS/ET acknowledges that this will be an enormous undertaking complicated by hydrogeological, climatological, economical, sociological, as well as political issues. All potable water and sanitation schemes (be they boreholes, hand-dug wells, spring development, roof-water catchments, ground-water catchments, latrines, or waste-disposal pits) must be carefully planned with the involvement of all major stakeholders in order to ensure that they truly benefit the targeted communities for many years to come.

Sustainability must be defined not only in hydrogeological terms but also according to the ability of the community to take primary responsibility for the long-term operation and maintenance of their water point. Technology choices must therefore be made on the capacity and ability of the targeted community, with support from local authorities, to maintain the scheme at an affordable cost. This involves ensuring that adequate cost recovery mechanisms are considered from the very start of the project, and that adequate management and technical skills are developed and maintained at the community and local government levels.

**Table-1: Rural, areas access to safe water and sanitation facilities, by regions (source: Ministry of Water Resource draft study report, 2003)**

Regional State	Water Supply			Sanitation
	1994(%)	1998(%)	2000(%)	
Afar	5.2	8.7	7.7	4
Amhara	15.2	11.2	11.3	3
Oromia	15.8	14.2	17.4	7
SNNPRS	15.5	14.6	20.4	9
Benishangul Gumuz	14.8	13.3	22.1	19
Somali	9	14.3	22.5	4
Gambella	21.3	19.8	24.6	1
Tigray	10.6	17.5	25.6	1
Harari	11.2	34.5	47.7	3
Dire Dewa	23.6	64.7	57.2	3
Total rural	14.7	13.7	17.1	6

The table above tells us that the sanitation coverage is insignificant. This is attributed to the fact that the sanitation situation in the country has not been a priority for a long time and there is a call that it now needs intensified efforts and considerable attention. Many people in living in urban areas do not have access to basic and reliable sanitation facilities. Besides, the majority of households do not have sufficient understanding of hygienic practice regarding food, water and personal hygiene

In response to water and sanitation problem CRS have participated in this sector at large. During 1984/85 emergency CRS supported 151 borehole drilling and from this over 600,000 people has got access. During the last 8 years 1997-2003 CRS has constructed and rehabilitated 242 water sources ( 64 springs, 87 hand dug wells, 18 roof water harvesting and 68 deep boreholes, 4 pond with sand filtration, 1 large scheme water expansion) through development and emergency programs these developed water sources 517,610 people have got access to adequate and safe water. Furthermore, linked to water sources 3826 pit latrines were constructed and as a result 19,130 people have got access to sanitation facilities.

This paper provides strategy discussion and reference information that helps to understand water and sanitation interventions under the following subchapters. The reference part is structured along the following lines:

- Identifying Potential Sources of Water
- Integrating Sanitation and Health Education Components into Water Projects
- Empowering Communities to Manage and Maintain Water Points
- Water Resource Development as a Component within the Integrated Watershed Management Framework
- Water Quality Standards

## **2. WATER & SANITATION INTERVENTION**

### **2.1. IDENTIFYING POTENTIAL SOURCES OF WATER**

Once communities have confirmed that one of their priorities is to increase access to potable water, it is important that various options be considered before making a decision.

The main criteria for evaluating the suitability of potential water sources are as follows:

- Are minimum water quality standards met?
- Will there be a sufficient yield to meet expected community requirements?
- Is it technically and economically feasible to develop the source?
- Will the targeted communities have easy access to the source with regards to distance and elevation?
- Is the source vulnerable to natural hazards or contamination?
- Can the appropriate equipment and material be realistically mobilized to develop and maintain the source?
- What is the most cost-effective option?

Water source options will depend on the area, and include: boreholes, hand-dug wells, spring protection, subsurface dams, perennial rivers, ponds and rainwater catchments.

Spring development should always be designed to make the groundwater discharge more efficient, to facilitate community use, to maximize storage capacity, and to protect the source from pollution and contamination. Since different types of aquifers and seepage patterns require different harvesting approaches, there are as many ways of constructing spring protection structures as there are springs. Two basic types can be considered depending on the hydrogeology and the source or ‘eye’ of the spring. In *granular aquifers*, spring outflow will vary little with distance along a contour. To tap this water, infiltration galleries of significant length may be required. In *fractured aquifers*, outflow will be concentrated and small-scale spring box works will be required. Therefore, the following general points must be considered:

- Spring capping and a storage reservoir should be designed based on the groundwater flow rates (L/sec) during rainy season and dry season, while taking into consideration the water demand pattern of the user communities.
- Construction of these facilities should be carried out during the dry season so that the spring eyes can be located precisely.
- Site clearing of bushes and other vegetation, laying out of the location of the capping structure, the excavation works, the construction of the masonry and concrete structures, and laying of the pipes should all follow the design specifications and the work drawings.
- The community should be mobilized to provide local materials, such as eucalyptus poles, stones, boulders, gravel, and sand. Projects should be designed the costs of manufactured materials, such as cement, bricks, PVC pipes, galvanized pipes, and faucets.

In large parts of the country, hydrogeological conditions mean that many communities do not have the option to access and protect springs. In these cases, the next option should be to explore the potential to develop hand-dug wells. Hand-dug wells are usually restricted to areas where the aquifer is unconsolidated and lies close to the surface. The wells are usually between 1.0 and 1.5 m in diameter and rarely extend more than 10 m deep. In semi-arid areas such as Borena where groundwater levels are deep, however, depths of up to 40 m are possible.

Siting the location of the new well should be done with great care, ensuring that both community and technical needs are addressed. Focus group discussions with community water users (particularly women) should look at issues of land tenure for proposed sites, distance from the village, and water-use patterns for human consumption, livestock consumption, and vegetable gardening. The site should be at least 50 m away, and not downhill, from the nearest latrine. All potential well sites should be assessed by a water technician to confirm its appropriateness before any work begins.

Well design should be determined based on the hydro-geological condition of the area to the anticipated depth, and digging should proceed according to the well’s design, depth, and diameter. After completion of the digging, testing should be carried out to determine the yield of the well. In most cases, the well should be completed with fabrication and installation of concrete rings, gravel pack, wellhead construction, and installation of a

manual hand pump. The selected hand pump should be capable of lifting the well's yield, resistant to corrosive water, and use appropriate technology which can be managed and maintained by the local community with relatively little cost and effort. As with spring development, the entire area should be protected by a sturdy fence with gate designed to regulate water user access and prevent entry to livestock.

Given its high development costs, borehole construction should only be considered in those cases where spring development and hand-dug well construction is not possible. This situation occurs quite frequently throughout Ethiopia, especially where groundwater levels are very deep. Given the highly technical nature of borehole siting, it is important that it be done in close collaboration with qualified and experienced professionals

All borehole wells should consist of an intake area, supporting casing, an above-ground well-head structure, and a water-lifting or pumping device. Boreholes can range from shallow hand-drilled holes less than 15 m deep in clay, silt and sand formations to deep holes drilled in hard rocks by mechanical drilling rigs. Successful borehole sites are developed only after careful study and testing. All necessary steps should be taken to select borehole site to increase the success.

Proper borehole design is important as it affects operating costs and the life of the borehole. Stages in the design and construction of boreholes usually include:

- a provisional design of the borehole in terms of type, diameter, and casing and screen material based on the detailed hydrogeological log
- the installation of casing, screens, filter packs and grout
- development to optimize borehole yield
- test pumping to determine borehole hydraulic performance and estimate appropriate pumping rates
- the installation of pumps and motors depending on the depth, discharge rates, community demand pattern, and available budget.

After a borehole has been developed, its hydraulic characteristics must be established by test pumping in order to determine its water level response at different pumping rates, to quantify its daily sustainable yield, and to determine the anticipated pumping head. This allows a pump to be selected, which delivers the required yield at the anticipated pumping head with a maximum efficiency, but does not exceed the capacity of the boreholes.

### ***Water-Lifting Devices for Hand-dug Wells and Boreholes***

#### **Hand Pumps**

Hand pumps are most commonly used for water points which supply less than 200 people per day. They can be installed on boreholes which yield as little as 0.2 L/sec. In selecting hand pumps, the impact of the operating conditions, the potential breakdown rate, and the repair implications must all be evaluated.

Hand pumps are suitable for pumping water from a depth of less than 50 meters. Suction pumps and lift pumps are most appropriate for wells less than 7 m deep. Some direct suction pumps can operate down to a depth of 12 meters, provided that the pump operator applies the required effort. Deep well reciprocating pumps are suitable for lifts of up to 45 meters.

The selected hand pump should be capable of lifting the well's yield, resistant to corrosive water, and use appropriate technology which can be managed and maintained by the local community with relatively little cost and effort. Only true Village Level Operation and Maintenance (VLOM) pumps which are in the public domain, e.g. Afridev or prototype, are recommended for implementation. However, for wells deeper than 45 meters, only modified versions of well known and tested pumps such as Indian Mark II/III or prototype should be used.

### Solar and Wind Pumps

Solar pumps may be installed on deep wells, where appropriate, on a trial basis as an alternative to other motorized pumps. The advantage of solar pumps is that they are a renewable source of energy which is environmentally-friendly and can be operated on a low-cost basis. The disadvantage of solar pumps is their high cost, as they are composed almost entirely of imported technology and materials. In those cases where solar pumps are piloted, a storage tank of appropriate capacity should be provided to ensure a continuous supply to community users even during periods of low solar energy.

The use of wind power for pumping water should be technically feasible in situations where there is wind 60% of the time with speeds of at least 3.0 m/sec. When siting windmill pumps, care should be taken to ensure that there is not any obstruction to wind flow within 150 meters. A storage tank should also be provided to cater for periods of insufficient wind. Like solar pumps, windmills cost more at the initial stage, even though they are designed to operate more cheaply over the long run. As such, windmill sustainability should be carefully examined beforehand.

In areas where neither of the above water sources is not feasible other alternative should also be foreseen.

Rainwater generally has the advantage of being contaminant-free and of suitable quality for human consumption without treatment. Rainwater can be harvested from zinc roofs, paved areas, or even specially prepared, rocky ground. It is important that these areas are kept clean and free of animals, so as to prevent contamination during the collection process. Roof systems are relatively cheap to construct provided that the structures already are roofed with zinc/iron sheeting. The costs obviously increase considerably if the structures are only thatched. Roof systems can be prioritized for community structures such as schools and health clinics, where the relatively large roof areas provides good catchment areas for those women and children who attend these institutions.

The limitations of rainwater catchment systems, however, should be acknowledged from the start. Given the fact that most parts of Ethiopia receive no more than 3-4 months of rainfall per year, such systems can not be considered as the sole water supply option for a household or community.

In semi-arid and arid areas where there are no other sources of water, ponds are a common means of collecting runoff water. Since these ponds are easily subject to contamination, particularly those which are also used by livestock, they should be considered only as an absolute last resort, when no other option is possible. This may often be the case in areas like Borana or Ogaden. While certainly not foolproof, the construction of sand filtration systems may help to improve water quality and minimize the incidence of some water-borne diseases. Such filtration systems are appropriate to rural Ethiopia since they are easy to construct and use locally-available materials

In arid or semi-arid areas where water resources are scarce and evapo-transpiration is high, construction of a sub-surface dam in the dry riverbed of wadis is often the only way to develop a sustainable supply of potable water. Storage capacity and location related to the community users would have to be investigated. Measures would also be needed to ensure that the catchment and dam areas are protected from contamination by animals and humans. Given the considerable environmental assessments which would need to be

## **2.2. SANITATION**

It is essential that any potable water project be linked with sanitation to ensure that it has an impact on reducing diarrheal rates, and thus improving nutritional and health status. There are many different aspects of sanitation to be considered. Some of Ethiopia's most common communicable diseases are related to poor sanitation, including worms, dysentery, skin infections, and gastroenteritis/colitis. Poor environmental sanitation around water points also contributes to high rates of insect-vector diseases which could otherwise be prevented.

There are three ways in which sanitation can break the faecal-oral transmission cycle—a leading cause of diarrhea: protection of water points, containment of human waste, improved personal/household hygiene. While the primary means of addressing all three of these aspects is through appropriate health education interventions, the first two may also require a certain level of investment in infrastructure development. *In developing potable water and sanitation projects, it is important that each of these three areas of sanitation be addressed specifically.*

### ***Protection of Water Points***

Any project which seeks to increase rural households' access to potable water must also work to ensure that potable water which comes out of a faucet or pump does not become contaminated before it is consumed by the household. Otherwise, any potential health benefits intended from an improved water point will not be realized, and all the time,

money and effort invested into that project will have been in vain. Excreta, or human and animal waste, is the primary source of diarrheal disease agents which are transmitted to humans through water, food, fingers, and fields. Developing and protecting potable water points is essential to removing the “water” transmission route, and is discussed in this section. Later sections will focus on removing the “food, fingers and fields” transmission routes.

Once a water point has been developed, it is important that minimum sanitary conditions are always maintained at the site. A sturdy fence should be built around the entire water point in order to keep livestock and other animals from defecating in the area. This fence will also help the community to better regulate water point usage and thus reduce damage or breakdowns caused by over-use or mis-use. In a number of communities, water for livestock consumption will also be a priority. To ensure that these livestock do not contaminate the water point, water should be piped to a separate location, at least 20 m away, and fencing introduced to steer the livestock in that direction. Depending on the materials available locally and the project budget, livestock troughs can be constructed of either cement or stones.

As described in detail below, hands which have come into contact with faecal matter can also contribute to contamination of the water point. Thus, one of the messages introduced during the health education sessions should emphasize that water carriers should wash their hands before collecting drinking water.

It is critical that water points be designed and developed so as to facilitate proper drainage of excess water. This is especially true in the case of spring development, where there will usually be continuous runoff once the reservoir is full. Failure to do so can often lead to the creation of stagnant water, one of the most common breeding sites for the *anopheles* mosquito, the insect vector which transmits malaria. Malaria ranks among the top five causes of mortality and morbidity in Ethiopia. Drainage designs will vary depending on the topography and potential uses for the runoff water. For example, some communities have established successful small-scale irrigation schemes which direct excess water from protected springs to nearby canals. It is important to consult a technical expert before making any final decisions regarding drainage.

### ***Containment of Human Waste through the Development of Sanitation Facilities***

One of the most effective ways to reduce these transmission routes is to contain human waste in an enclosed area where it will not come into further human contact. Promoting proper human waste disposal accomplishes a number of objectives, in that:

- it prevents contamination of both surface water and groundwater sources;
- it prevents contamination of surface soils which come into contact with humans;
- it minimizes the incidence of flies and other disease-carrying animals which are attracted to human waste; and
- it minimizes the direct handling of fresh waste.

There are two main types of human waste disposal systems: water carriage and non-water carriage. In water carriage systems, human waste is deposited directly into properly constructed sanitary fittings, and are then carried away by water through a closed piping system (drainage) to the final disposal site. Given the high costs associated with this system, it is usually found only in urban areas of Ethiopia. Non-water carriage systems do not use water to dispose of the human waste. A typical example of this method is the pit latrine. In rural areas, where land is readily available and public infrastructure is limited, the most cost-effective way to dispose of human waste is by increasing household access to and usage of latrines.

Rural households in Ethiopia have historically not used latrines. Thus, any effort to introduce or increase its usage must be preceded and accompanied by properly-conducted assessments and health education. After all, constructing latrines is pointless if they are not used by the targeted communities. Assessments should use PRA techniques in an effort to better understand how the targeted communities currently dispose of human waste, what their knowledge of the causes of diarrhea is, and any history they may have previously had with latrines. These results should then be used to shape health education messages which explain the need for improved sanitation and the beneficial impacts it can have on household health.

Water and sanitation committees and any interested sanitarians from local government structures should be used from the start to facilitate this sensitization process. Once communities accept the need to improve their sanitation facilities, then the next step should be to determine *how* best to go about doing this.

While pit latrines are designed to contain human excreta, the rural household in Ethiopia also produces a certain amount of non-excreta waste which can lead to high rates of insect vector-based diseases. The most common example is the large number of flies which are attracted to household compounds by untended garbage and livestock droppings. These flies readily transmit faecal-based diseases when they come into contact with prepared foods or even children themselves. Similarly, piles of garbage on the ground provide an attractive habitat for rats, which are a major vector of a number of infectious diseases. The introduction of waste disposal pits throughout a community, when combined with appropriate environmental sanitation and personal hygiene messages, can help reduce the incidence of these diseases.

### ***Improved Personal and Household Hygiene***

While the first two aspects focus on combining health education and infrastructural development, this third aspect is implemented almost entirely through educational interventions. Those partners which are implementing Community-Based Health Care (CBHC) programming may already have some experience in integrating potable water projects with targeted health education. In fact, CBHC systems provide an ideal mechanism through which development organizations can promote attitudinal and behavioral changes in women, who are usually responsible for fetching water, caring for children, and maintaining household cleanliness. It is critical, however, for those

partners which are interested in developing potable water resources, and yet are not implementing CBHC projects, to find alternative mechanisms through which targeted communities will get access to the necessary health education messages aimed at improving attitudes and behaviors at the household level. In this regard, water and sanitation committees could provide a good entry point.

Health education should always be in line with the interests, needs and cultures of the targeted community. An approach which works successfully in one region may not always be the most appropriate in another region. In spite of the positive interest mothers have towards visual-assisted behavioral changes, however, they still do not want to stray too far from their traditions, cultures and languages. Increasing efforts should be made to promote health education and behavioral changes through techniques such as peer teaching. Mother-to-mother teaching can be applied in a number of areas, including personal hygiene, environmental sanitation, and diarrhea case management. There is an increased likelihood that women will adopt new behaviors if other women in the community who have the same issues encourage them.

Unfortunately, many ongoing health education initiatives in Ethiopia do not benefit from regular monitoring and evaluation. If the objective of health education is to promote attitudinal and behavioral changes, it is critical that efforts be made to determine whether the objective was met, and to what extent. The findings of M&E reports should form the basis for improvement and changes to the program, in addition to measuring how the health education has benefited the community. M&E can be particularly effective if the community members are involved throughout the process, particularly in data collection, analysis, and lessons learned.

Therefore, all potable water projects should be linked with community-based health education sessions. Ideally, when one is designing the project, the following principles of sanitation should be born in mind:

- Remember sanitation is the first barrier to many fecally– transmitted diseases
- Promote behaviors and facilities together to maximize health and socio-economic benefits
- Give sanitation its own priority in implementation
- Take a systems approach by integrating wastes, the natural environment, local cultural beliefs and practices, and technologies
- Generate demand through education and participation
- Be gender sensitive to the needs and preference of children, women and men
- Build incrementally on existing practices and work towards small sustainable improvements
- Empower people to achieve a sense of ownership and responsibility for sanitation programs
- Continually promote sanitation to sustain past achievements and maintain awareness in future generations

## **2.3. MANAGEMENT OF WATER & SANITATION**

As indicated in the introduction, too many water supply systems in Ethiopia do not function today as a result of insufficient participation by the targeted communities. A number of studies have confirmed that those potable water projects which genuinely involve the community from the outset in planning, construction, management, and maintenance turn out to be the most successful and sustainable over the long term

Since the term “community participation” is very broad, it may be useful to specify which aspects are the most important when it comes to project design. For general purposes, it is appropriate to focus on the following aspects:

- Involving the community in the planning process
- Insisting on minimum self-help components during the construction phase
- Ensuring that water and sanitation committees and associated personnel are established, trained, and functioning
- Encouraging the collection of water user fees which are used by the committees to support recurrent costs associated with their community-based systems.

### ***Community Involvement in the Planning Process***

It is important to involve communities from the outset, i.e. the needs assessment phase. Whether these assessments are informal (occasional site visits by project staff) or more formal (implementation of PRA techniques such as pair-wise rankings, transect walks, focus group discussions, etc.), this is the time to begin to sensitize community members as to the philosophies and principles outlined in this document, with particular emphasis on the community’s role. At no point should you try to impose these ideas on reluctant communities. Rather, you should use your judgement to determine which communities are genuinely interested and committed and prioritize them for any potential project

activities. Documentation of the results of these assessment visits will go a long way toward strengthening your project proposal.

### ***Incorporating Self-Help Principles into the Construction Phase***

Once a community has been selected to participate in a water and sanitation project, you should identify the most appropriate way to apply self-help principles to the project. Do not underestimate a community's ability to contribute to such projects, even during times of severe natural or man-made emergencies. Any basic SWOT analysis will demonstrate that even these poor, vulnerable communities have strengths and opportunities in spite of the many weaknesses and threats. Failure to insist on a minimum level of community investment will almost certainly result in a reduced feeling of ownership in the future.

While the actual specifics will vary from case to case, the following self-help criteria should be discussed and considered with targeted communities:

- Community contribution of at least 10% of total project costs in-kind
- Community in-kind support for all skilled and/or unskilled labor
- Community contribution of all locally available materials

Hand-dug wells and spring development projects should require a minimum community contribution of sand, gravel, stones, and provision of food/lodging/in-kind support for both skilled and unskilled labor. Latrine construction at the household level should be facilitated by water and sanitation committees, with the household taking responsibility for all digging, materials, and constructing except for the reinforced concrete slab. In the end, whatever self-help principles are selected should be explicitly included and described in the project proposal.

### ***Establishing Water and Sanitation Committees (WSC)***

One of the most effective ways to formalize community participation is through the establishment (or re-establishment in some cases) of water and sanitation committees (WSC). Experience in Ethiopia overwhelmingly shows that well-functioning WSCs play an important role in improving the food security of their communities. If communities have already established other local structures to manage their water resources, then it may be preferable to work through those existing systems, provided that the community accepts these structures as representative of them. In those communities which do not have such systems in place, you should raise the idea from the very start of the project, and not wait until the water source has been developed. A WSC should consist of 5-7 community members, including at least two women who should be encouraged to participate actively in all meetings.

In the end, the WSC must be established and owned by the community. Interested community members who have the trust of the larger community should be selected. The

committee should have a chair, a treasurer, and a secretary. Communities should be encouraged to meet with the committee occasionally to discuss and evaluate their performance. These meetings could provide opportunities to replace unfit or non-functioning members. WSC members could serve for any length of time as per the choice of the community. All of these details should be documented in committee by-laws. In addition to identifying committee positions and their responsibilities, these by-laws could also document decisions reached regarding how and when user fees will be collected, water collection schedules, penalties for misuse of the water point, maintenance requirements, labor mobilization, service periods for WSC members, guidelines for replacing non-functioning members, how user fees will be managed and used, etc. Community members who are also members of the peasant association (PA) administration committee should be encouraged to join the WSC, as this will strengthen the linkage between these two community-based systems.

In general, major responsibilities of a WSC should include the following:

- Mobilizing and sensitizing the community
- Initiating and facilitating community labor, material and money contribution
- Creating accessibility and good working environment
- Participation in site selection for water points and sanitation facilities
- Coordinating labor flow during establishment and maintenance
- Ensuring that the water point has appropriate fencing and drainage
- Appointing pump caretakers to manage and maintain the water point
- Appointing a treasurer to collect and document water user fees
- Facilitating the promotion of health education on sanitation and hygiene
- Facilitating the promotion of household latrine construction and usage

### ***Collection of Water User Fees***

Each WSC should look to establish a system of water user fee collection and management as soon as possible. In some communities which are experiencing acute emergency conditions, it will clearly take a longer period of time before this objective can be achieved. The amount to be collected will be decided by WSC in conjunction with the larger community. (CRS' experience Ethiopia shows that communities often charge between 0.50 – 1.25 Birr per household per month.) One way to organize this system is to have the community nominate two WSC members to open a savings account at a nearby bank in the name of the community. The collection would then be done on a monthly basis, with receipts issued and the fees deposited immediately. The WSC treasurer will maintain a recording ledger which lists the names of paying community members and how much they have paid. In this system, the WSC would need to monitor the treasurer and conduct periodic audits of the account. Of course, partners and communities are encouraged to develop alternative user-fee systems, provided that the minimum levels of accountability are followed.

The user fees which are collected and deposited in the bank account can be used for a number of purposes, depending on the amount involved and community priorities. These include, but are not limited to:

- purchase of spare parts for repair and maintenance of developed water points
- compensation for pump caretakers, guards, and others
- community self-help cash contributions for new development projects
- support to community-based health care systems

### ***Building the Capacity of Communities to Manage Water and Sanitation Systems***

As described in this section, community participation in water and sanitation projects will certainly require a level level of commitment and performance on the part of the community. Given the fact that many communities lack this type of experience, you will have to invest considerable time and resources into developing a training plan which will build the capacity of targeted communities to manage and maintain these water and sanitation systems.

In general one has to bear in mind the principles of community participation and empowerment :

### **Participation**

- The community is actively involved in all aspects of the projects, starting with needs identification and continuing through planning, design, construction, operations, maintenance and evaluation
- The leadership fully represents the interests of the community and is able to control project resources and activities
- Existing local organizations are involved in creating the management structure of the project
- The community has an organization with an adequate capacity to manage and supervise project activities.

### **Health Related Community Development**

- Communities can and should determine their own priorities for disease prevention
- People within a community collectively possess a great deal of health related experience and knowledge
- Communities are capable of arriving at consensus regarding the hygiene behaviors and sanitation systems most appropriate to their needs
- When people understand why improved sanitation is to their advantage they will act.
- All people, regardless of their education, are capable of understanding that feces carry disease and can be harmful, and can learn to trace fecal-oral routes of disease transmission within their communities
- Community can identify manageable barriers to block disease transmission, based on their own assessment and available resources

### **Empowerment**

Starts with the recognition that rural women have traditional responsibilities for WATSAN

- To carry water
- To maintain watsan facilities
- To be consulted on WatSan projects
- To be member of village WatSan committees
- To accept leadership positions on WatSan committees

## **2.4. WATER SHADE MANAGEMENT**

It is important to note that water resources form one of the most essential components of the larger watershed area. As such, any effort to develop or tap into these resources should be considered as part of a broader integrated watershed management framework. However, it must be acknowledged that integrated watershed management is such a complex strategy that it cannot be dealt with entirely in this section.

Since one of the objectives of water and sanitation projects is to increase rural household access to potable water, it is important to assess the quantity and quality of the area's water resources, and any trends which may be related to them. Community interaction with the environment, be it through agricultural-related activities or other man-made infrastructure development, plays a key role in determining these trends, to the extent of either increasing or decreasing the levels and potability of groundwater aquifers.

In many parts of Ethiopia, land in and around populated areas has become highly degraded as a result of both natural and man-made factors. Ethiopia's steep and rugged topography is certainly an inherent factor which makes the country vulnerable to land degradation. Poor land management practices by the host communities can quickly turn this vulnerability into reality. Some of these practices include widespread deforestation for agricultural and household purposes, and increased cultivation of hillsides and steep lands. These practices became increasingly common during the 20<sup>th</sup> century as the country's population levels grew dramatically. As families expanded, each new generation found itself with increasingly smaller plots of land for cultivation, thus forcing them to clear hillsides and create new farmland. Since many of these new plots were improperly designed, the rate of erosion from these denuded hillsides worsened. A recent study concluded that Ethiopia now loses an estimated 1 billion tons of fertile topsoil every year as a result of erosion. Increased runoff and erosion can also result in reduced recharge rates of groundwater aquifers in the area, meaning that there is less water resource available for the nearby communities to access.

Therefore, any water and sanitation project which aims to increase targeted communities' access to potable water should also consider assessing the condition of the local watershed to determine whether rehabilitation interventions are required. The most common aspects of improved watershed management throughout Ethiopia's highlands are a combination of cropland bunding, hillside terracing, gully reclamation, and reforestation/revegetation in the catchments areas.

Two important points should also be considered during watershed assessments:

- When cultivating crops, the appropriate soil preparation method should be carefully selected to ensure that the crops grow at a uniform rate.
- Incorrect mechanical land preparation techniques may cause serious environmental damage to land and water resources, as a result of the following:
  - churning of hillsides with heavy machinery resulting in loss of topsoil, organic matter and plant nutrients;

- soil compaction leading to restricted growth because of impeded root development, poor water infiltration and percolation, poor aeration, increased run-off and erosion; and
- development of undesirable non-wetable soils by slash-burning or any other type of inappropriate burning practices.

### ***Soil and Water Conservation Measures***

Soil conservation can be defined as proper utilization of the soil and water resources to achieve a high level and sustained production (crop, livestock, wood, etc.). Soil conservation measures include ploughing along the contour, ridging, strip cropping, crop rotation, companion crops, utilizing legumes to improve the soil, increase of high productive forage, appropriate use of manure, and soil improvement by ploughing in plant residues.

As a result of linkage of soil and water conservation to water developed positive impact can be sited from DAP-II areas. The Legoda case study done in HCS/CRS project area indicated that the discharge of springs located within managed water shade area by regular program has been increased by an average of 20% and the water level of water in hand dug well also increased.

The increase of water level and yield was observed in all USAID/CRS project areas where water shade management system is linked to other development programs.

### ***The Effect of Eucalyptus Trees on Water Resources***

It cannot be doubted that the introduction of the eucalyptus tree to Ethiopia at the end of the 19<sup>th</sup> century was of extreme significance. It is believed that Addis Ababa would not have been able to develop as the nation's capital without the eucalyptus to provide fuel and building material. However, while no one doubts the benefits Ethiopia has gained from eucalyptus with regards to fuel wood and building materials, there is great concern about the potential effects it may have on the country's water resources.

Extensive plantation of eucalyptus has been shown to result in reduced water yields in that area. Forests utilize more water than other land uses but may increase useful water yield by increasing dry season stream flow and reducing reservoir sedimentation. Clearing plantations will increase the water yield and by raising the groundwater level to surface may in some cases cause problems with flooding and salinity. Eucalyptus utilizes more water than many broadleaved trees. Use of water is proportional to the amount of biomass (wood, branches and leaves) produced.

The advantages and disadvantages of planting eucalyptus are as follows:

#### ***Advantages***

- Eucalyptus can provide benefits to communities quickly, thus motivating the community better than other potential benefits which are more long-term

- Fuel wood and farm timber can be produced from small plantations
- They form good shelter–belts and rapid tree cover
- Many species produce nectar for honeybees, as well as oils and tannins
- They can quickly produce fiber for pulp and paper industries
- They can be grown on a variety of sites
- Most species do not need protection from grazing animals.

#### *Disadvantages*

- Since eucalyptus grows very quickly, it consumes a lot of groundwater
- They may negatively affect soil fertility in certain circumstances
- Sparse canopies may not protect the soil against erosion
- They may not provide adequate food and habitat for wildlife

It has been understood that eucalyptus consumes a great amount of water from the soil, and when grown in plantations, lower the groundwater level more than other tree species. Trees get their food from soil in the form of nutrients dissolved in water, and they use the water to pump these nutrients through the roots and branches to all living parts—wood, leaves, flowers, and fruits, after which most of the water evaporates through the leaves through the process of transpiration leaving the nutrients to feed the tree. To produce one unit of woody matter, young trees require 300-500 units of water. Older trees require ever more.

Examples to be cited in this regard is that Alitena Water Supply:

Three hand dug wells were rehabilitated to provide water for Alitena rural town and its surrounding dwellers. All the three hand dug wells have been sunk in the same alluvial aquifer. One is located along the river bed and two hand dug wells were located on the flood plain.

The average thickness and area of the aquifer is estimated to be 8 meters and (300 meters\* 40 meters) 12,000 square meter respectively. The water levels ranges 5 meters below groundwater after rainy season and 7 meter after long dry period. Only one meter water column is there during dry season. The average yield of the wells is estimated to be 1.5 liter per second. The fall of draw down is fast when pumping with submersible pump during the dry season making the water level below pump suction position. Therefore, it is difficult to pump with submersible pump during dry season. The only means of harvesting water in this area is by hand pump during dry season. The two hand pump equipped wells are function recently.

The 10% cover of the aquifer by eucalyptus trees and extensive use of the water for over 3000 communities is anticipated to be the high risk for high depletion of the groundwater in the sand. This was evidenced from the fact that fast lowering of the water during dry season is mainly attributed over extraction by the people and trees.

It is strongly believed that eucalyptus trees in Alitena

- can provide benefit quickly
- fuel wood
- form good shelter belts and rapid tree cover

though the aforementioned prospects can not be denied the following constraints were observed as a result of eucalyptus trees

- Consumes much ground water
- poor soil fertility is anticipated as no grass observed growing
- Possibility of trees to serve for wild life can not be foreseen

From the above arguments it can be understood that eucalyptus trees take up a great amount of water from the soil, and when grown in plantation they lower the groundwater level more than other tree species

Part of the water in the soil is absorbed by the roots and travels inside the tree to the branches and leaves. Some of it is used by the tree to form new growth, but most of the water passes through the leaves into the surrounding air. This process is called transpiration and in eucalyptus the rate can be reach between 20 and 40 liters per tree each day depending on the size of the tree and the surface area of the leaves

Taking the minimum consumption rate 20 liters per tree per day 2400 trees in the Alitena well field extract about 48 cubic meter water daily. This implies the high depletion rate of Alitena groundwater is mainly attributed the trees.

Therefore, it is strongly recommended to eradicate the tree in the Alitena well field as there is no means of getting other source different from this in the area.

## 2.5. WATER QUALITY

Water quality refers to the suitability of water for human consumption and for all usual domestic purpose including personal hygiene. The World Health Organization (WHO) in its Guidelines for Drinking Water Quality has assessed the threats to human health associated with drinking poor-quality water. The water quality standards recommended by WHO and proposed by USAID/CRS workshop for major microbiological, chemical and physical constituents of water are summarized in table below. Testing should be conducted before the start of a project to confirm the baseline, at completion of the developed water point to confirm that minimum standards have been met, and at intervals thereafter to ensure continued adherence to the standards.

### Standard and Guidelines of drinking water quality for selected parameters for physico-chemical constituents

Water Quality Parameter	Unit	WHO	Developing Countries	Ethiopia
PH	-	6.5-8.5	6.5-9.2	6.5-8.5
Color	Pt-	15	2-50	22

	Co			
Turbidity	NT U	5	2-30	7
Sodium	Mg/ l	200	-	358
Fluoride		1.5	1-8	3
Sulfate		400	200-600	483
Nitrate		44	44-100	500
Chloride		250	250	550
Iron		0.3	0.4	0.3-0.1
Arsenic	µg/l	50	100	40-200
<b>II</b>	<b>Microbiological Constitutes</b>			
Coliform				10
E-coli				Nil
T. coliforms				100

Source: WHO (1993), Guidelines for drinking –Water quality , DHV consultant 2003 and CRS 2001

Due to the fact that international guidelines and national standards for water quality cannot easily applied in rural Ethiopia, the following permissible levels of the main water contaminants are to be used for Title II projects.

Organism or Chemical	International Guideline Maximum Desirable Level	Title Projects Maximum Allowable level
Fecal (E.Coli) coliforms	Nil	50 FC per 100 ml
Arsenic	0.01 mg/l	0.05 mg/l
Fluoride	1.5 mg/l	3.0 mg/l
Nitrate as NO <sub>3</sub>	50 mg/l	50 mg/l

Source: USAID/CS Draft water quality guideline

### ***3. STRATEGIC AND MANAGERIAL ISSUES IN WAT/SAN PROJECTS REFERENCE TO ENVIRONMENTAL ASPECTS***

The environmental degradation in Ethiopia in combination with the population growth is a big threat to future development. Therefore, organization involved in water and sanitation sector must become aware of how environmental degradation has negative implications on their lives, including the issue of water.

Some environmental problems which can arise from water and sanitation projects are:

- Lowering of the groundwater table and depletion of aquifers due to over pumping of boreholes
- Threats to the biodiversity of the ecosystem by diverting total spring flow for gravity-feed schemes
- Creation unhealthy environments around water sources with stagnant pools of water, which turn into breeding sites for mosquitoes and other parasites
- Pollution of groundwater sources from poorly-designed or poorly-situated latrines

- Deforestation and hydrological disruption due to clear-cutting trees for project purposes
- Overgrazing around water points leading to increased soil degradation

In order to mitigate these potential problems, you should work with targeted communities to conduct basic environmental assessments before starting any project. Some mitigation measures are as follows:

- Groundwater recharge rates should be identified and used to determine the safe maximum pumping rates for boreholes.
- Flows from springs should be studied for at least 2 years, with no more than 70% of the dry weather flow diverted for gravity schemes.
- Properly-constructed drainage channels from hand pumps, springs and public fountains should be constructed. Spillage water from hand pumps and public fountains should be diverted through the channels into plots cultivated with plants which will benefit the community, e.g. reeds, bamboo, bananas, ginger, vegetables etc. The project could even facilitate the acquisition of seeds or tree seedlings for this purpose.
- Messages on environmental aspects should be disseminated to community members during WSC training. Communities should be encouraged to plant trees and live fences from thorny bushes or pine trees (plants that do not consume much water) around water collection points and catchments area of springs. This will keep away animals and regulate human interaction.
- Latrines should be constructed at a minimum distance of 30 m from water points in order to ensure that they are not contaminated.
- Replacing of trees should be promoted as part of the hygiene/sanitation promotion programs to replace any trees cut for water point development or latrine construction.
- Households should be encouraged to use stones and unburned bricks when constructing their latrine superstructures.

## 4. CONSTRAINTS AND LESSON LEARNED

### Constraints

In general, water and sanitation sectors have met with many setbacks in the past due to varied and several reasons. Few among the many are:

- Lack of or low awareness of the communities particularly the rural ones about health implication of sanitation practices. Insufficient government commitment to the sector. Lack of or insufficient government commitment to the sector. Lack of or insufficient government funding to the sanitation programme.
- Lack of, inadequate or not clearly defined, sector policies, legislation, regulation strategies, guidelines, standards, to promote the sector services, programmes and projects.
- Lack of integration and networking among key sectors such as health, water, education and NGOs
- Inadequate or lack of support for research and experimentation on low-cost, affordable and sustainable water and sanitation technology options.
- Inadequate technology choice. No appropriate water and sanitation technologies which take into account cost, weather, ground water level, availability of water, construction materials, culture/religion and special needs of women and children.
- The level of hygiene education and general awareness of the communities concerning safe water and environmental hygiene is very low. Lack of awareness of the health implications of water and sanitation and hygiene practices particularly by the rural population have resulted in high water, sanitation and personal hygiene-induced morbidity and mortality affecting all ages. The low level of consciousness of communities is also responsible for the un sustainability of most of water supply and sanitation schemes developed in the past.
- Gender (women) not addressed adequately in decision making
- Duplication/overlapping of efforts between NGOs

- No systematically established coordination mechanism exist between health and water offices
- Absence of WatSan agents at lower level
- No clear guidelines to handle emergency interventions when the situation arises
- Cost structures with partial (rural) and total (urban) cost recovery plans as long-term objective are not yet established yet.

### **Lesson Learned**

- Safe water and adequate sanitation not only are the bases of life and health, but they also are essential contributors to human dignity. Improved sanitation and water supply must be an important goal if improved health and sustainable development in Ethiopia is to be ensured.
- Community participation is an effective method in undertaking and sustaining problems/schemes,
- The community is well aware of the importance of community contribution in all level, this implies the projects will be sustainable based on ownership development of the projects
- The community is well aware of importance training
- Promotion of sanitation facilities in linkage with water supply and health have been effective
- Encouraging sense of awareness developed among communities

## **5. CONCLUSION AND RECOMMENDATION**

In conclusion::

- The constraints encountered in the course of project implementations are part of the lesson learnt, which will greatly influence and inform the future water and sanitation programming.
- The expansion of intervention, either under emergency conditions or rehabilitation and long term development reduce the vulnerability status of the target community.
- Independence of community from unprotected water by getting access to potable water is a change of phase for rural community
- The fee-collection associated with the established water committee is the basic for sustainability aspect of this program.
- Attitudinal change of the community through training, adequate awareness and working together contributed to sustainability at large
- In order to achieve broad health impacts promotion of safe excreta disposal and proper use of water for personal and domestic hygiene are key parameters

- Linkage of sanitation facilities ( pit latrine, waste disposal pits) in conjunction with water supply schemes is vital
- Empowering communities to take responsibilities for the control of their water supply and sanitation needs is also important

**The followings are recommended:**

- Sanitation, Water Supply and hygiene education should be linked to bring health improvement
- Capacity building of communities and technicians should be strengthened
- Water supply and health programs should emphasis hygiene education to encourage people to use more water for personal and domestic water
- Guides in water quality and environmental protection should be considered in any projects
- Multiple use of water should be promoted for addressing nutrition
- Previous experience ( achievements, challenges, lesson learnt) be considered during planning ( s.g. timing, staffing, coordination etc.)
- Training and work shop - these forms the basis for the sustainability of the activities done through upgrading the know how of the beneficiaries, hence should be strengthened
- Community participation should be encouraged:
  - Women's participation mainly in decision making
  - Community decisions endorsed and their knowledge valued
- Local capacity building promoted focusing on training of technicians and various types of water construction should be promoted