

A Review on Sustainability of Community-Led Rural Water Supply and Sanitation Systems with Special Reference to Berik Sub-Zone in Eritrea

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Abstract

This Assessment of the Sustainability of Community-Led Rural Water Supply and Sanitation System with special reference to Berik Sub-Zone in Eritrea was conducted between August 2018 and March 2019. Both published and unpublished literatures collected from various sources were critically reviewed and thoroughly analysed. After the literature review it was found that the participatory approach was the best method for sustainability of any water supply and sanitation project. Water supply projects is sustainable when consumers are aware to pay user fees that are sufficient to cover all the costs. In the study area, Water, Sanitation and Hygiene Committees have been formed with the participation of women, men and people with disabilities. There has been tariff collection of 0.5 Nakfa to 1 Nakfa per jerrycan of 20 litres, availability of trained technicians, spare parts and plumbing tools to conduct regular repair and maintenance of the water supply system. There is a practice of regular meeting, monitoring and proper accounting for the sustainability of the water supply and sanitation system. Also, community participation, linkages and coordination with the local and national government lead to sustainability of the water supply and sanitation scheme.

Keywords: Community led water supply and sanitation system; community participation; sustainability; water sanitation and hygiene; monitoring and evaluation at community level.

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1. Introduction

Water is considered as a right of the people, not a privilege which is vital to sustain life for economic and social development and for protection and conservation of the environment [1]. Multiple research and studies conducted in many developing countries have shown the interdependence between the availability of the water and economic development and linkage between water and poverty. Access to safe drinking water is a significant issue and can cause deaths in absence of proper water supply and management. It can trigger poverty alleviation and improve the living standards of people by accelerating better health and sanitation services. This study assesses the sustainability, monitoring and evaluation system of the rural water supply, sanitation and hygiene system in Adi Musa and Adi Qontsi of Berik Sub Zone. This study provides insight to the exemplary water supply system versus the general rural water supply system, which help to understand the parameters of the sustainability of community based rural water supply systems. This study also provides recommendations which would be beneficial for policy makers, implementing agencies, local bodies, community members, technocrats, social activists, researchers and academicians [2]. The study was based on the small sample of the Berik Sub Zoba (district). Thus, the study could not be generalized across the country. The study describes the socio-economic aspect of the community, identification of demand responsiveness factors of the services, water tariff, repair and maintenance of the water supply system. Additionally, community participation, women & people with disability participation, sustainability of the water supply system, community perception on the water supply system, protection of the water supply system and community engagement have been explained in the study. The prevailing water stress in many developing countries, especially in urban areas is not only due to source limitation and high growth rate in population but also due to other factors such as poor water distribution efficiency, inequalities in service provision between different section of the city and the poor ineffective management system. Research and water utility reports indicate the major challenges facing water supply providers in Sub-Saharan Africa is high level of non-revenue water. It is not unusual to find the non-renewal water in the region to be as high as 40 to 50 per cent, almost as twice as much as the best practice of 20 per cent. Such losses are not only depriving millions of people from access to clean water, but they incur huge financial losses to the water services [1]. There are several sources which suggest that sustainability is a major concern [3,4,5]. Many factors have been suggested as possible determinants of sustainability - where determinant means 'an influence factor', and sustainability means 'continued functioning over time'. While some factors - for example the availability of spare parts for water points - are proximate determinants, with immediate and direct bearing on sustainability, their influence is driven by underlying social, political and economic dynamics. Asmara Water Supply, which is urban water supply system is overwhelmed with several problems affecting substantial proportion of the city's population. The water related problems include low service coverage by the water distribution network, intermittent modes of supply, and prolonged period of cut-offs. These problems are related mainly to limited or scare water sources, substantial water losses due to leakage, limited hydraulic capacity of water distribution system and ineffective system of management. The water related problem is distributed among maximum areas of Eritrea. To overcome these challenges in the water sector, policy makers and water agencies must understand the underlying principles of good water governance, especially in the light of water scarcity and climate changes. Sound governance can help create a favorable environment to increase both public and private sector participation [1]. Technology, people and institutions are the three main factors of

water supply system, which determines whether the scheme is sustainable or not. This study is carried out on sustainability of rural water supply systems implemented by community participation. The study was focused on organizational management of water users to ensure the proper functionality and sustainability. Many researchers claim the water supply projects will be sustainable when consumers are aware to pay user fees that are sufficient to cover all the costs. Willingness to pay can be interpreted as an indication of the demand for improved services and their potential sustainability [6].

2. Concepts Related to Water and Sanitation System

2.1. Community Participation

Community participation as a concept focused on the idea that involving stakeholders in decision-making process about their communities and broader social issues has important social, economic and political benefits. Government, donors, policymakers, NGOs, INGOs, emphasized the value and potential benefits of participatory approaches. The participation of communities is given more emphasis because the key concern was the failures in community-led development. For economic development and service delivery, the focus must be on “community participation” and effective, accountable and transparent public institutions [7]. Since gaining independence in May 1991, the Government of the State of Eritrea allocated substantial budgets for infrastructure development to improve provision of water services in Asmara. The Asmara Water Supply and Sewerage Department (AWSDD) is the only public utility responsible for water and sewerage services in and around Asmara. The advocates and experts of the concept state that community’s empowerment, local knowledge and community ownership are crucial ingredients of project success and sustainability [8]. The project can be effective and efficient when real beneficiaries of any proposed project are themselves directly involved in the shaping of their future environment. Participatory planning therefore means people are not only the beneficiaries of the change in the development process, but more importantly are the agents of the changes so desired. Participation is an approach through which right holders and other stakeholders can influence project planning, decision-making, implementation and monitoring phases. Alternatively, participation is a condition for project ownership, successful implementation and sustainability of the projects. Participation doesn’t mean acceptance of all ideas from diverse groups. Participation enables the community to take ownership, involvement of the community, mutual partnership, and empowers the community for the sustainability of the project [9].

2.2. Community Based Management

Community Based Management is a management system that enables a community to take charge and ownership of their water supply systems using the community’s own human, material and financial resources [10]. This is in partnership with other supporting agencies, especially government, NGOs, and private sector [11]. Concerns about the sustainable impact of development interventions in general was the initial stage of this study, and the focus on sustainability of community led rural water supply in Asmara emerged soon thereafter. The simplicity of the water project model makes it an ideal study of sustainability: inputs (simple technology and funding) are used to build an output (a water point) which produces an outcome (people having access to clean water) leading to long-term positive impacts (reduced drudgery, improved health and economic benefits).

2.3. Sustainable Development

Sustainable Development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs [12]. The concept of sustainable development can be interpreted in many ways, but at its core is an approach to development that seeks to balance different and often competing needs, against an awareness of the environmental, social and economic limitations we face as a society. The concept of sustainability and sustainable development are commonly used as interchangeable terms. However, the former received much wider acceptance after the Brundtland Report “Our Common Future” of the World Commission on Environment and Development [13]. The Brundtland Report noted that a development can be made sustainable by ensuring that “it meets the needs of the present without compromising the ability of future generations to meet their own needs”. Since then, this concept has been adopted as a key element for sustainability, or sustainable development [14]. Sustainability (noun) represents the ability of a system to sustain, and the word sustainable (adjective) implies the capability of being sustained. Both words are derived from the English verb “to sustain”. The various English dictionaries trace this verb back to the late 13th century and link it to a Latin verb “sustinere” (to uphold) as its origin, which was introduced into the English language via the old French word “sustenir” [14]. According to the principle of non-retrogression, governments are responsible for creating policies that protect the sustainability of water supply and sanitation services [15]. Sustainability of services must consider the following dimensions: functionality, reliability, quality, equity and accessibility [16]. Based on the dictionary definitions, “sustainability” can be considered to be an ability of something (which for our purposes may be considered a system) to continue to exist, maintain, and remain operational for an extended period of time (equal to or more than the design life) into the future without any significant interruptions, breakage or failure, resulting in improvement of the quality of life by providing strength, energy, and hope (which we may refer to as resilience) [14].

2.4. Sustainability Attributes

Since 1987, several different definitions of sustainability have appeared in the literature along with the attempts to understand the concept for its application to practical life [15]. It is noted that misdirection in developing a definition for sustainability was due to the differences in opinion on “prediction of what will last, and of achieving consensus on what we want to last”. In addition, the failure to account for “the range of interrelated time and space scales over which the concept must apply”, which creates further difficulties in development of a clear definition. They concluded that sustainability cannot be maintained forever as all systems have limited durability. If system sustainability was supposed to have an infinite life span, nothing would be sustainable. Rather, a system is sustainable if it “attains its full expected life span within the nested hierarchy of systems [a meta-system] within which it is embedded” [17]. They provided the example of an individual human being considered sustainable in the earth meta-system, if he/she achieves normal life span. Factors causing a reduction in normal life span of a system component reduce sustainability of the system; for the human example, these factors could include various life-threatening diseases. A system can be sustainable if “it persists in nominal behavioral state” for a time equal to or more than its normal natural expected life, keeping in mind that the life span of a component can be different from that of the system. Therefore, sustainability cannot mean existence, continuation, or maintenance of each component of a system, or a sub-system for ever. It is reported that “the

word sustainability implies continuance or maintenance”, whereas development implies change. Therefore, sustainable development “can be viewed as maintenance of a positive rate of improvement.” Again, “improvement involves change”; therefore, this provides an important base to understand that “continued existence [of something] is not a necessary condition for sustainable development”. Periodic modifications of the systems are required to meet changing demands and conditions [18].

2.5. Sustainability Aspects

For a Community Based Drinking Water Supply (CBDWS) system, the following five aspects constitute the basic components of sustainability [14].

- Social Aspects requiring equitable access to safe drinking water in adequate quantity and of good quality and ensuring protection of human health and social welfare.
- Institutional Aspects requiring effective local community organization and management units, who are responsible for all operations and budgets and for collection of the needed funds from community members.
- Economic Aspects requiring the lowest optimized life-cycle cost, besides the project being financially self-sufficient with the agreed contributions from community members. Funds would always be available for maintenance, which must never be deferred.
- Environmental Aspects involving the required environmental assessment, maintenance of the renewable source capacity and protecting it from contamination.
- Technical Aspects involves conception, feasibility studies, design, construction, maintenance, operations, rehabilitation (when necessary), and finally, decommissioning and sustainable disposal at the end of its useful service life. Basically, these constitute planning, design and management of the physical infrastructure, and the technologies involved.

For the sustainability of CBDWS, it is necessary to develop the required guidelines with active involvement of the stakeholders, using a bottom-up approach [18].

3. Water Sustainability in the Context of Eritrea

Eritrea has made considerable progress in water and sanitation service delivery since independence in 1993 and has shown commitment to fully realizing SDG 6. In Eritrea, there are major contrasts and similarities between the housing typologies within the various parts of the city. Based mainly on geographical location, the type of housing typology or housing design within the city can provide some information on the social functioning of the neighborhoods, the presence of modern infrastructure facilities such as water, road and sewerage, and the inhabitants’ socio-economic position. In the report ‘Asmara Infrastructure Development Study’ several types of housing settlements, excluding the central commercial district within Maekel Ketema (city center), had been classified into five residential or settlement categories

- Established residential area: these types of neighborhoods are characterized by well-established villa

type of houses and recently built houses with modern facilities. Most of the areas within Tiravolo sub-region could be classified under this category.

- Mixed residential area: these are mixed type of residential areas with villa type typology mixed with courtyard housing typologies. Areas such as Gezabanda, Paradizo, part of Gejeret and Edagahamus fall under this category.
- Planned low-cost (popular planned) residential area: These types of neighbourhoods are mainly the courtyard housing typology which are low cost housing constructed in a planned manner. Sembel, Akria, Maitemenay, and part of Godaif can be classified under this category.
- Traditional spontaneous residential area: These are neighbourhoods which were constructed in a spontaneous manner without planning. They are characterised with narrow and winding streets. Aba-Shawil, Arbate Asmara and some parts of Akria belong to this classification.
- Traditional village settlement: These are usually villages located just on the periphery of Asmara which have been absorbed by the city. To some extent, these neighborhoods are characterized by some sort of farming activities. Part of Gejeret village and Godaif village are classified under this category.

There are definitions of sustainability and even more interpretations of its meaning. International Fund for Agricultural Development [19] strategic framework defines project sustainability as the ability to ensure that the institutions supported through projects and the benefits realized are maintained and continues after the end of the project's external funding. Sustainability has also been defined as the ability of a development project to maintain or expand a flow of benefits at specified level for a prolonged period after project inputs have ceased [20]. A project is sustainable if the communities are capable on their own without the assistance of outside development partners, to continue producing results for their benefit for as long as their problem still exists [21]. The project sustainability is described as the capacity to maintain services and benefits both at the community and institution levels without detrimental effects after special assistance of financial, technical, managerial support [22]. There are four elements of sustainability which need to be recognized and analyzed. They include: community influence, which measures the impact a community makes upon the project in terms of the social contract and stakeholder influence; Environmental Impact, which is the impact of the project on its geophysics environment; Organizational Culture, which is the relationships between the project's internal stakeholders; and Finances, an adequate return for the level of risk undertaken in pursuit of sustainable development and financial sustainability [23]. Participation is a concept that has been popularized in community development since the 1970s. The approach is due to the recognition of failure of the top-down approach to community development. The past several decades of development funding has demonstrated the failures of the top down approach [24]. It attributes lack of community participation as a likely reason for these failures [25]. It also contends that while a lot of money has been allocated to developing countries' projects, there is shockingly little growth to show for it. The author argues that this occurs when bureaucratic interventions by governments, foreign agencies, or transnational conglomerates impose top-down solutions that fail to consider both the needs and wishes of the bottom [26]. In an evaluation of community development projects funded by the Agha Khan Rural Support Programme in Northern Pakistan it was found that community managed projects were better maintained than projects managed by the local government. The author suggests that since community managed projects are better maintained, they are also more sustainable than those managed by local governments. It has

analyzed lessons from 121 rural water-supply projects funded by different agencies in 49 developing countries in Africa, Asia and Latin America. The author found that participation was the most significant factor contributing to project sustainability [27]. Most of the projects referred to community participation or made it a specific project component. It was when people were involved in decision making during all stages of the project, from design to maintenance that the best results occurred. If they were just involved in information sharing and consultations, then results were much poorer. It is mentioned that unless people are central actors in activities and programmes that affect their lives, the impact of the interventions would either be negative, irrelevant or insignificant, as far as transforming people's lives is concerned [28]. When communities are involved in project initiation and implementation, there is the assurance of sustainability to some conditions unlike when they have no idea about the project or when it is imposed on them [29]. It is found that community participation significantly increased sustainability and established a strong linkage between participation of the household members and sustainability of the projects. Community participation in projects also has several benefits [30]. Through participation, the community develops skills for collective action, maintenance and sustainability [29]. It argues that community participation allows people to build their capacities and identify and own the project, leading to efficiency and sustainability [27]. It has been observed that when communities participate in their own projects, the community becomes empowered, and there is greater efficiency, transparency, accountability, enhanced service delivery and better project outcomes [31]. Community participation in projects leads to better designed projects, better targeted benefits, cost effective projects, equitable distribution of project benefits, less corruption, strengthens the capabilities of the citizenry to undertake the initiative. Development activities improve the match between what a community needs and what it obtains since the project becomes consistent with the preference of the community [32]. Although community participation in projects has benefits that promote sustainability, it is important to recognize the challenges in the participatory approach that threaten sustainability of community-based projects. According to Mulwa (2014) some communities have little or no organizational and managerial skills, and this lead to mismanagement and failure of the project. Participation does not take place in a vacuum but in a socio-political context; social obstacles such as the mentality of dependency, the culture of silence, domination of the local elite or gender inequality reduce people's participation in community projects threatening the sustainability of the projects [33]. Participation in community projects is connected to power relations and politics within the community, thus, whenever a project tries to promote participation, it must be ready to confront the political context and its consequences. As a result, the use of participation to drive community development projects can eventually give an opposite result [34]. Gender inequality in communities negatively influences participation of women in community projects. It recognizes the fact that women form the bulk of community labor force for community-based projects but are marginalized when it comes to access to information, decision making and access to opportunities for capacity building [35].

4. Key Project Approach

Sustainability can be defined from two approaches namely, continuous service approach and life cycle approach. Continuous service approach: Sustainability can be defined as if Water, Sanitation & Hygiene (WASH) services and good hygiene practices continue to work and deliver benefit over time No time limit is set on those continued services behavior changes and outcomes. In other words, sustainability is about permanent

beneficial change in WASH services and hygiene practices. Life cycle approach: A service is sustainable when it functions properly and is used; functions over a prolonged period, according to the designed life-cycle of the equipment; provides the services for which it was planned, including delivering the required quantity and quality of water; easy access to the service; continuity and reliability; and providing health and economic benefits [36]. From a governance perspective, sustainability demands that users of the service are, as a minimum, represented in the governance of the service - in some cases they may have a direct management and operational role. The management of the service needs to be sensitive to gender issues to reach out to all users. From an institutional perspective, sustainability should establish and build on partnerships with local authorities and involve the private sector when advantageous. From a financial perspective, operation, maintenance, rehabilitation, replacement and administrative costs should be covered at the local level through user fees, or through alternative sustainable financial mechanisms. From an environmental perspective, there should be no harmful effects on the environment.

5. Community Participation in Project Cycle Management

Monitoring and Evaluation (M&E) are important management tools used to track progress of a project and facilitate decision making [37]. United Nations Development Programme [38] defines monitoring as a continuing function that aims primarily to provide the management and main stakeholders of an on-going intervention with early indications of progress, or lack thereof, in the achievement of results. It defines monitoring as the systematic collection and analysis of information as project progresses [39]. Monitoring has also been described by International Federation of Red Cross and Red Crescent Societies [40] as the routine collection and analysis of information to track progress against set plans and check compliance to established standards. Evaluation on the other hand has been defined as the systematic and objective assessment of an on-going or completed project, programme, or policy, and its design, implementation and results, with the aim of determining the relevance and fulfilment of objectives, efficiency, effectiveness, impact and sustainability [40]. Evaluation is the comparison of actual project impacts against the agreed strategic plans. It looks at what was set out to be done, what was accomplished, and how it was accomplished. It can be formative; taking place during the life of a project or organization, with the intention of improving the strategy or way of functioning of the project or organization.

6. Global Context

Globally, 844 million people lack basic drinking water service and 2.3 billion people lack basic sanitation service [41]. An estimated 1.6 million people die from diarrheal diseases each year due to lack of access to safe water and sanitation, and persons with physical disabilities face additional barriers. Safe drinking water delivery and basic sanitation and hygiene are key global priorities for both governments and NGOs. Safe drinking water and basic sanitation have been recognized as vital components to ensure healthy living and environment sustainability [42]. Many adults are affected by water-borne diseases and ill-health, making them less productive economically and with weak health systems. Women and girls who trek miles to access drinking water are deprived from productive work and school education. Over 400 million school days are missed every year due to water-related illness among the children who attend school [43]. In 2015, 263 million people spent over 30

minutes including round trip to collect water from an improved source following limited drinking water services. More than 159 million people collected drinking water directly from unprotected surface water sources of which 58 per cent live in sub-Saharan Africa. Approximately 2.3 billion people lacked basic sanitation service, 600 million people used limited sanitation services and 892 million people worldwide practiced open defecation [43]. On September 2015, United Nations member states adopted the 2030 Agenda for Sustainable Development. The 2030 Agenda for Sustainable Development Goals comprises of 17 Sustainable Development Goals and 169 global targets addressing social, economic and environmental aspects of development, and seeks to end poverty, protect the planet and ensure prosperity for all. The SDG Goal 6 aims to “Ensure availability and sustainable management of water and sanitation for all.” The target 6.1 aims to achieve universal and equitable access to safe and affordable drinking water for all and target 6.2 aims to achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations by 2030 [44].

7. Water Governance in Eritrea

Eritrea is located in the Sahel zone, with rainfall occurring during the south western monsoons. The climate ranges from hot and arid near the Red Sea to temperate sub-humid in the eastern highlands. Average annual rainfall is about 380 mm, varying from less than 50 mm to over 1000 mm. Over 90 per cent of the total area receives less than 450 mm and only 1 per cent receives more than 650 mm of annual rainfall. Rainfall in Eritrea is torrential, of high intensity, short duration, and varies greatly from year to year. The rainy season for the highlands and western region extends from June to September. As a result of the topographically ragged nature of the highlands, thin soil formations and a completely deforested terrain, most of the runoff turns into violent flash floods [45]. In 2004, the demand for water in Asmara city was estimated at 36,000m³/day, whereas the average production from the water treatment plants was 24,000 m³/day, indicating that the water production at the treatment plants for that year was only 75 per cent of the demand. To manage the water shortage, AWSD has implemented distribution sectors and organized a rationing system with scheduled services. Due to the water shortage and hydraulic problems associated with extended intermittent system of supply, it became impossible to meet the demand in all sectors [46]. There is only one perennial river, the Setit River, which also forms the border with Ethiopia. All other rivers are seasonal and contain water only after the rains and are dry for the rest of the year. There are no other natural fresh surface water bodies in the country. Artificially dammed water bodies are found here and there in the highlands of the country. Groundwater can be tapped in all parts of the country but not in the quantities and of the qualities desired [45]. Eritrea’s water distribution system is organized from Water Treatment Plants. A water tanker service is organized for the areas without piped connections. In recent years, the city has been under serious water stress conditions due to limited available water resources, unreliable rainy seasons due to climate change, growth in population, and aging infrastructure [1]. A water resources law for the State of Eritrea was proclaimed in 2010 and is yet to be put in to effect. The objective of the Water Resources Proclamation is to conserve and develop the water resource base of Eritrea; to promote and integrate all efforts by various institutions, considering acceptable international norms and practices so as to achieve a sustainable socio-economic development and ecosystem stability [46]. The major source of water supply for Asmara and the surrounding villages is surface water collected from rainfall occurring during the rainy months of summer. The runoff created from the rainfall over the drainage area joins streams and rivers and

is finally collected in dam reservoirs located around the city. Ground water has not been widely exploited as a direct source of water for municipal use [1]. The root causes of water related problems in Eritrea include highly uneven distribution of water availability, extreme catchment degradation, low investments on water storage and infrastructure, increasing water demand, pollution of freshwater, improper procedures and regulatory instruments, absence of water costs, lack of monitoring, assessment and evaluation of water resources, absence of enacted water resources policy, insufficient legislative and legal framework, inefficient institutional framework, weak financing mechanisms and inadequate professional and technical capacity. In addition, inadequate water conservation practices, inefficiency in water use, water reuses etc., are also prevalent challenges [46].

8. Water Profile of Eritrea

In Eritrea, only 19 per cent of the total populations have access to basic drinking water service and only 5.5 per cent of the rural population have access to basic water supply service [47]. Eritrea along with other nations worldwide, has adopted one of the Millennium Development Goals (MDGs) of increasing access to improved drinking water. Access to safe source of drinking water is important because potentially fatal diseases including typhoid, cholera, and dysentery are prevalent in unprotected water sources. Sources that are likely to provide water suitable for drinking are identified as improved sources. These include a piped source within the dwelling, yard, or plot; a public tap/stand pipe, or borehole; protected well; spring water and rainwater; piped water is mainly accessible in urban areas. More than eight in 10 (84 per cent) of households in Asmara, more than six in 10 (64 per cent) in other towns and 36 per cent (all from public taps) in rural areas, use piped water. Overall, nearly six in 10 of the households in Eritrea have access to improved water source with the corresponding figures for urban and rural areas at 73 and 50 per cent, respectively. Overall, 34 per cent of Eritrean households have a water source on their premises (76 per cent urban and 11 per cent rural). Adult females aged 15 and above are mainly the ones who fetch water for the households [48]. Eritrea made moderate progress towards the achievement of the MDG targets for safe drinking water. Despite progress, water scarcity and poor water quality are increasingly common across Eritrea and open defecation is practiced by most of the population. Demand for freshwater in both rural and urban areas is expected to increase because of rapid climate change, population increase, economic activity, rapid urbanization, high competition for water among users and improved standards of living [46]. Only 5.5 per cent of the rural population have access to basic water supply and 88.6 per cent of rural population practice open defecation [47]. Located in the arid and semi-arid region of Africa, Eritrea is not endowed with natural resources including water. The rainfall is very low and mean annual rainfall in the highlands is in the range of 400-500 mm and in the arid lowlands below 300 mm. In Eritrea, the lack of water is a threat to agricultural, domestic, and industrial development projects. This is mainly due to mismanagement of water resources as a result of different factors such as fragmentation of work, weak institutional set-up, low capacity, knowledge gaps, and finance [49]. Access to improved water source has increased significantly from 23 per cent in 1995 to 55 per cent in 2002 and slightly up again to 58 per cent in 2010 [48].

9. Conclusions

Water is considered as a right of the people to sustain life for economic and social development and for

protection and conservation of the environment. Globally, 844 million people lack basic drinking water services and 2.3 billion people lack basic sanitation services. An estimated 1.6 million people die from diarrheal diseases each year due to lack of access to safe water and sanitation, and persons with physical disabilities face additional barriers. Various research works conducted in developing countries have shown the interdependence between the availability of the water and economic development and linkage to poverty as well. Access to drinking water is a significant issue and can cause deaths due to unsafe use. Eritrea is located in arid and semi-arid zone of Africa where there is not availability of adequate drinking water. Rainfall in Eritrea is torrential, of high intensity, short duration, and varies greatly from year to year. The rainy season for the highlands and western region extends from June to September. Sustainable Development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs. This concept is applicable in the case of water and sanitation systems. Water supply projects is sustainable when consumers are aware to pay user fees that are sufficient to cover all the costs. There is a need for active community participation from planning to monitoring and evaluation of the water and sanitation programme, and the ownership by women and men ultimately leads to sustainability. Furthermore, local institutional development, capacity building of local WASH committee, provision of spare parts and plumbing tools, repair and maintenance funds, linkage and coordination with government line agencies, regular monitoring and evaluation are critical aspects for the sustainability of water, sanitation and hygiene system.

10. Recommendations

The following recommendations have been suggested based on the review of the various published and unpublished literatures:

- Community level training and awareness sessions should be organized regarding the use of drinking water and maintaining sanitation and hygiene system.
- Regular water quality testing and monitoring and evaluation of the water supply system should be conducted.
- The household level water supply and sanitation system should be introduced in the study areas rather than provision of public tap stand to make a significant difference in the life and livelihood system of the local community.
- Solar powered rural water supply systems should be introduced to reduce the operating and maintenance costs.
- The local technicians should be trained and equipped with plumbing tools for the repair and maintenance of rural water supply system.
- The spare parts should be made available locally.

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