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Water supply dams in Ethiopia and sustainability

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Holistic water resource management needs the integration of community participatory water supply development and catchment management activities for sustainable livelihood improvement and ecological conservation. Proper management of water supply development dam projects contribute a lot for social development, economic growth, environmental conservation and climate change adaptation. But inadequate quantity and quality of water due to poor management of the catchment area limits development resulting in poor water supply, sanitation, hygiene, food insecurity and reduce energy production. Sustainable use of water depends on the functionality of the whole ecosystem. The need for holistic water resources management is well understood by the government and the people of Ethiopia and effort are made to conserve the natural resources. The objective of is paper is to integrated catchment management for the development of water supply dam projects, improve livelihood of the community and reduce sedimentation in reservoirs.

Background

Ethiopia, with a total surface area of 1.1 million square kilometers and projected population of 90 million in 2015 (CSA) is the second most populous country in sub-Saharan Africa. The higher amount of rainfall and extreme difference in altitude is major cause soil erosion, land degradation and siltation in the reservoirs. The erosive effects of rainfall are significantly augmented by severe deforestation and traditional agricultural practices on steep slopes without soil and water conservation measures. The loss of forest cover in general associated with high rate of population growth and the increase in demand of biomass for energy production, with the reduction of the vegetation cover soil erosion and sediment transportation in the rivers sedimentation in dams is a major problem that shortens the lifespan of municipal water supplies, irrigation and hydropower generation dams. The reduced regulation capacity of dams also increases flood risks for downstream communities, which poses a particular risk for the poor, who tend to live in the most vulnerable locations. Clean water and sanitation are basic human needs in everyday life and becoming more urgent requirements for health protection and for improvement of living condition of people in line with this The Government of Ethiopia's has Comprehensive and Integrated Water Resources Management Policy. In 2014 76.7 percent of the total population of Ethiopia has access to potable water services. The Government of Ethiopia announced a remarkable achievement in the Water Supply, Sanitation and Hygiene (WASH) sector as it met Target 10 of the MDG 7c for access to drinking water supply on 23 March 2015.

The country's principal environmental challenges involve complex cross-sectoral linkages. The lack of holistic approach to water resources management and land degradation are the major challenges for sustainable development. Surface water harvesting is one of the major sources of water supply for the urban areas in Ethiopia, but siltation in rivers and reservoirs has substantially increased the treatment cost for water supply. Sustainable water supply is a component of holistic water resource management. The practice bringing together multiple stakeholders in order to determine how water should managed. In order to decide a water system development project is sustainable various economical, social and ecological considerations must be studied. A sustainable and integrated watershed management program is a critical and in dispensable element in enhancing sustainable livelihoods and reduce poverty. Integrated watershed

management is a system-oriented concept with a holistic approach to problems and potentials. For this reason it is necessary that interventions complement each other in a synergistic way (ENTRO, 2008).

Material and methods

Both primary and secondary data were collected during the desk and field works.

The methods are presented as follows:

- Review of the available documents of the water supply dam projects in Ethiopia;
- Reviewing different topographic maps, sketches and photographs of the catchment area ;
- Discussion with the project managers, chief technicians and with the community living in and around the catchment areas of the water supply dam projects;
- Field observations upstream and downstream of the dam; and
- Documentation of the existing conditions using cameras.

Results and discussions

Water supply dams

Historically, for more than 5,000 years, dams have provided people with a reliable source of the water they need to live. Dams have enabled people to collect and store water when it is plentiful and then use it during dry periods (CIGB-ICOLD, 2007). The water supply dams to impound water for drinking as a survival necessity and domestic applications (cooking, cleaning, bathing, sanitation). In this paper four major water supply dams in Ethiopia. These dams are the source of water for city of Addis Ababa, Gondar and Adwa Town.

Legedadi Water Supply Dam

Legedadi dam is located in the Awash River basin of the Oromia Regional State. It's located 35 Kms North-East of Addis Ababa. The dam is located in catchment with intensively cultivated areas and the source of water for the Legedadi reservoir is mainly the run off during the rainy season which carries heavy sediment loads. The major source of the sediment is the cultivated fields situated on the steep and undulating slopes that are without soil and water conservation measures. The sediment not only decreases the water holding capacity of the dam but also reduces the water quality and increases the cost of water treatment.

Dire Water Supply Dam

The Dire dam is located in north-east of Addis Ababa. It is approximately 40km from Addis Ababa and adjacent to the north west of the Legedadi catchment area and covers an area of 77.7 Km². As the demand of water supply in the Addis Ababa city increases, there was a need to extend the availability of water in the Legedadi treatment plant. For this reason the Emergency Dire Dam Project was constructed.

Name of the water supply dam	Catchment area (km²)	Reservoir Capacity (Mm³)	Dam height(m)
Legedadi	225	47	44
Dire	77.7	19	46
Angereb	120	5.3	33.5
Midmar	75	10	33



Photograph 1. Legedadi reservoir area



Photograph 2. Dire reservoir area

Angereb Water Supply Dam

The Gonder Water Supply (Angereb) project is located within the Gonder Zuria and Armachiho woreda of Amhara Regional State. The catchment of Angereb dam is roughly 12000 ha. The topography is predominantly hills. Angereb River and its tributaries have cut deep trenches that divide the catchment into several sub- catchments. The slope classes in the catchment range from 0-60 percent encompassing the steep moderate to gentle topography. The mean annual temperature varies between 16 °C and 20 °C and average annual rainfall Gonder station is 1200 mm. The fertility of the soil in the catchment declined due to deforestation and cultivation without soil and water conservation activities. The major problems in the reservoir area are sedimentation as shown on Photograph 3, water weeds and reduction of water. The Water Supply Office fully aware of the problems and there are some efforts to protect the catchment from erosion by planting different trees species around the reservoir, hills and marginal lands.

Midmar Water Supply Dam

Midmar dam is found near Adwa town. The landscape is generally a “u” shaped valley. The dam is also found near the foot of Soleda Mountain to the North West direction from Adwa town. It is 4 km far from Adwa town .The catchment have lost vegetation cover and severely degraded due to soil erosion. The slopes on both sides of the river are steep slopes between 30% and 60%. From conservation point of view these areas are not recommended for cultivation and grazing. However, due to scarcity of agricultural land, farmers are cultivating these steep slopes with limited soil and water conservation activates along the slopes. On upstream of the dam land is severely degraded and rate of silt transportation along the drainage system is very high and very high sedimentation in the reservoir is observed. Farmers cultivate on the accumulated silt in the reservoir as shown on Photograph 4 below.



Photograph 3. Angereb reservoir



Photograph 4. Midmar reservoir

Conclusions and recommendations

In conclusion water security and future sustainable water supply will be the major concern of the city of Addis Ababa, Gondar, Adwa and other major towns of Ethiopia with the rapid economic development and population growth. The existing and future water supply development dam projects needs a holistic planning that integrates the water supply development with catchment management for sustainable use and conservation of the natural resources. Forest, soil and water conservation activities are necessary to reduce the sediment transportation from its sources rather than living large volume of the reservoir sedimentation. Based on the assessment of the four major dams in Ethiopia the following recommendations are given:

- Integrated catchment management is very important to minimize erosion and sedimentation in the reservoir for sustainable water supply;
- The water weeds around the reservoir should be removed to protect the decomposition of the weeds in the reservoirs that brings additional cost for chemical application and reduce the water quality for drinking;
- Focus should be given for regular dam safety inspection to increase the live of the dam by reducing sediment transportation and improve water quality ;
- After the installation of the necessary dam safety instrumentations date should be collected , recorded and analyzed on regular bases;
- Regular Environmental and Social Impact Assessment (ESIA) upstream and downstream of dam structures to protect the community living downstream of the dam and take timely measures.

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