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MAXIMIZING THE BENEFITS FROM WATER AND ENVIRONMENTAL SANITATION

Water resources utilization on the slopes of Mount Kilimanjaro: Resolving the conflict

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In this paper, a general introduction on the conflicts resulting from utilization of limited water resources and some previous attempts to tackle them have been briefly explained. Moshi Rural District has been taken as a typical example where water use practice and socio economic points of conflicts have been highlighted. Engineering aspects have been considered in resolving the matter where by, technical investigations and proposals are discussed herein. A conclusion has been drawn regarding the community reaction on the technical proposals and the envisaged benefits from the proposed measures have been explained. Recommendations have been provided to make the proposal feasible and sustainable. It also recommends the adoption of the approach in other areas with similar concern.

Introduction

Conflicts (others deadly) in water resources utilization has been growing daily among water users due to the ever increasing demand while the worlds water resources are being declining. This has been happening for centuries from local communities to international levels. In a bid to tackle such problems, some relevant measures have been taken such as the formation of water shed management bodies and community based water users groups. Others include setting of laws and by laws governing water uses and environmental conservations. This report explains lessons learn and experience obtained by the Author while working on the Moshi Rural Water Supply Study conducted by CES Bau GmbH from March, 2004 to February 2005.

Moshi rural district

One of the typical examples with water resources utilization conflict is the Moshi Rural District, which is located in the slopes of Mount Kilimanjaro, in the Kilimanjaro region, Tanzania. There are other similar areas on the slopes of the Mount Kilimanjaro, others within Tanzania and also among the (especially developing) nations. The slopes of the Mount Kilimanjaro are among the densely populated rural areas and the Moshi Rural District has a population density of up to 3000 people per square kilometre. Total population of this pilot area is 317,882 according to year 2002 national census and the average area is 870.15km2.Water sources are from the melting ice on the Kibo peak of Mount Kilimanjaro.

Water use practice

The main water uses in the area are agriculture (irrigation) and domestic (consumption). These are the two main conflicting water uses in the area. For centuries, agriculture has dominated the water uses in the upper slopes of the mountain and domestic water was fetched from irrigation furrows. Some pipeline systems were laid in 1950s and 60s for domestic supply and are now out of design period and dilapidated. The low lands rely on the shallow wells and turbid perennial rivers. The crops which are grown are coffee for commercial and banana for food. Some seasonal crops include maize and beans. There are total of 368 irrigation furrows in the pilot area with a total length of about 3700 kilometres. The total length of pipeline system is about 700 kilometres which is about 20% of the total length of furrows. The water, though not treated, is still described by the users to be clean and safe for consumption. Most of furrows are owned by group members and there about 10 commercial coffees farms using such furrows. Irrigation with piped water is limited to gardening. The population served by irrigation furrows (for irrigation and domestic uses) is about 127153 (40%) people. On the other hand, only 38146 (12%) get reliable piped water supply, this implies that the pilot area needs an improvement in domestic water supply services to cover the remaining 88%.

Socio-economic point of conflict

Despite about 279736 (88%) people suffering the consequences of limited or no piped drinking water supply services, about 52% of the entire population insisted to having water for both domestic and agriculture use (for consumption and production) as their first priority. This is because 81% of the population in the pilot area rely on agriculture for their livelihood. 45% of the population had their first priority on drinking water only. This brings an engineering challenge on the optimum allocation and utilization of limited resources to meet the felt community demands and also to maintain natural resources conservation. These results are according to the household survey conducted in April, 2004 on the

Moshi Rural District Water Supply study.

Technical aspects

Technical point of view on current situation

Though the furrows serve a relatively small population, they comprise a considerable length and take substantial amount of water from the sources for irrigation. And because they are not lined, it result in to a water loss of up to 95% due to seepage and spillage. So, water in the furrows is always considered by users to be not sufficient for irrigation while actually most of it is lost on the way and hence is not used productively. This has made the community to be reluctant in releasing any more water from the same sources for domestic (piped) water supply projects, though they need it.

Technical investigations

A technical investigation on water resources utilization was conducted in the Uru area, which is located within Moshi Rural District. The area has a total population of 28053 according to year 2002 national census and population density of 700 persons per square kilometer. About 10 square kilometer (1000Hectares) is used for agriculture and 50% of which is irrigable. This area depends on the Rau River as a sole water source for irrigation and domestic use. It is also a proposed domestic water source for the area and northern parts of Moshi Urban District (Figure 1). Four irrigation furrows which are close to the proposed domestic water intake were visited on 6-12 January 2005 (accompanied with furrow representatives) to investigate their location, conditions and abstraction rates. The four furrows are Washayo furrow whose intake is located furthest in the forest, Kisamo and Wa Chuwa furrows whose intakes are located further down in the forest and Mchengeli furrow whose intake is lowest but also located in the forest reserve. The findings show that the Mchengeli furrow (located at the proposed intake site) had a substantial flow of 70.4 l/s while at the first off take point there was 8.2 l/s only. This shows a water loss of 62.2 liters which is about 88%. During site visit, Kisamo furrow had an abstraction rate of 4.7 l/s but it was diverted back to the river at about 800m where it was measured 4.2 l/s. This showed a loss of 0.5 liters (0.6 l/km). The Wa Chuwa furrow had an abstraction rate of 50.6 l/s and at the first off take point measured only 6.5 l/s, showing a water loss of 44.1 liters (about 87%). The abstraction of Rau River to Washayo furrow was blocked during site visit and it was getting its water from other intercepting streams of Kimamasao, Ongu, Usima and Mang'ana River. Out of about 27 l/s abstracted at the first point (Kimamasao River), only 6.3 l/s (23%) reached the first consumption point, about 6 l/s (23%) was diverted by other users and the remaining 14 l/s (54%) either spilled or seeped away.

Technical proposal

From the findings obtained, it is proposed that one conveyance pipeline has to be constructed to replace the four irrigation furrows so as to minimize water losses and wastage resulting from seepage and spillage. This pipeline will be used to supply irrigation water and part of it will be treated for domestic use. It is also suggested that the existing overnight water retention ponds to be improved especially by lining with cement sand blocks to meet water use requirements during day time. This will minimize confrontation with the irrigating community which is very keen with their water source which has also to be used for piped water supply. The proposed abstraction point for the irrigation pipeline is at the current abstraction point of Kisamo furrow on Rau River. The total measured minimum flow from this catchment is 47.3 l/s, (equivalent to 1200mm/year rain fall) which is considered to be sufficient for irrigation requirements and the excess water, during off peak will over flow to recharge the down stream of the river. The domestic water pipeline intake point will be located further down, at the existing Mchengeli furrow abstraction point where there will be a sufficient and reliable flow from more than three rivers and springs which will provide a minimum flow of 200 l/s and meet the required water demand of 60 – 120 l/s for Moshi Urban and part of Rau village. The proposed layouts for the systems are shown in Figure 1.

In the environmental aspects, the proposed pipeline scheme will contribute to the reduction of the effects resulting from the presence of irrigation channels, especially in the Mount Kilimanjaro forest reserve where they have contributed to the destruction of the forest environment. Irrigation channels always need foot paths for all year maintenance, which in turn provide access for other destructive activities. In Uru alone there is about 25 Kilometers of foot paths inside the forest for channels attendance. On the other hand, channel maintenance activities which involve cutting across the ground slopes and bush clearing also contribute to soil erosion and land slides. For example, in a survey conducted in 2001 by the UNDP,UNEP, Kenya Wildlife Service, the University of Bayrenth and the Wildlife Conservation Society of Tanzania on the threats to Mount Kilimanjaro revealed that, the forests are heavily impacted by illegal activities and encroachment including logging, fire occurrences and establishments of forest villages. During the survey, over 6400 recently-logged indigenous trees were counted on the southern slopes of Mount Kilimanjaro only and the evidence of 57 land slides were noted. The destruction activities have resulted in to a complex of other effects including global warming (and hence melting of the snow cap on the mountain), silting, water pollution and decline of rains. For example, the study by UNEP reported that between 1962 and 2000 the mountain has lost approximately 55% of its glaciers, while the rainfall data from the Directorate of Meteorology showed that there was a decline of rains for the months of January, May and August in the year 1995 to 1997. For the month of January, the rains declined from 20.1mm to 0mm. Human pollution was evident from the water quality analysis conducted from Rau River. Results showed some parameters exceeding the World Health Organisation (WHO) Standards shown in the brackets, namely Manganese mg/l 0.8 (0.1), Nitrite mg/l 2.0

(0.2) and faecal coliform per 100ml 3 (0). A water sample was taken from within the forest reserve.

The economic point of improvement will be due to the increased production of coffee (as a main cash crop), banana and cereals for food (81% of population are farmers). During the study, it was revealed that, the decline of rainfall over years has resulted on more reliance on the very limited irrigation systems and others have presently resorted to forest products harvesting (including logging) and other destructive activities for their livelihood. River and stream flows also showed a tremendous decrease as compared to the past hydrological data. The interview to the elders showed that , some rivers which used to have water all over the year are now running dry most time of the year, and this was obvious during the study. This has therefore decreased the irrigation potential of rivers and the catchment basin. Currently, the average banana yields per hectare is 2500 Kilograms according to a survey conducted by The Ministry of Agriculture from 1991-1998. This gives about 1250 tonnes per year. With irrigation improvement it may double to about 2500 tonnes per annum as the production will be all year round (assuming the area gets reliable rains for six months). This is equivalent to about 100 KG per person per year which is sufficient for the average of six months food requirements. Production of other crops may also improve as well.

Project costs and financing

The cost estimate for construction of the proposed domestic water system is about € 2,000,000 and irrigation system for the farming community € 900,000. The project is expected to be funded jointly by the Government of Tanzania and the Federal Republic of German.

Conclusion

In general the furrow representatives and village leaders understood, agreed and accepted the proposal and the whole idea of the project. This is the first and important step to wards sustainability of the project.

Apart from supplying the community with sufficient water to meet their demands for domestic and irrigation, the following improvements are also envisaged:

- Environmental Aspects e.g. Soil erosion will be reduced, deforestation resulting from maintaining of four furrows will be reduced and water resources will be conserved and utilized properly.
- Health e.g. reduced water related diseases due sufficient and safe water supply and reduced mortality and morbidity rates resulting from water shortage consequences.
- Poverty and Hunger e.g. increased and improved crop production as a source of income and food, reduced expenditure on medicine has economic advantages, reduced time and distance for women and children in fetching water and hence ample time for other economic activities.
- Social aspects e.g. harmony and peace among the community resulting from participatory approach of the project and improved standard of life due to improved social services.
- Others include technical convenience of operation and maintenance of water systems, and sustainability of the systems and the community livelihood.

Recommendations

It is recommended to install flow monitoring and control

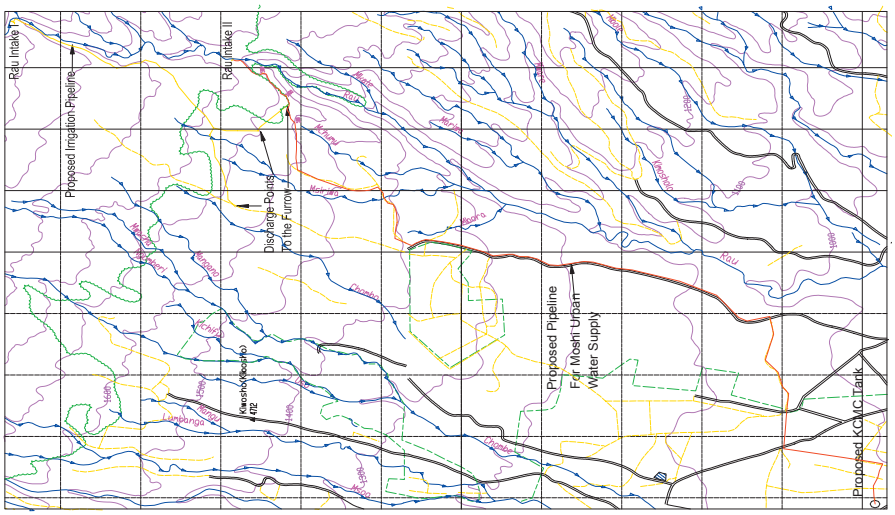

Figure 1. Rau river source development

Source: CES GmbH, Water Supply Programme, Moshi-Rau River source development

devices for the proposed pipelines and a river gauge to monitor the river flow patterns and the water abstraction rates. In future, when water demand and use increases, improved irrigation systems e.g. drip irrigation can be introduced in the area to control wastage.

Metering of domestic connections and paying according to consumption can also control excessive and unnecessary water use. Back up institutional support on various disciplinary has to be provided by the relevant bodies dealing with water supply, environment and irrigation and involvement of other stake holders for better results in implementation, operation and sustainability of the systems. Further and detailed investigations on this and other similar matters are recommended for better results and solutions.

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