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Conflict Resolution in Water Resources and Environmental Management

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Contents

Chapter 4
Paying to Conserve Watershed Services in Pangani River Basin, Tanzania

Makarius C.S. Lalika, Patrick Meire and Yonika M. Ngaga

Abstract Human beings depend on the integrity of watersheds to provide ecosystem services (e.g., water) that they need for their survival. The current watershed degradation represents the most serious threat to the provision of watershed services. The worldwide demand for integrated approaches to provide solutions to water flow reduction represents a significant shift towards management focussed on the sustained use of water catchment areas. This paper reports the findings of a study that was carried out to explore the potential for paying for the management of watershed areas in the Pangani River Basin in Tanzania. Site visits enabled the collection of hydrological data, and documented reviews and structured questionnaires were used to collect socioeconomic data. MS Excel was applied in drawing figures. We found that the minimum and maximum quantities of water discharge were 11,300,365 and 15,839,833 m^3 and 7,787,600 and 8,602,361 m^3 in Arusha and Moshi, respectively. Similarly, the minimum and maximum revenue collections from water users were €987,766, 60 and €1,659,160, 71; and €920,916, 40 and €1,456,075, 49 as projections and actual revenue collection, respectively. We conclude that water supply problems are caused by watershed degradation and obsolete water infrastructures. We recommend the integration of payment for watershed conservation approaches into watershed management to enhance sustainable water flow.

M.C.S. Lalika (✉) · P. Meire
Department of Biology, Ecosystem Management Research Group, University of Antwerpen, Campus Drie Eiken,Universiteitsplein 1, 2610 Antwerp, Belgium
e-mail: makarius.lalika@yahoo.com; makarius.lalika@student.uantwerpen.be

M.C.S. Lalika
Department of Physical Sciences, Faculty of Science, Sokoine University of Agriculture, P.O. Box 3038, Chuo Kikuu, Morogoro, Tanzania

Y.M. Ngaga
Department of Forest Economics, Faculty of Forestry and Nature Conservation, Sokoine University of Agriculture, P.O. Box 3011, Chuo Kikuu, Morogoro, Tanzania

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4.1 Introduction

Many ecosystem services (ES) from watersheds have gained attention in recent years across the entire globe (De Groot 1994; Pattanayak and Kramer 2001; Pattanayak 2004). Governments, international conservation organisations, private firms, and individual firms are progressively paying attention to the value of the innumerable ES provided by these watersheds (Krishnaswamy et al. 2006; Lopa et al. 2011). This awareness has drawn attention to the economic benefits of intact ecosystems and conservation initiatives, which had been taken for granted until recently (Pagiola et al. 2002; Lalika et al. 2011).

Increase of human population and pressure on watersheds in recent years (MEA 2005; Lalika et al. 2011) in search of ES is to blame for degradation of the resource base (Egoh et al. 2012). The current conservation and incentive structures for sustainable conservation of watersheds across the globe have rarely motivated the upstream communities who pay the opportunity cost for watershed conservation (Panayotou 1994; Costanza et al. 1997; Daily et al. 2000; Landell-Mills and Porras 2002; MEA 2005). As a result, land uses that provide watershed services are rarely enhanced at a socially and economically optimal scale, marginal upstream landowners continue to remain poor, and the downstream water users are gradually facing water supply fluctuations.

As in elsewhere around the globe, watersheds in the Pangani River Basin (PRB) are currently facing environmental degradation, due to the lack of sustainable approaches to conservation (Kulindwa 2005; Mwanyoka 2005; Turpie et al. 2005; Sotthewes 2008; Notter 2010; Lalika et al. 2011). Kilimanjaro Mountain, for instance, which is located within the PRB, is facing rampant environmental degradation to such an extent that even the distinctive snow at its peak is projected to disappear completely by 2020 (Kamugisha 2009). Environmental changes to the mountain through anthropogenic activities have contributed to the inefficiency of watersheds to supply water downstream (Kulindwa 2005; Ngana et al. 2010; Notter 2010; Msuya 2010). For PRB residents, their livelihoods, quality of life, community and children's health, and ultimately, the ability to survive are dependent upon effective watershed and water management. Degradation of watersheds means water scarcity and the emergence of conflicts among water users (Mbonile 2005).

Water shortages especially during the dry season contribute to hydroelectricity production fluctuation, resulting in power cuts. The three hydroelectric power plants located along the PRB contribute up to 17 % of the country's power capacity, which is mainly from hydropower (Ngana 2001; IUCN 2007). Power production at Nyumba ya Mungu Dam (NyD), the biggest reservoir for hydropower generation in the PRB, and its sister hydroelectric power plants (Hale and New Pangani) rely on water from the PRB watersheds. Recent studies carried out in the PRB (Ngana et al. 2010; Notter 2010; Msuya 2010; Lalika et al. 2011; Hellar-Kihampa 2013) indicated that there is a need for direct and innovative solutions for ecosystem conservation. Paying communities who reside in proximity to watersheds is perceived to be the ideal approach for sustainable watershed conservation (Muñoz-Piña et al. 2008; Cantor et al. 2012; Thatcher 2013).

While successful stories for payment for watershed services (PWS) implementation have been reported widely at global and local scales (Landell-Mills and Porras 2002; Pagiola et al. 2002; Pattanayak 2004; Pagiola et al. 2005; Pagiola 2008; Cantor et al. 2012), there is limited information on how PWS would be able to enhance watershed conservation in the PRB. Similarly, information on the amount of money to be set aside for watershed conservation is not known. Therefore, enhancing PWS as a policy option for watershed management in the PRB is crucial. Once the mechanism for benefit sharing and rewarding upstream communities for their involvement in watershed conservation is known, it will be easier to bring together sellers of ES (upstream communities) and buyers of the service (downstream water users). We carried out this study in order to identify and examine watershed conservation techniques that are in place in the PRB; to determine funds allocated for financing watershed conservation; and to document projected and actual revenue collection from downstream water users in the PRB.

4.2 Materials and Methods

4.2.1 Location and Description of Study Area

This study was conducted in four villages, namely, Kaloleni, Rau River, Chekereni and Lekitatu, along PRB, Tanzania (Fig. 4.1). The PRB extends from the northern highlands to the north-eastern coast of Tanzania. It lies between latitude 03° 05′ 00″ and 06° 06′ 00″ south and longitude 36° 45′ 36″ and 39° 36′ 00″ east.

The PRB is the largest river basin within the Pangani Basin (PB) and covers an area of about 43,650 km^2 (IUCN 2003). The terms "PRB" and "PB" have two different meanings. The former refers to the basin where the Pangani main river and its river tributaries are located, whereas the latter incorporates the PRB and the other three smaller basins, i.e., Umba, Zigi-Mkulumuzi and Msangazi (IUCN 2003; Faraji 2007; IUCN 2007). PB is a shared transboundary resource between Tanzania and Kenya (IUCN and PBWO 2008).

The PRB, which is the focus of this study, drains the southern and eastern sides of Mt. Kilimanjaro (5,985 m) as well as Mt. Meru (4,566 m), then passes through the arid Maasai Steppe in the west, draining some of the Eastern Arc Mountains (Pare and Usambara Mountains, which are World Biodiversity Hotspots) (Newmark 1998; Mwanyoka 2005; Mbeyale 2009), before discharging into the Indian Ocean at Pangani Estuary. The PRB hosts an estimated 3.8 million people, 80 % of whom rely directly or indirectly on irrigated agriculture for their livelihoods (IUCN 2007; IUCN and PBWO 2008; Kamugisha 2009).

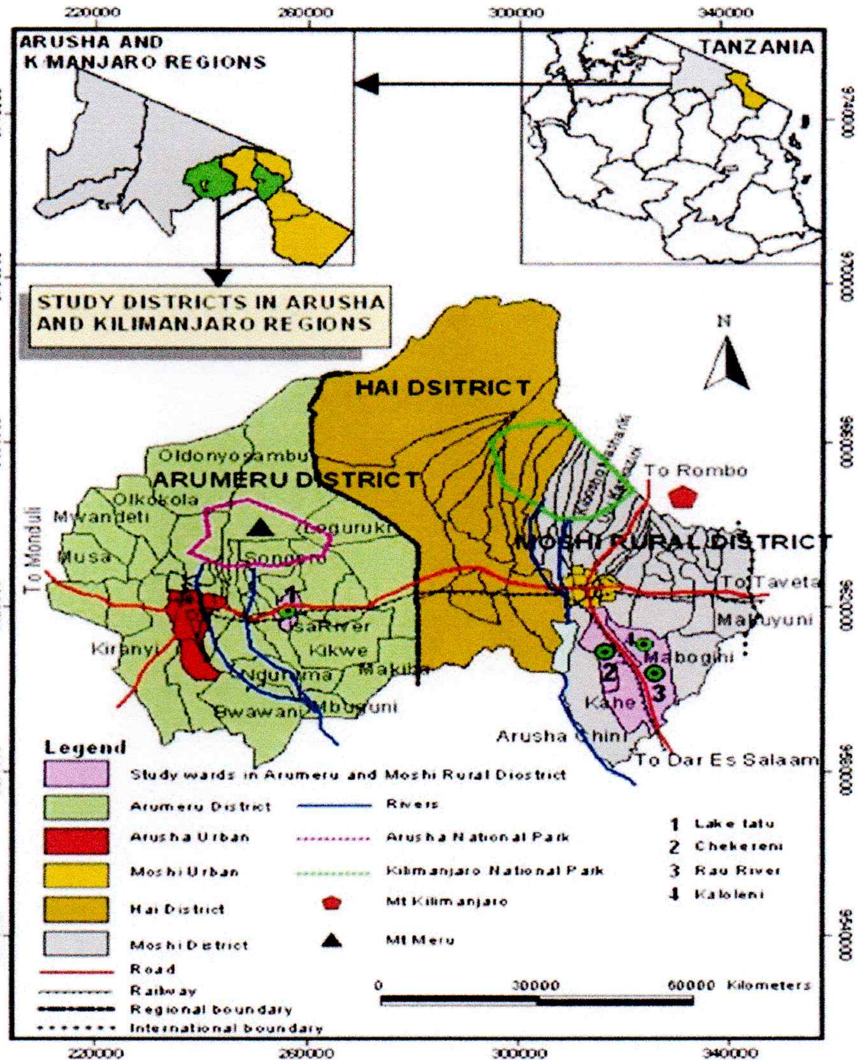


Fig. 4.1 Location of the studied villages in Pangani River Basin, Tanzania

Vegetation in the PRB ranges from forests on mountain slopes, to semiarid grasslands (IUCN 2003). The major vegetation types include forests, woodlands, bush lands, grassland thickets and plantation forests (Turpie et al. 2005). Excessive forest utilization has led to forest degradation and previous studies show that the natural forest in the Kilimanjaro region declined by 41 km^2 between 1952 and 1982 (Lambrechts et al. 2002). The main causes of forest degradation and deforestation include encroachment for settlement and agricultural, and increasing demand for forest products (mainly timber and fuel wood) (IUCN 2003).

Table 4.1 Total number of households sampled for questionnaire interviews

Village	Total households	Sample size	Sampling intensity (%)
Kaloleni	490	49	10
Rau River	340	34	10
Ckekereni	550	55	10
Lekitatu	250	25	10
Total	1630	163	10

4.2.2 Research Design and Sampling Procedure

We used a cross-sectional design as suggested by Casley and Kumar (1988) and de Vaus (1993) to execute field activities. The design allowed us to collect information at one point in time. To avoid bias in choosing respondents for our questionnaire survey, we adopted a simple random sampling technique. This technique allowed us to select respondents from the entire population in such a way that every member of the population had an equal chance of being selected. The sampling frames for this study were the village registers containing the lists of all households in the respective villages. The sampling units for our study were households, because household are where all decisions are made with the head of the household being the ultimate decision maker. In each village, we randomly selected households using a table of random numbers by matching their numbers in the register books. Within each of the identified four villages, a random sampling technique was adopted to identify respondents, and 10 % of the total households in each village were selected for interviews. Due to the variations of total population in the study villages, 10 % of all households was adequate to get a representative sample for our study. Therefore, a total of 163 household heads were sampled as indicated in Table 4.1.

4.2.3 Data Collection Methods

We executed this study in two main phases to collect both primary and secondary data. During phase one, we carried out a reconnaissance survey with the aim of familiarizing ourselves with the study area, pre-testing questionnaires and selecting study villages. Questionnaire pre-testing is an essential step for socioeconomic studies not only for checking the validity and reliability of the questions, but also for identifying weaknesses, ambiguities and/or omissions necessary for the main study.

In phase two, we collected socioeconomic data in the four villages using a structured questionnaire as the main field tool. We also used writing pads to document interesting and useful information from respondents whenever appropriate. During this research phase, we also carried out field excursions to identify the location of spatial features (such as springs, rivers, wetlands, dams and swamps/marshes); catchment forests; and irrigation farms. During field excursions, we conducted formal and informal interviews in order to attain insights on watershed services in the PRB. We collected data on water discharge from gauging stations after every hour for twenty-four hours. We also consulted response officers from the Arusha Urban Water and Sewerage Authority (AUWSA) and Moshi Urban Water and Sewerage Authority (MUWSA) for more data and information on water discharge and production.

Moreover, we collected secondary data from relevant published and unpublished reports. This information was collected from regional and district water authorities (e.g., AUWSA and MUWSA), Pangani Basin Water Office (PBWO) and the International Union for Nature Conservation (IUCN) Water and Nature Initiative (WANI) project. We conducted a literature survey and review in order to understand the water flow situation and supply and the efforts made so far by different actors for watershed conservation in the PRB. Various reports for studies conducted in the PB were also extensively reviewed. They include River Health Assessment Final Report (PBWO and IUCN 2007); Pangani Basin: A Situation Analysis Volume 2 (PBWO and IUCN 2009a); Pangani River Basin Flow Assessment: Basin Delineation Final Report (PBWO and IUCN 2008a); Development of Climate Change Scenarios (PBWO and IUCN 2008b); and Hydroelectric Power Modelling study (PBWO and IUCN 2009b). Key issues during secondary data collection include water supply, quantity of water sold, budgets for watershed management, revenues from water sales, water user payment mechanisms, main water users, and problems related to water flow, just to name a few.

4.2.4 *Data Analysis*

Later on the 163 structured questionnaires were coded, cleaned, categorized and transformed to enable analysis. Quantitative data (collected through the structured questionnaires) were analysed using Statistical Package for Social Sciences (SPSS) version 12.0. Multiple analysis was carried out to obtain frequency and percentages of responses from respondents, and tables were constructed. Data on quantities of water production, revenue projections and actual collection for water utilization were summarised, and MS Excel was used to draw figures based on the data. Before being used in MS Excel, information related to finances were converted from Tanzanian shillings (Tshs) to Euros (€). The exchange rates used is: 1€ = 2,273 Tshs.

4.3 Results

4.3.1 *Watershed Management Techniques*

We found that water control and decision-making with respect to watershed management are guided by various local approaches and different management techniques in the study area. As indicated in Table 4.2, building concrete walls/canals

Table 4.2 Watershed management techniques in PRB, Tanzania

Activity	Frequency (n = 161)	Percentages (%)
Building concrete walls/canals	148	92
Retaining riparian vegetation/trees	137	85
Planting trees	136	85
Uprooting weeds and removing muds in water canals	130	81
Removing muds and weeds in water sources	131	81
Total responses	682[a]	424[a]

[a]The total responses for frequency (682) and percentage (424 %) are greater than 161 and 100 %, respectively, due to multiple responses

(92 %); retaining riparian vegetation (85 %); tree planting (85 %); uprooting weeds and removing muds in water canals (81 %); and removing muds in water sources (81 %) are the water management methods that are in place in the study area.

From the table above it is evident that almost all techniques are applied in watershed management as the range between the techniques with the highest and lowest score is just 11 %. Nonetheless, from an ecological point of view, retaining riparian vegetation and planting trees are favourable techniques for watershed management because they have multiple benefits as far as watershed functioning and delivery of ecosystem services is concerned. Some of the retained trees in their natural habitats (e.g., *Rauvolfia caffra*, *Melicia excelsa* and *Ficus sycomorus* and varieties of *herbs* species) control soil erosion, purify the air, and serve as habitats for wild animals.

4.3.2 Water Supply and Sale for Domestic Uses

Analysis of water discharge indicated that Moshi had high figures in terms of maximum and minimum water discharge as compared to Arusha (Fig. 4.2).

The minimum and maximum quantity of water discharged in the study sites is 11,300,365 and 15,839,833 m^3 and 7,787,600 and 8,602,361 m^3 in Moshi and Arusha, respectively. In both cases, sources of water for domestic use are natural springs and bore holes. We found that water sources for Moshi town are from *Shiri* and Nsere springs and two boreholes, namely Mawenzi, Kilimanjaro Christian Medical Centre (KCMC) and Karanga. MUWSA is the government agency responsible for water abstraction, water infrastructure development and water supply in Moshi town. Like MUWSA, AUWSA is the government agency responsible for water abstraction, water infrastructure development and water supply in Arusha town. AUWSA has a mandate of managing water sources for Arusha town. These sources include Masama, Oldadae, Olesha and Midawe springs; and Sekei, Sanawari, Ilboru, Ilkieri and Sakina boreholes.

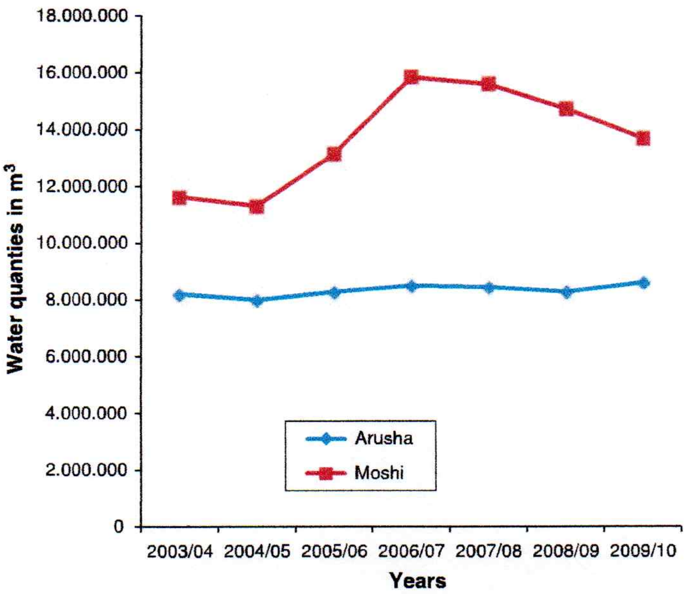
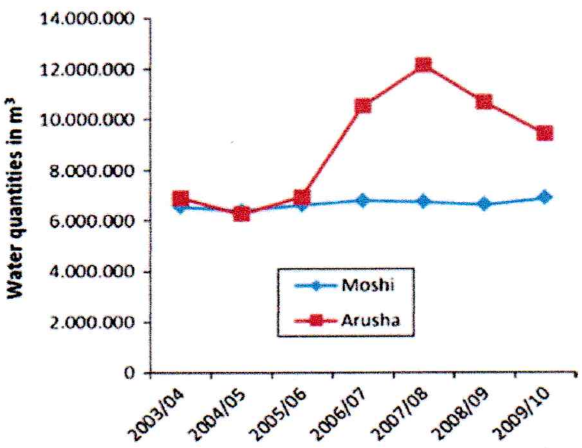


Fig. 4.2 Water discharge from 2003/2004 to 2009/2010 in Moshi and Arusha, Tanzania

We also documented the total quantity of billable water (i.e., water expected to be sold). We found that the highest quantity of billable water for the 2009/10 financial year in Moshi and Arusha was 6,881,888.8 and 12,135,143 m^3, respectively (Fig. 4.3).

Findings for billable water indicated that minimum quantities were 6,396,876 and 6,265,965.96 m^3 for the financial year 2004/2005 for Moshi and Arusha, respectively. The low quantity of billable water is attributed to water leakage while on transit; obsolete water pipes that burst due to high pressure; illegal water abstraction; poor meter reading and deliberate destruction of water pipes.

Fig. 4.3 Quantity of billable water from 2003/2004 to 2009/2010 in Moshi and Arusha,Tanzania



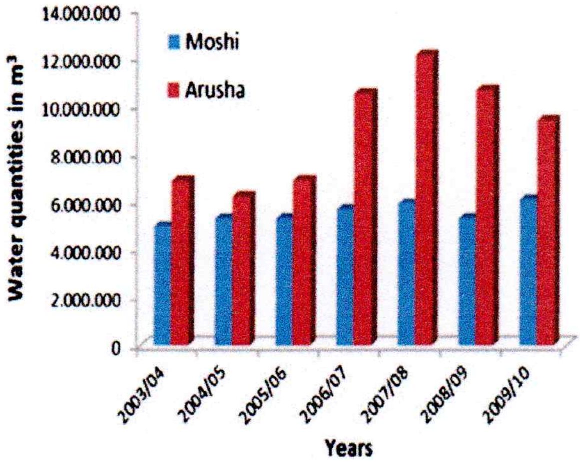


Fig. 4.4 Quantity of water sold from 2003/04 to 2009/10 in Moshi and Arusha,Tanzania

4.3.3 *Quantity of Water Sold*

Our findings on the quantity of sold water indicated that there was an increase from 5,004,853 to 6,140,488 m^3 for the 2003/2004 and 2009/2010 financial years, respectively, in Moshi town. Similarly, we observed an increase of water sold from 6,265,966 to 12,135,143 m^3 for the 2004/2005 and 2009/2010 financial years, respectively, in Arusha (Fig. 4.4).

We also found that the gap between billable and sold water is caused by water leakages while in transit either to the central tanks for storage or by illegal abstraction. However, a number of standing community water taps are fixed in villages where water pipes cross from watersheds to users downstream. This is a direct incentive for local community involvement in sustainable watershed conservation. In other words, this forms the basis for water users to realise the benefit of watersheds and to be convinced to pay for their conservation. In both cases, Arusha had a higher quantity of sold water than Moshi. This trend is similar to of billable water, shown in Fig. 4.3.

4.3.4 *Financing Watershed Management in PRB*

4.3.4.1 Budget Allocated and Amount Received

With respect to financing conservation programmes, we found that watershed management is not given outstanding priority as compared to social services sectors (e.g., health, education, roads, etc.), which is why the amount donated for watershed conservation is less than what was projected (Fig. 4.5).

As indicated in Fig. 4.5, the PBWO (the sole and mandatory institution that collects water user fees) had projected budgets of €159,490, 62 and €329,665, 85 for the

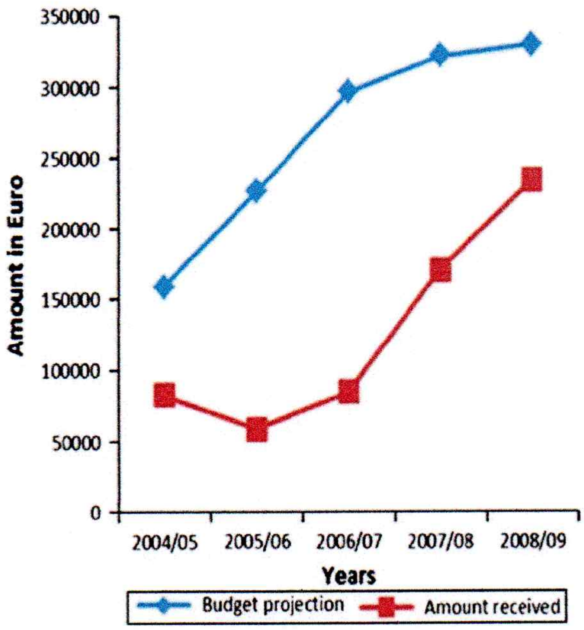


Fig. 4.5 Fund allocation for financing watershed conservation between 2004/05 and 2007/08 in PRB, Tanzania (*Source* PBWO database, 2009). Exchange rate used: 1€ = 2,273 Tshs.

2004/2005 and 2008/09 financial years, respectively. Surprisingly, only €82,693,72 and €234,537,77 were made available for the 2004/05 and 2008/09 financial years, respectively (Fig. 4.5). Potential sources of the budget include water user fees from Tanzania Electricity Supply Company (TANESCO), Ministry of Water and Irrigation (MoWI), other water user fees (from industries, small- and large-scale irrigators, water abstractors, domestic users), and water right application fees.

4.3.4.2 Projected and Actual Revenue Collections

We were also interested in finding out the projected and actual revenue collected from water users in the PRB. Findings indicated that projections were €987,766, 60 and €1,659,160, 71 for the 2004/2005 and 2009/2010 financial years, respectively, whereas the actual collection was €920,916, 40 and €1,456,075, 49 for the 2004/2005 and 2009/2010 financial years, respectively (Fig. 4.6).

Contrary to finances for watershed management where the budgets were not attained in any financial year, there is an exception for projected and actual revenue collected. As indicated in Fig. 4.6, the actual collection for 2003/2004 was greater (€1,074,874, 81) than the projected collection (€987,766, 60). This might be attributed to efficiency in user fees collection, or motivation given to employees in charge of water revenue collection, just to name a few.

As in Fig. 4.6 above for Moshi town, the actual collection in Arusha town (Fig. 4.7) was less than the projected collection with the exception of 2003/2004 and 2004/2005 where the actual collection was greater than the projected collection.

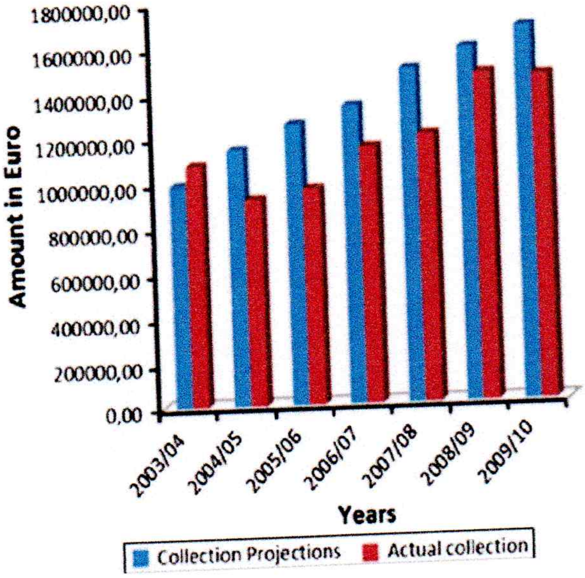


Fig. 4.6 Revenue collection from 2003/2004 to 2009/2010 in Moshi, Tanzania. Exchange rate used: 1€ = 2,273 Tshs.

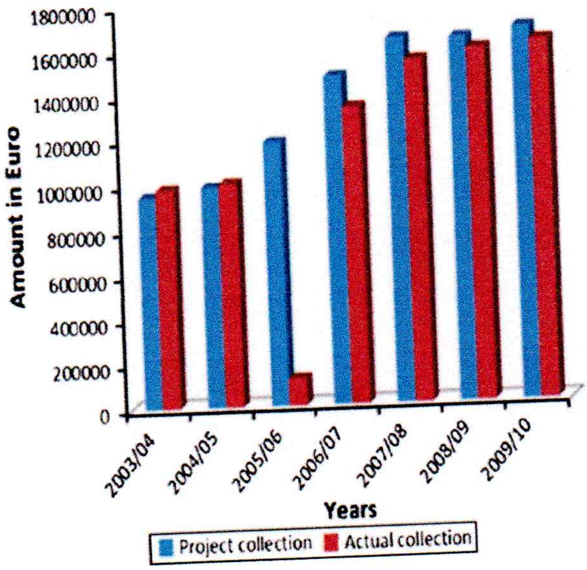


Fig. 4.7 Revenue collection from 2003/2004 to 2009/2010 in Arusha, Tanzania

The reason for the actual collection surpassing the projected collection might be attributed to efficiency in the whole process of revenue collection. Nonetheless, we found a shocking fall in the actual collection compared to the projected collection in the 2005/2006 financial year (Fig. 4.7). The reason for this dramatic fall in actual collection might be due to drought, poor water infrastructures (pipes), inefficiency of personnel responsible for revenue collection, and, of course, little water flow caused by the degradation of the watershed ecosystem upstream. If revenue collection increases due to payment from water users, a certain percentage could be diverted to finance forest conservation which might result in more water availability in the long run.

4.4 Discussions

4.4.1 Water Resource Management Techniques

As indicated in Table 4.2, concrete canals were preferred by a majority of smallholder irrigators on the ground that concrete canals prevent water infiltration as water flows downstream. Their preference for concrete canals may be attributed to their desire for sufficient water irrigation. From an economic perspective, water is an essential input for production in primary, secondary and tertiary sectors, as well as for household consumption (UNESCO 2006).

However, stakeholders in the study area seemed to focus more on the economic benefits of water rather than the ecological aspects. In view of this reality, Zoumides and Zachariadis (2009) contend that although water pricing is potentially an effective tool in terms of economic efficiency, its environmental effectiveness is not guaranteed; thus, it may not drastically improve water resource management.

Retaining riparian vegetation (85 %) and tree planting (85 %) were also applied as water conservation methods as well as to enhance ecological integrity. Various studies (Costanza et al. 1997; De Groot et al. 2002; Krishnaswamy et al. 2006; Notter 2010) have indicated that natural vegetation has the potential to offer hydrological functions including groundwater recharge; water quality improvement; regulating the timing and extent of runoff; storing water; reducing salinization; filtering and decomposing organic material; and many more. These hydrological functions and services are particularly important for enhancing sustainable water flow in the PRB either because rainfall is highly seasonal or locally limited, or because intensively cultivated and densely populated agrarian landscapes downstream are affected by soil-hydrological processes in the watersheds. Thus, the advantages of watershed conservation through ecological approaches (i.e., retaining natural vegetation) are innumerable. Apart from enhancing water flow, ecological conservation approaches enhance watersheds to provide multiple ES and regulate ecological functions (Cheng et al. 2002; Lu et al. 2001; Muñoz-Piña et al. 2008; Pattanayak 2004).

4.4.2 Water Production and Supply

Water supply in PRB depends mainly on natural flow from various springs, boreholes and rivers originating from Kilimanjaro and Meru Mountain watersheds.

Frankly speaking, water supply in Moshi and Arusha towns is not sufficient and MUWSA and AUWSA, the legal water abstractors, are yet to fulfil customers' demands. Sustainable water supply is crucial in the area and MUWSA and AUWSA are trying their best to accomplish this.

The current watershed degradation and reduction of water (Notter 2010) is attributed to the lack of a holistic/integrated approach towards watershed management (Msuya 2010). Ngana (2001) asserts that ineffective enforcement of conservation laws, climate change, population growth, socioeconomic and political changes and lack of an effective institutional framework contribute to the decrease in water in the basin.

Increased population in the basin, coupled with economic activities requiring water as an input such as hydropower generation, irrigated agriculture, industries, tourism, mining, livestock keeping, domestic uses, fisheries, wildlife and forestry activities, has further aggravated the situation (Mbonile 2005). Water scarcity is a problem in many places due to unreliable rainfall, multiplicity of competing uses, degradation of sources and catchments (Faraji 2007; Kulindwa 2005; Turpie et al. 2005, 2007). Mbonile (2005) found that water scarcity threatens food security, energy production and environmental integrity and, consequently, there are water use conflicts between various water actors, including communities and conservationists; upstream and downstream users; hydroelectricity producers and other users; communities and donor agencies; farmers and pastoralists; rural and urban areas; and communities and river basin authorities.

Comparing the quantities of billable water and sold water for Moshi and Arusha, the quantity of billable water presented in Fig. 4.3 is higher for both of the towns than that of sold water displayed in Fig. 4.4. This might be due to the differences in efficiency of workers and the level of water infrastructures. In fact, intact and good water pipes retain much more water than obsolete water pipes. Other reasons for the differences are that water users in Arusha might be more civilised and, therefore, they do not abstract water from pipes illegally while it is on transit to reservoirs and storage tanks.

4.4.3 Financing Watershed Management and Revenue Collection in PRB

Despite being stipulated clearly in the Tanzania National Water Policy (URT 2002) on integrated water management and the need to finance catchment areas for sustainable water flow, little has been done on the ground in PRB. For quite some time, watershed management in Tanzania has been financed by the World Bank through the Ministry of Natural Resources and Tourism (Forestry and Beekeeping Division) and District Natural Resource Offices. In some cases, international conservation organisations such as World Wildlife Fund for Nature Conservation (WWF), International Union for the Conservation of Nature (IUCN), CARE International and other local conservation organisations have been in the forefront in addressing the need for conserving critical watershed areas.

On the other hand, setting aside funds for nature conservation has been quite a problem in PRB. This is attested by Fig. 4.4 which indicates that the minimum budget for watershed management was €159,490, 62 while the actual amount of money given was merely €82,693, 72. Similarly, the maximum budget was €329,665, 85 while the actual amount collected was €234,537, 77. This implies fees for water utilization are not properly dealt with and this finding is in line with that of Turpie et al. (2005), who found inefficient collection of fees from water users.

Furthermore, lack of sufficient quantity and quality of manpower, and skilled and committed personnel; poor water infrastructures; energy (electricity) fluctuation; and low capacity of the watershed to produce water, are among the factors leading to low revenue collected from water users. As portrayed by Fig. 4.5, only €1,456,075, 49 was collected as revenue from water users, while the projected collection was €1,659,160, 71 for the 2008/2009 calendar year. Similar findings with regards to poor revenue collection in PRB are reported by Kulindwa (2005), Msuya (2010) and Turpie et al. (2005).

Despite the significant advances in scientific understanding of forest and water interactions, the roles of forests in relation to the sustainable management of water resources in PRB remains a contentious issue. Uncertainty, and in some cases confusion, persist because of difficulties in transferring research findings to different watershed scales, different forest types and different forest management regimes.

We also think that priorities and key decisions by policy makers have been geared towards financing social services for political gains at the expense of nature conservation. This may partially be due to the gap existing between research and practice. The policy gap, which persists at least in part because of a general failure to communicate results of hydrological research effectively to policy-makers and to challenge conventional assumptions with scientific evidence, also plays a key role.

If conservation initiatives are to be successful, deliberate efforts should be made to manage watersheds using a holistic approach. This can be achieved by integrating financial matters in water resource management, which could improve people's willingness to pay for and improve water supply in the long run. This is only possible, however, once water users are assured of sustainable water flow and supply.

4.5 Conclusions

Water supply in PRB is handicapped by a higher water demand than the watershed can provide. multiple water uses; rampant influx of water users in the area; electricity cut-off, especially where the water supply requires pumping; obsolete water infrastructures (e.g., water pipes) that cause water leakages before reaching downstream users; and lack of transparency in utilization of the collected revenues, just to name a few.

On the other hand, commitment for watershed conservation is still low among stakeholders in PRB and this is testified by the low revenue collected compared to the projected amount. The low amount of revenue collected is contributed to by the inefficiencies of the methods used during revenue collection. Retaining natural vegetation around water sources is by far the most sustainable ecological approach for watershed management and sustainable water flow in PRB as it has multiple benefits including ecosystem integrity.

As mentioned above, enthusiasm for financing watershed conservation in PRB is still low. This may be partially due to scepticism about misuse of contributions, lack of concrete plans on how to collect and utilize funds from water users, or lack of people's awareness of the clear link between conservation and increase of water availability. The current study is the basis for securing funds from downstream users for financing upstream communities, who are principally the guardians of watersheds. In addition, it is high time that a strategy be conceived that would incorporate the tourist sector in the payment for watershed services. Nevertheless, awareness and capacity building among water users is essential for sustainable watershed conservation through PWS. Therefore, it is crucial to increase the potential for the establishment of PWS schemes in PRB and in other river basins facing similar problems.

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