

MINISTRY OF NATURAL RESOURCES AND TOURISM

FOREST AND BEEKEEPING DIVISION



**MANAGEMENT OF CATCHMENT FORESTS IN
MOROGORO REGION**



**ASSESSMENT OF WATER QUALITY AND QUANTITY FOR
RIVERS ORIGINATING FROM ULUGURU CATCHMENT
FOREST RESERVE-MOROGORO REGION
DRAFT REPORT**

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EXECUTIVE SUMMARY

Forests are managed to achieve one or more clearly specified objectives of management with regards to the production of continuous flow of desired forest products and social environment. In keeping track with the objectives, water measurement was carried out to assess management impact in the Uluguru Catchment Forest Reserve, Morogoro region. Some authors have shown the importance of forests in water and soil conservation and the relationship there in. It was against this relationship of forest and water conservation that water assessment in four rivers originating from Mount Uluguru Forest Reserve was carried out. Trained villagers were used to collect water samples on daily and monthly basis. Total Suspended Solids and water quality were analysed from the Water Department Laboratory in Morogoro. Analysed data were graphically presented using computer excel program.

The study revealed fluctuations in water quantity and quality with seasons of the year in the four rivers. This phenomenon was attributed to forest disturbances on the periphery and outside the forest. However there was less fluctuation in water passing through the forest compared to that passing through agricultural land. Forest/ground cover on Catchment area is important to ensure clean and continuous water flow, the case which was not clearly observed in the study area. However the study form a platform for improvement in data collection as well as acting as a baseline in monitoring management impact of the Uluguru Mountains. Soil erosion as a result of poor farming system outside the reserve were observed. Concerted efforts are recommended to ensure sustainable management of watershed areas along Mount Uluguru Slopes.

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ABBREVIATIONS / ACRONYMS

DCFM	District Catchment Forest Manager
CFR	Catchment Forest Reserve
dm	decimetre
mg/lt	Milligram per litter
MNRT	Ministry of Natural Resources and Tourism
NORAD	Norwegian Agency for Development Cooperation
SUA	Sokoine University of Agriculture
TSS	Total Suspension Solids.

1.0 Background Information

1.1 Catchment Forestry

About 38% of the Tanzania's 886,000 km² total land area is covered by forests and woodlands that provide for wildlife habitat, unique natural ecosystems and biological diversity and water catchment amounting to 1.6 million hectares (MNRT, 2001). In 1976 the Ministry of Natural Resources and Tourism initiated a project dealing with the management of Catchment forests in four regions viz; Arusha, Kilimanjaro Morogoro and Tanga. The project started receiving support from Norwegian Development Agency (NORAD) in 1989, aimed at strengthening the management of the forests in the four region covering 120 forest reserves with a total area of about 700000 ha.

Regional Catchment Forestry in Morogoro-takes cares of about 47 individual forests reserves with area coverage of about 365,000 ha. The forests are scattered all over the five districts of Morogoro region viz; Ulanga/Mahenge, Kilombero, Kilosa, Mvomero and Morogoro. The forests were gazetted under the central Government in the Ministry of Natural Resources and Tourism, Forestry and Beekeeping Division. At District level, the District Catchment Forest Manager (DCFM) who reports to the Regional Catchment Forest Manager administers the forests. Forest management activities were geared towards improvement of the forest condition and community well being i.e. to attain a well-managed forest that contribute to improved rural livelihood, forest protection being the major activity. Protective approach which has been carried out by the government was realized to be a failure because among others low involvement of stakeholders. Currently community involvement is receiving a priority in the management of forest resources, the approach anticipated to play a big role in reducing rural poverty and ensure equity in distribution of benefits related to sustainable utilization of forest resources. Community involvement in the management of Uluguru Catchment Forest, it has just started in year 2003/2004 under WCST vide signed MoU with the Forest and Beekeeping Division.

1.2 Uluguru Mountains

Uluguru Mountain is the Catchments for the spring feedings streams and rivers, which join to form the large rivers. The quality of water supply has been reduced substantially due to excessive Agricultural activities near water sources, previously flourishing in the Uluguru Mountains (Ivera, 2003). Different sectoral laws like Forestry and Water, prohibit human activities on both sides of the riverbanks. A non-utilization zone is 20 m-50 m from the river itself. The water law is more vigorous indicating that a distance of 200 m from the river should be left free from human activities to ensure sustainable water supply.

Uluguru Mountain suffers from various human activities including seasonal fires and encroachment. Usually fires were used as a means of land preparation especially for shifting cultivation practices. At a time this fire come out of control and burn the forest. Sometimes fire is used for hunting of small animals found in the forest. It was difficult to put off the fire once it occurs because of the steep slopes and unpreparedness of the forest adjacent communities and other stakeholders. Hilly slopes outside the reserved forest were severely affected by poor agricultural practices and uncontrolled tree cutting. The forest has been mostly converted to rotational maize and pulse farms, with bracken (*Pteridium aquilium*) dominating the fallow periods, or in the remaining forest areas has been heavily thinned and under planted with bananas (Burgess *et al* 2000). Soil erosion and frequent fires were common phenomenon. Riverbanks were destroyed by poor agriculture that extends to the river bottom.

1.3 Agricultural practices

Rainfall variability on on-set dates and amount was a major constraint to agricultural development and food security in Uluguru Mountains. As an alternative to rain fed agriculture, farmers cultivate in valley bottoms in which they irrigate by traditional means. The practice is very important in ensuring year round food security as well as giving farmers opportunity for production of cash crops like horticultural crops. Farmers attempts to harness the available water from rivers, springs for purpose of producing both

food and cash crops. Characteristically the cultivated plots are usually small in size and they are scattered without proper layout. Much of the diverted water is lost due to seepage before reaching the field and in the field the irrigation efficiency is very low. Irrigation plots are scattered along the valleys, near the rivers and some go to the extent of blocking the rivers or valleys resulting into distraction and depletion of water sources. Also leads to soil erosion particularly for the lower lying farms or plots. Most of the farms are clear of forests occupy both the upper and lower slopes. During the rainy season off-site effect run-off becomes clearly visible, as soil and other debris are taken down slopes by run-off and deposited in the rivers and or streams resulting into soil degradation and water pollution and siltation.

1.4 Importance of the Forests

Local people derive diversified benefits from the forests. These include: wood for firewood, building, artisans and handles. Non-wood products include food, weaving materials and variety of services including water and cultural places. The forest is quite important as watershed area. It controls soil erosion and conserve biodiversity and water. Hydrological process such as precipitation, infiltration, percolation, and surface-runoff, sub-surface flow and ground water flow can alter the magnitude of various storage components including soil water, lakes, reservoirs and rivers. Big rivers like Ruvu originate from this forest; the river feeds about 3.5 million people in Morogoro, Pwani and Dar-Es –Salaam. The forest is also important as an Eastern arc mountain with species of restricted distribution. The forest hosts the Tanzania-Malawi endemic birds as well as primate species including black and white colobus monkey (Doggard, 2002 in Ivera 2003). Of its uniqueness the forest has started attracting researchers and tourists. To put the forest under effective management forest adjacent communities have started been involved in the management. Effective management of the soil and land over which water must flow will determine the quantity and quality of water available to man. Conversely, the stability and productivity of soil depend to a large extent, upon proper conservation and management of water. Water assessment going on will therefore form a basis for monitoring management impact of the forest.

1.5 Water Assessment

Of all the efforts to attain the aforementioned goal, there was no established ways and means of assessing the management impact to these forests. It is assumed that a well-managed forest among others, its water will be clean and increase or be stable in volume-discharged overtime, erosion and flood hazard will be reduced and recreation and wildlife population enhanced. To monitor forest management impact Water assessment was therefore carried out in four rivers originating from Uluguru CFR. Of its importance in biodiversity and water conservation and the high threat exerted upon this forest, Uluguru Mountain was given a priority among many forests in the region with an added advantage of it being in the vicinity to various facilities offered in the township of Morogoro, including water measurement laboratories.

1.6 Objective of the study

The objective of the study was to assess management impact by measuring water originating from Mt Uluguru Catchment Forest Reserve and its surroundings.

Specific objective

- (1) To assess water quantity (level) and quality (Total Suspended Solids) for rivers originating from Mt. Uluguru Catchment Forest Reserve.
- (2) To propose measures that will ensure proper management of the Mountain.

2.0 Methodology / collection of water samples

2.1 Study sites

Local anomalies in the rainfall pattern may be produced by small-scale topographic influences or by obstructions which distort the wind pattern in the immediate vicinity of the gauge. This distortion may make the particular gauge site non-representative of the general forest. It was for this reason that water gauging instruments were installed in the four identified rivers originating from Mount Uluguru Catchment Forest Reserve viz: Luhungo, Morning site, Tangeni and Mgolole rivers.

The activity was carried out in collaboration/corporation with Regional water Authority. The aforementioned rivers were identified and gauging stations established. One local person for each river was trained on how to collect water samples and bottling ready for laboratory work. The activity has been going on for the past three years now and collection done twice per month per river for water quality while water level measurements were carried out daily.

2.1.1 Luhungo River

The gauging station was located about 10 m inside the forest from the forest boundary. The river is formed by only one prominent tributary. From the forest the river pass through agriculture land on hill slopes. Some forest patches were left along the river but because of improper agricultural practices done on these slopes signs of soil erosion was observed. SUA is implementing a Soil Conservation and Agroforestry Project by in trying to conserve the surrounding hills along the river. The project has just started, by formulation of village committee and trains some villagers on raising tree and fruit seedlings.

2.1.2 Morning side

The gauging station was located outside the forest about 50 m away from the forest boundary. There was no vegetation reserved for the riverbanks were left. Cultivation has

gone outright to the riverbanks and the river course disturbance increases with prolonged drought in search for wetter areas for farming. Consequently, siltation is common along the river.

2.1.3 Tangeni River

The gauging station was located outside the forest about 25 m from the forest edge. The river pass through agriculture land on the hill slopes. Two tributaries contribute their water to this river.

2.1.4 Bohomela

The gauging station was located inside the forest about 15 to 20 m from the FR boundary. Only one tributary form this river. From the forest the river pass through, agricultural land

2.2 Data collection and analysis

The collected samples from these rivers were sent to District Catchment Forest office to keep records. The samples were then sent to the Regional Water Department, ready for laboratory analysis. Total suspended solids (TSS) were measured and the results were sent back to our office for interpretation. Microsoft excel was used for statistical data analysis.

2.3 Data interpretation

Graphs for water quality were developed for the four rivers, weighing TSS against months of the year. Water quantity were measured as water level in dm using graduated bar. The recorded data were directly fed into the Microsoft excel software for analysis. Developed graphs include water quantity and quality for Morning Site and Luhungo Rivers, water quality assessment and water quantity assessment for the four rivers.

2.4 Study Limitation

Being a day-to-day activity it was not possible to closely supervise field data collection thus difficult to ascertain its accuracy. However data for year 2002 stand a better chance

to be good representative. Also rainfall data to supplement this study could not be availed.

3.0 Results and discussion

3.1 Seasonal variation

Results basing on the data as well as the drawn graph (below) portray the following. Water quality for Morning Site and Luhungo Rivers showed a variation varies from wet to dry season. During dry season water level decrease where as water quality increase with decrease in Total Segments (TSS) for the respective rivers (Fig. 1 and 2). The situation may be attributed to low rainfall accompanied by less surface water run off. December to January and June to September are the noted dry period of the year. On the other hand during wet season water level increases and water quality decreases with increase in TSS. February to May and October – November are the months receiving rains. Rainfalls in this case seemed to be associated with surface water run off however differ in magnitude depending on where water passes through.

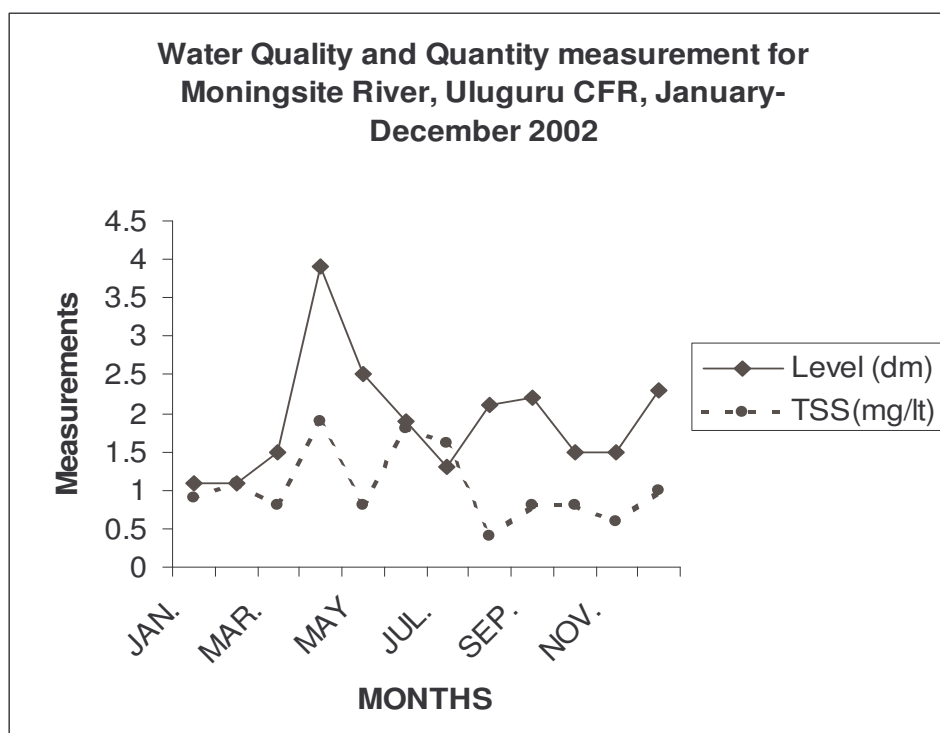


Figure 1: Water quantity and quality for Morning site River.

Quality of water running through the less disturbed forest surface like Luhungo River and the disturbed one like the Morning site River differ, with the former having clearer water

than the other. There was also less fluctuation on water quality for Luhungo R as compared to Morning side R for the same reason given above. Such differences for river passing through ground cover and open land signify the importance of having ground cover that protect the riverbanks and adjacent slopes.

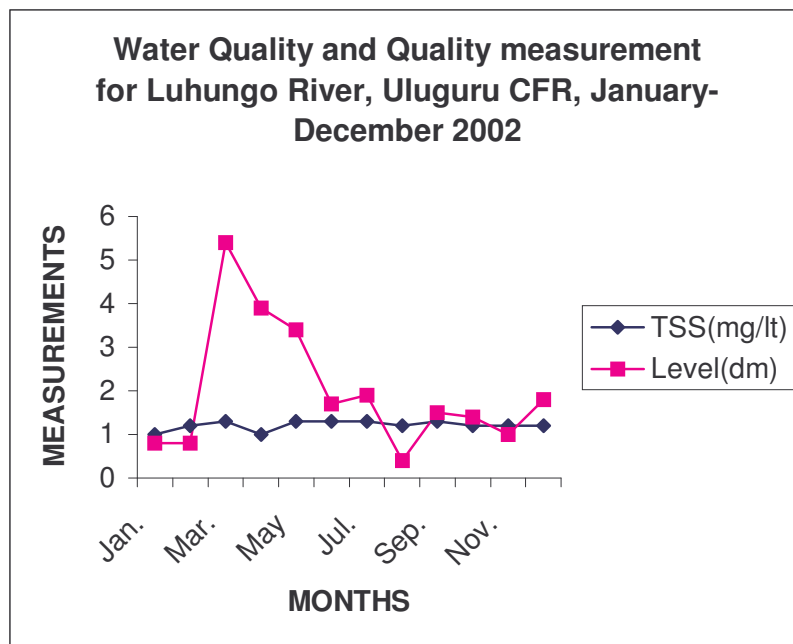


Fig 2: Water quantity and quality along river Luhungo

3.2 River to river variation

The chosen gauge stations for measurement of water quality shows a notable variation from one river to another. Human activities adjacent to these rivers were observed as a factor contributing to these variations. Human activities affect forest/ vegetation cover; hence destruction of forest vegetation impairs rainfall interception, stem flow, percolation and regulated discharge of water. These activities are like Catchment disturbance by tree cutting, forest fires, cultivating agricultural crops such as cocoyams. Other disturbances are like grass cutting and riverine tree cutting. The most disturbed river according to the analysed data was river Tangeni.

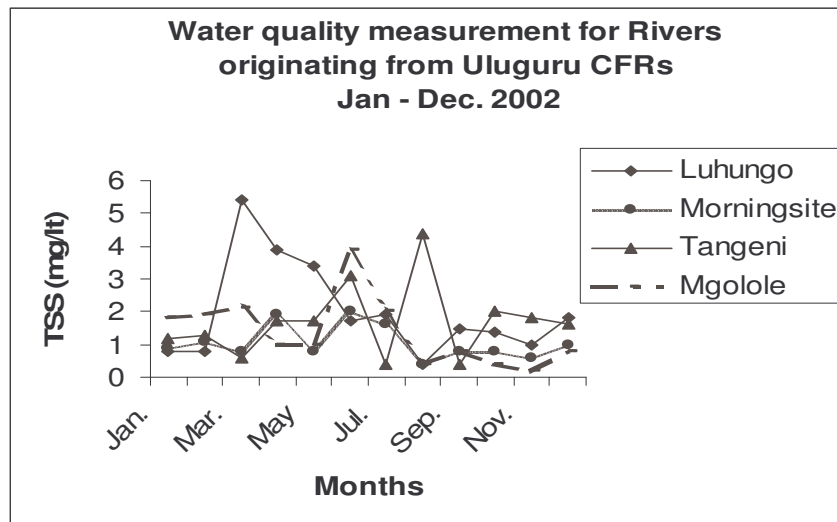


Figure 3: Water quality measurement for rivers originating from Uluguru CFRs

Tangeni River passes through relatively disturbed forest in comparison to other rivers. This shows a significant difference for water passing through the less disturbed forest to that passing through more disturbed forestland. This calls upon a need to maintain and improve forest vegetation cover and protection of riverbanks. Water quantity follows the same trend to water quality. Water level for Tangeni River is higher than the rest. This might be contributed to the fact that more than two tributaries contribute its water to Tangeni River. The other reason might be poor water infiltration due to lack of vegetation cover.

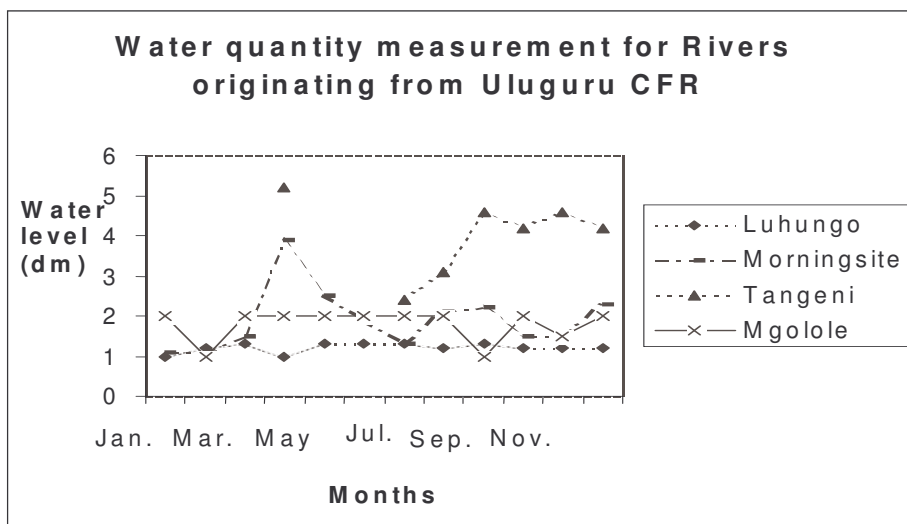


Figure 4: Water quantity measurement for rivers originating from Uluguru CFR

4.0 Conclusions and Recommendations

4.1 Conclusions

Result from water assessment as carried out in these rivers showed that water quality and quantity varies with season. During rainy season water quantity and Total Suspension Solids tends to increase. The reverse is true, that during dry season, water quantity decrease and Total Suspension decreases too. Such trend was a clear indication that on the periphery and outside the forest where the water passes were more disturbed and unsustainably managed. However the magnitude of disturbance differ from one site to another.

The study provides baseline information to assess management impact in Uluguru forest reserve with regards to the newly established participatory approach in the management of the Forest. Improved management means increased in good flow and good quality of water.

4.2 Recommendations

From the study the following can be recommended.

- To ensure continuous flow of clean water, efforts are to be made to reduce forest disturbances along the river courses and improve agricultural practices along the slopes.
- Extension services and awareness campaign should be carried concurrently with providing technical and material support with a focus in improving the farming practices. Technical support required includes water use efficiency; plot layout and design and required agronomic practices.
- Enforcing the by-laws to protect water sources, which restricts cultivating near water sources (should be >30 m), deforestation and controlled burning.
- Provision of short and long-term financial credit facilities should be thought of. Lending institution should some how be soft but which can enable recovery of borrowed money. The loans will not only boost their cash income but will also

assist in environment protection by the use of modern irrigation techniques such as water pumping.

- In order to improve or restrict the farming system a research is needed to understand physical characteristic of the area, how the areas are located and pass from one generation to another, what are the management systems and how effective are they in productivity and environmental conservation or degradation so as to establish strength and weaknesses of the practice.
- For better results, an improvement in data collection and placement of gauging stations is needed. Close supervision during data collection is needed and that measurement should be taken from both within and outside the forest to make a difference for water passing through the forest and that passing through agricultural land. To correlate the level of river water and the amount of rainfall, rainfall measurement should also be taken.

References

- Burgess,N.D., Doggard,N.C., Temu, R.P.C.,Nsolomo,V. (2000) Overview of the biodiversity valueof the Uluguru Mountain, Morogoro, Tanzania. pp6
- Ivera, G (2002)Protection of Watershed and Problems Associated with their Mangement. Acase study of Kiroka Village; Noth West Uluguru, Morogoro. A special Project submitted in partial fulfilment for the Bachelor of Science Degree in Environmental Science and Mnagement of Sokoine University of Agriculture. Up.
- MNRT (2001) National Forest Programme in Tanzania. Ministry of Natural Resources and Tourism, Forestry and Beekeeping Division. pp 143