Universität Siegen
Kenyatta University

DAAD Alumni Summer School

Water Demand in Participatory Watershed Management

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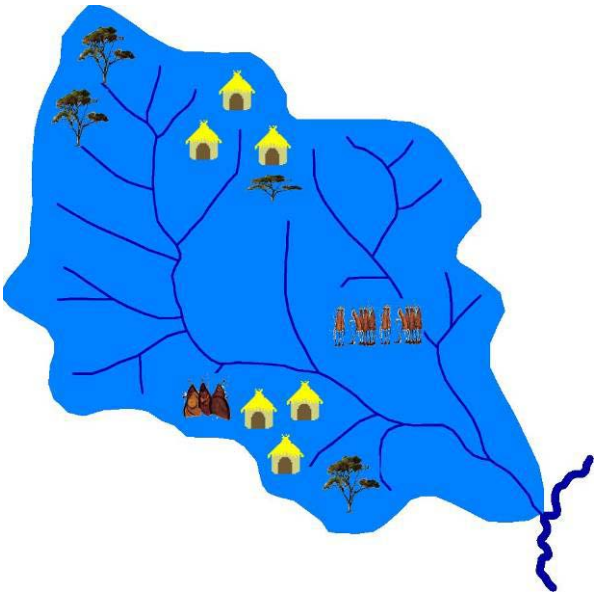
Ngaciuma-Kinyaritha Watershed Kenya

November 2008



University of Siegen, Germany
Kenyatta University, Kenya
GTZ – Water Sector Reform Programme, Kenya
Water Resources Management Authority, Kenya
Ngakinya Water Resources User Association, Kenya

DAAD Deutscher Akademischer Austausch Dienst
German Academic Exchange Service

Participants of the DAAD Alumni Summer School 2008

Content:

Abbreviations:

BWARUA	Bwathonaro Water Resource Users Association
DAAD	German Academic Exchange Service
GTZ-WSRP	German Technical Cooperation - Water Sector Reform Programme
NGAKINYAWRUA	Ngaciuma-Kinyaritha Water Resource Users Association
WRMA	Water Resources Management Authority
WRUA	Water Resource Users Association

1. Acknowledgements

The DAAD Alumni Summer School 2008 took place in Meru including a number of field days spent in the Ngaciuma-Kinyaritha Catchment, Kenya. After a Field Monitoring of the Sub-catchment Management Plan for the Ngaciuma-Kinyaritha Catchment participants developed a methodology to assess water demand within the Catchment. The water demand assessment should follow an easy format applicable to other WRUA´s in Kenya.

All activities were funded by the German Academic Exchange Service (DAAD). The GTZ-WSRP provided logistical support and workshop facilities to assist the Summer School and the preparation work in Kenya. All participants would like to thank all our development partners for their assistance and funding.

Special thanks go to all representatives of Water Resource User Organisations (WRUAs) from the Kawaya WRUA, NYAWRUA, BWARUA and especially NGAKINYA WRUA and the associated local community for their invaluable support and contributions.

WRMA is sincerely appreciated for providing an enabling environment, without which the success of this workshop would not have been possible.

Thanks to all local and international participants for their very fruitful input during all activities in the field and at the conference sessions.

The White Star Hotel at Meru is thanked for their hospitality and providing good conference facilities.

Thanks also to Ruger Winnegge, Nele Förch and Stefan Thiemann, who organised all activities carried out in Kenya and Germany, respectively.

2. Introduction

2.1. Vision

To ensure the availability of adequate and good quality water resources for the well-being of all people and the environment in the Ngaciuma-Kinyaritha Catchment.

2.2. Mission

To involve the community and stakeholders in understanding and allocating the limited water resources for the given area and planning for its sustainable use.

2.3. Goal

To ensure equity in water distribution and utilisation and manage water use conflicts.

2.4. Objectives

Ngakinya WRUA has outlined the following objective, amongst others, in their constitution:

To promote reasonable, equitable and priority-based sharing of water resources between the environment, wildlife, livestock, commercial activities and all the communities who rely on the Rivers Ngaciuma and Kinyaritha and tributaries to always ensure the use of water resources ranks in priority from the highest to the lowest as follows:

- Domestic livestock, public environment, wildlife, fisheries;
- Irrigation power generation, industry; and
- Recreation.

The objective of the Summer School is to underscore the sharing of water resources with collected data on the actual water demand, mainly by human consumption, agricultural activities such as irrigation and livestock keeping, as well as industrial use. Management options are formulated to regulate the existing demand given available resources. A further objective is to stimulate the WRUA to monitor their activities regularly.

3. Geographical Settings

3.1. Administrative Unit and Population

Ngaciuma/Kinyaritha is a catchment of 167 km^2 in Imenti North District in Eastern Province of Kenya (Figure 3.1). The population estimate according to the District Development Report of 2008 is about 65,000, representing a high density of approximately 390 persons/km^2. The main part of the catchment is located within Meru Municipality. Geographically, it is bound by latitudes 37.5° E and 37.75° E and 0.04°N and 0.15° N. All the rivers originate from Mt Kenya Forest (Upper and Lower Imenti) generally, and flow eastwards to join Kathita River. The Upper and Lower Imenti Forest covers about 50 km^2. The catchment can be divided into three zones for management purposes, i.e. Lower zone 30 km^2, Middle 47 km^2 and Upper 90 km^2.

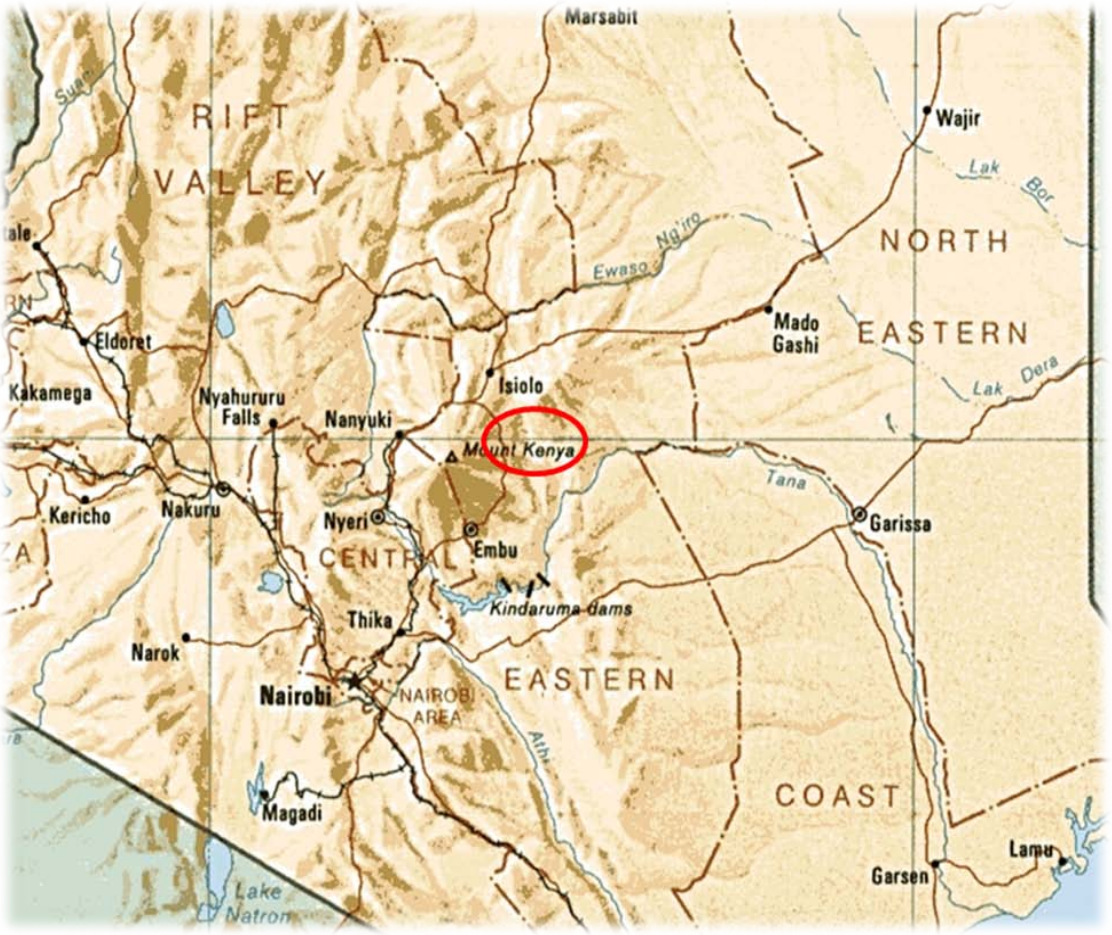


Figure 3.1: Location of Study Area

3.2. Physiography and Drainage

3.2.1 Topography

Altitude ranges from 2600m down to 1120m. The catchment slopes generally eastwards. Several hills are in the catchment and include Nkuriga, Maitei, Kiringo hills in the upper zone, Kamithagana, Mukundu, Kiathandi in the middle and Kagijuu in the lower zone.

The upper zone has a generally undulating terrain. The middle and lower zones are highly dissected by streams and there is a rugged structure. The major river is Kinyaritha with the tributaries Ngaciuma, Kambakia and Gachiege. Kinyaritha drains into Kathita River. The catchment has several springs and wetlands concentrated in the middle and lower zones. The upper zone has a crater lake Nkunga, which is fed by three springs and has a sub-surface outlet. In the upper zones there is no significant permanent surface drainage.

3.2.2 Climate

The climatic conditions range from humid to semi-humid and rainfall is bimodal, falling during the long rains from March to May and short rains from October to December. The mean annual rainfall ranges from about 1100 mm in the lower zone to 1600 mm in the upper zone. The rainfall pattern is summarized in Figure 3.2.

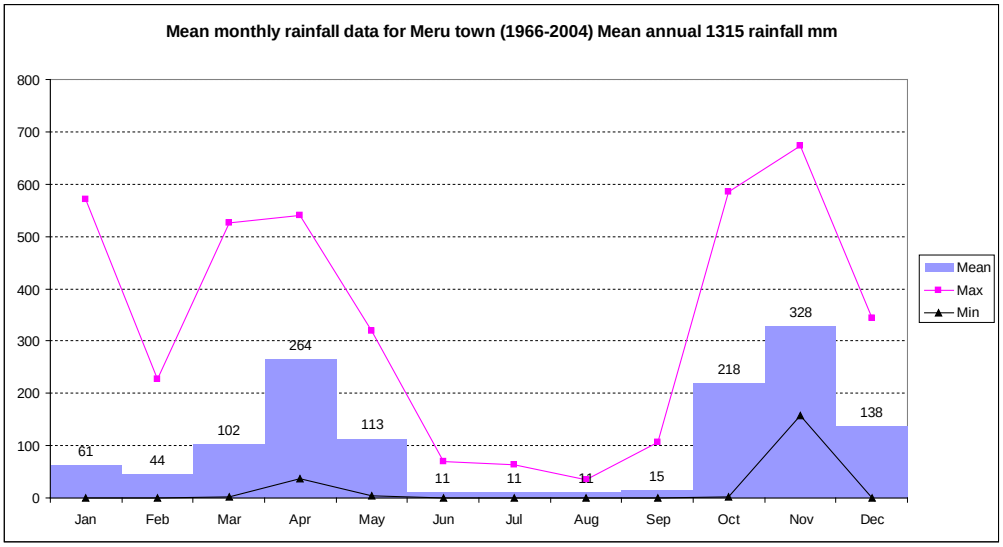


Figure 3.2: Mean monthly rainfall for Meru Town (1966-2004)

3.2.3 Geology and soils

The geology of the catchment comprises of basaltic volcanic rocks with volcanic tuffs and pyroclasts of Nyambeni eruption of the Pleistoscene age. The soils are young geologically except for the forested parts. The major soils are nitisols with some gleysols in the wetlands and andosols on hillslopes. The soils are poorly consolidated hence with the steep slopes they are susceptible to erosion and mass movement. The geology results in soils with high infiltration rates resulting in little or no surface drainage

especially in the upper zone. High seepage losses are experienced where water is conveyed in open channels.

3.2.4 Socio-Economic Activities

Apart from Meru Municipality, where there are commercial activities, farming is the main socio-economic activity. A variety of food crops are grown including bananas, maize, beans, potatoes, yams, arrow roots, sweet potatoes, finger millet, peas, cowpeas, sugar cane, a wide variety of fruits and horticultural crops. Commercial farming involves growing of horticultural crops, macadamia nuts, coffee and fruits. Livestock rearing includes dairy and beef cattle, sheep and goats, poultry, pigs and bee keeping. Donkeys are important means of goods transport. Cattle are also used for goods transport and land preparation. Lumbering is another source of income where trees such as eucalyptus, cypress and grevillea and other indigenous trees are grown for timber and firewood.

Meru town is the main commercial centre but there are also small market centres in the catchment such as Gitimene (Naari), Muruguma, Kienderu, Chugu, Kauthene, Rwanyange, Ndiine, and Mugeene. Solid waste from Meru Municipality is disposed in a dump site at Nkunga in the upper zone. The market centres are connected by earth roads which become partially impassable during the rainy season. Roadside erosion creates gullies which further complicate the problem. The major tarmac roads linking Meru to Maua and Meru to Nanyuki traverse the catchment.

The main source of energy for domestic purposes is firewood. The demand for firewood has led to depletion of indigenous tree species, scarcity of wood resources, deforestation, high prices, and introduction of fast growing trees such as Eucalyptus. Women walk long distances to collect firewood. Connection to electricity network has been done to the major market centres, and there are developments to install electricity to homes through rural electrification programme. Some homes have solar electricity and there is also over reliance on paraffin for lighting in the rural areas.

The catchment has generally high potential for rainfed agriculture as most areas receive over 1000 mm of rain annually. Surface water is not evenly distributed in space and time and this gives rise to water use conflicts. However, most farmers abstract river water for commercial and subsistence irrigated agriculture. The irrigation methods include furrow and overhead irrigation. The water is conveyed in open canals and pipes. Due to poor irrigation practices and poor maintenance of pipes, there is a lot of wastage through leakages, seepage and over irrigation. In the upper zone, there is no significant surface water. Water is transferred from neighbouring catchments from River Kamarai and from the headwaters of Kathita River. Most homes have tanks where they store piped water and in a few cases also roof water harvesting occurs. The springs and wetlands have been severely degraded through exploitation for agricultural purposes. Water pollution from agrochemicals is also an issue throughout the catchment.

Demographic pressure and economic activities have contributed to forest encroachment. Between 1987 and 2000, the area under forest cover decreased from 37% to 24%. Currently, the wildlife in the Forest Reserve causes a threat to people living on the fringes of the forest.

4. Methodology

4.1. Field Assessment of the 2007 Ngakinya WRUA Activities

The Ngakinya WRUA and the BWARUA reported on their activities on implementation of the Sub-catchment Management Plan formulated during the Summer School 2007 and. 2006 respectively. Following the presentation, group work for one day has been carried out in the Ngaciuma-Kinyaritha catchment to familiarise new participants with the catchment and to get an insight on the performance of the WRUA within their area. Out of the participants of the Summer School, groups of about 6 members were formed. Each group had to cover a certain part of the catchment. Parts were selected by the WRUA and agreed upon in the plenary. Each group consisted of members of WRUA, WRMA and university representatives. A report writer, two or three interviewers, a photographer were chosen within each group and guided through specific areas within the catchment by a WRUA member. Results of the group work were presented at the plenary. Slide shows are attached to the report. Recommendations were gathered and reformulated in the plenary of the Summer School.

It was not the aim of the Summer School to roll out a full monitoring programme. Yet, the WRUA is encouraged to independently and regularly update their implementation plan, as they have followed the steps to carry out the monitoring and evaluation process during the Summer School of 2007. Assisting this process, the Summer School formulated recommendations for the WRUA.

4.2 Water Demand and Water Resource Allocation

Water demand assessment and water resource allocation concentrates on three areas, namely on the resources of water, the uses of water and the methodology on how to assess these. For assessment of resources, data for rainfall, runoff, groundwater and temperature or evapotranspiration are collected and analysed. Not all data are necessary to be collected from the field. Relevant administration units have a lot of regional data already collected and published. A very good resource for data is the Farm Management Handbook of Kenya as well as the District Development Plan (Imenti North).

For the use of water, normally data from supply side is analysed. This data, obtained from the water service provider MEWASS, is only available for a small part of the Ngaciuma-Kinyaritha catchment, because only part of the catchment is covered by the services of MEWASS. Therefore, statistical data on population are used to estimate an average demand. The domestic water use is divided into rural population, urban population and institutions such as schools and administrative offices.

The industrial sector in the Ngaciuma-Kinyaritha catchment is limited to the processing of agricultural products.

The agricultural sector uses water mainly for irrigation and livestock production. Water is supplied by abstractions from the rivers in the area. Rain fed irrigation is widely practised, yet is not taken into account for the water demand estimation in this study. This would require a water balance study, which would also have to include environmental water demand.

4.2.1 Methodology to Estimate Water Resources

Water resource availability was estimated in this case in stream flow, and was based on field measurements and modelling. Water flow measurements were computed from water levels and constructed rating curves of the two main streams (Ngaciuma and Kinyaritha) draining into the sub-catchment. Two staff gauges were installed at two sub sub-catchments (Kinyaritha minor, and Ngaciuma) and one at the sub-catchment outlet (Kinyaritha main), and were monitored twice a day; at 9.00am in the morning, and at 3.00pm in the evening (Figure 4.1). Gauge height data from Kinyaritha main and minor were collected from November 1st 2007 to October 31st 2008, and Ngaciuma data were collected from October 1st 2007 to October 31st 2008 (Figure 4.1). Rating curves of the different streams were constructed using water levels and discharge measurements for six days (see Annex).

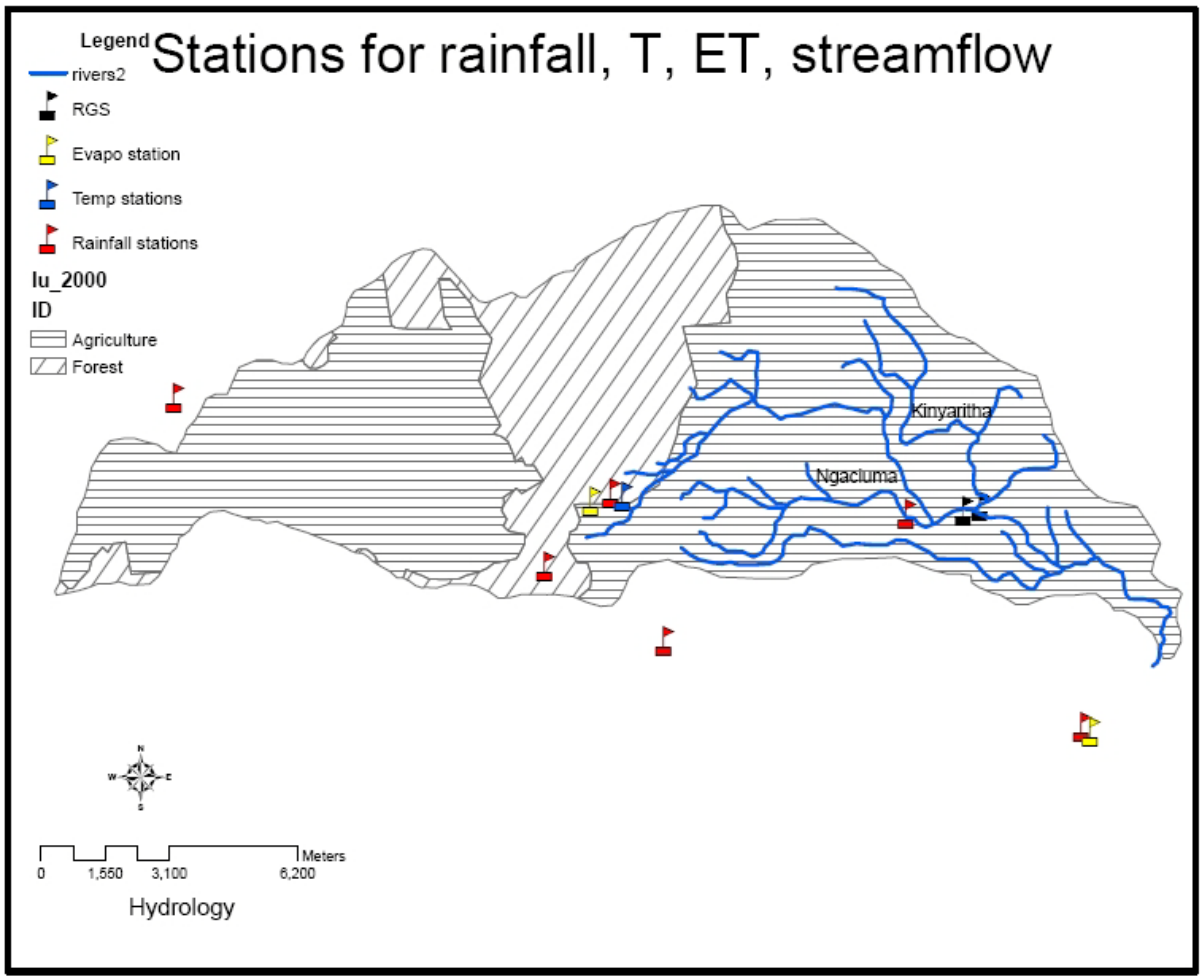


Figure 4.1. The drainage network for Ngaciuma/Kinyaritha catchments (Authors, 2008)

Stream flow parameters were determined by fitting the measured flow to the curve of the form $Q = A*H^b$. Estimation of coefficients A and b enable to predict daily gauge heights and flows (Figures 4.2 and 4.3). Kinyaritha main stream flow data could not fit the above mentioned curve, because of the very weak correlation coefficient between stream flow and gauge height. This information was discarded from the analysis.

Daily flows were aggregated into monthly flows and annual flow was computed as the sum of the monthly flows (November 2007 to October 2008). (see figures below).

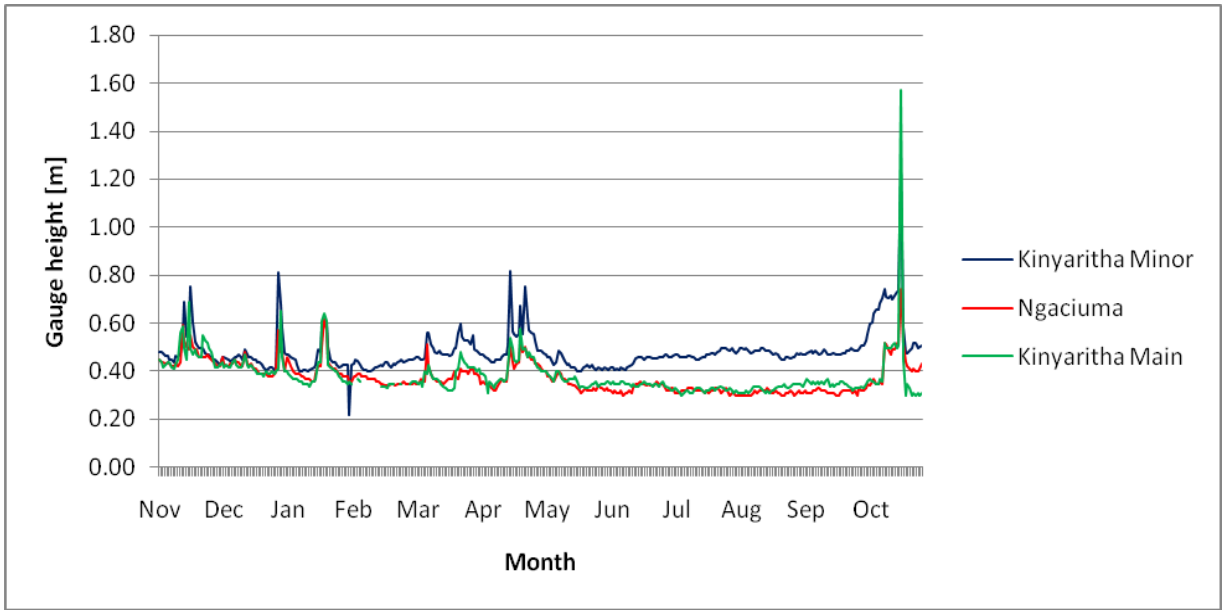


Figure 4.2: Gauge heights for Kinyaritha (main and minor) and Ngaciuma

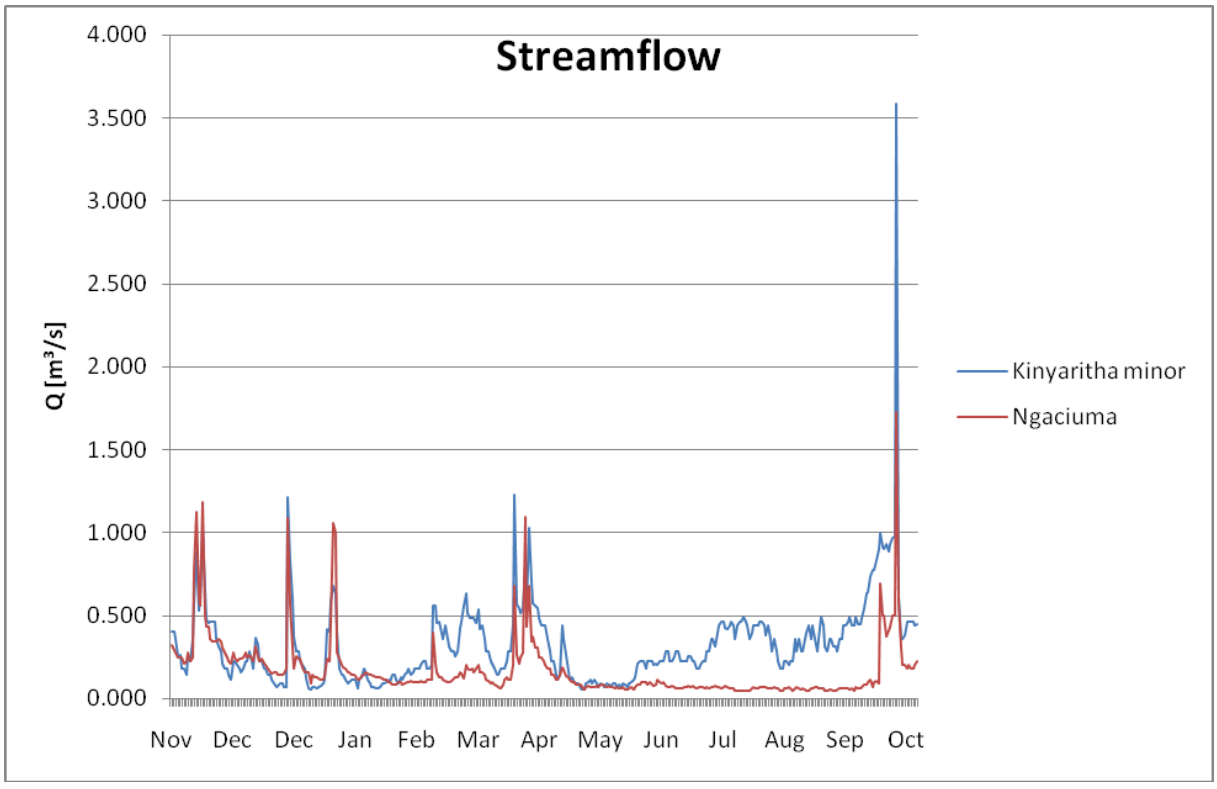


Figure 4.3: Predicted annual flow patterns for river Ngaciuma and Kinyaritha minor

4.2.2 Methodology to Estimate Water Demand

Water demand from the sub-catchment was estimated as the sum of water use for domestic use (rural and urban human consumption), agriculture (livestock and irrigation), institutions (boarding schools, day schools, hospitals, dispensary, hotels, and administrative offices) and industries (shops, bars and coffee factories).

4.2.3 Water Demand for Domestic Use

Water demand for domestic use was computed for each sub-location as the product of the total human population per sub-location and the average monthly water consumption per person. The human population per sub-location was estimated from the population census of 1999 (District Development Plan, 2008). The average monthly consumption rate per person was obtained from the Design Manual for Water Supply in Kenya (MoWI, 2005).

4.2.4 Water Demand from Institutions and industries

Water demand for institutions and industries was estimated as the sum of water consumption demand per category (boarding schools, day schools, hospitals, dispensaries, hotels, and administrative offices for institutions; and shops, bars, coffee factories for industries). Water consumption per category was determined as the product of the category consumption rate times the number of units in the category. The number of units in each category was based on secondary data collected from:

- Ministry of Education (list of primary and secondary schools and their population, and list of tertiary institutions)
- Ministry of Trade and Industrialization (list of industries and/or factories)
- Coffee Farmers Cooperative Societies (production figures)
- Bakeries (production figures)
- Meru Water Services and Sanitation (MEWASS) (Area of coverage within the catchment, and customer consumption list)

4.2.5 Water Demand from Agriculture

The water demand from agriculture was estimated as the sum of livestock and irrigation water use. Livestock and irrigated land estimations were based on secondary information and socio-economic surveys conducted in the sub-catchment. Secondary information was obtained from different local government officers, Kenya Methodist University database, reports, and scientific publications. The socio-economic survey was conducted mainly in the middle and lower sub-catchment. Six groups were formed from the participants of the third German Academic Exchange Service (DAAD) Summer School. Each group was allocated a zone within the sub-catchment for data collection. Each group comprised at least one member of the local Ngaciuma-Kinyaritha Water Resource Users Association (WRUA) and DAAD Alumni. During the survey, households were selected randomly in each allocated zone for an interview. A semi structured questionnaire was developed around key thematic areas. The information collected included:

- Total area per household
- Irrigation (area under irrigation and frequency of irrigation)
- Household size
- Number of livestock (cattle, goats and sheep) and poultry.

Irrigated area and livestock number were calculated as an average of estimates based on aggregated district and socio-economic values. To estimate livestock number and

irrigation area using aggregated district values, the following equation was used, assuming homogenous distribution of the livestock and irrigated area:

A = District value*catchment size/ District size

Where A can be number of livestock or irrigated area.

The second approach used mean values of livestock and irrigated area per household computed from the socio-economic survey to make extrapolation at sub-catchment level.

4.2.6 Estimation of Water for Livestock

Water demand for livestock was computed as the sum of water required for each category based on the requirement per unit head per category.

4.2.7 Calculation of irrigation Water Requirement

Irrigation water requirement (IWR in m^3 per month) was computed using the following equation:

$$IWR = 10*NIWR*MIA$$

Where NIWR is the net irrigation water requirement (mm/month) and MIA is the maximum irrigation area (ha) determined from the socio-economic and aggregated district data.

The net irrigation water requirement (NIWR in mm/month) is the ratio of irrigation water requirement (IWR in mm/month) and irrigation efficiency (IE) and was computed using the following formula:

$$NIWR = IWR/IE$$

It was assumed that sprinkler irrigation is the main method used in the sub-catchment; therefore an efficiency of approximately 70% was considered (FAO, 1984). The irrigation water requirement was computed as a difference between crop water requirement (ET_c) and the effective rainfall, and was set to zero when (ETc – ER) > 0. Crop water requirement is a measure of water lost from a crop surface through transpiration and evaporation. ET_c was computed as the product of the potential evapotranspiration (ET_o) and the crop coefficient K_c. In this case, K_c was fixed at 0.8.

4.3. Conflict Mapping

The relevant actors were identified through participatory conflict mapping. Under the moderation of Nele Förch, Ngakinya WRUA in cooperation with BWARUA, Kawaya WRUA and NYAWRUA were invited to describe the kind of relationships they have in the catchment with other entities. The activity consisted of mapping the relationship between the relevant actors in the catchment for watershed management and Ngakinya WRUA. Members of WRUA and WRMA were given cards of different sizes standing for the significance of the relationship between different actors. The criteria used as a basis for mapping was mainly related to their relevance to the WRUA in implementing watershed

management. After defining the actors the link between the WRUA and the respective actors was defined (e.g. strong or weak cooperation).

4.4. Data Analysis and Presentation

Collected information was entered in Microsoft Excel, processed and analysed. Spatial information was processed in ArcView GIS version 3.3. Results are presented in form of tables, graphs and maps, all of which are attached to the document as Annex.

5. RESULTS

5.1. Results from Field Assessments of the 2007 WRUA Activities

The results from the 2007 Ngakinya WRUA field visits were summarised into the following recommendations:

5.1.1 Recommendations for WRUA

- Incorporate the following recommendations and adjust the time frame, the budget and priorities to revise the Management Plan.
- Sustain awareness creation about water sector reforms and roles of different institutions such as WRMA and WRUAs.
- Create continuous awareness by:
    - Use of local radio
    - Billboards, Posters, and Leaflets
- Attend Chief's barazas
- Use religious gatherings as forum
- Use social gatherings
- Visit schools and learning institutions
- Organise charity walks
- Use forums like World Water Day, Environment Day, and so on
- Create awareness about metering
- Explain requirements by the law
- Express benefits of metering water such as equitable water distribution, waste reduction, and sense of ownership
- Encourage water harvesting and storage techniques, e.g. roof water harvesting, water conservation techniques
- Continue educating communities on the need to legalize abstractions
- Promote maintenance of hygienic watering points for people and animals
- Promote maintenance of technical installations
- Identify critical wetlands and give recommendations to WRMA on their conservation
- Encourage water users to merge their intakes and share the benefits

5.1.2 Recommendations for WRMA

- Sustain awareness creation on water sector reforms and roles of different institutions
- Continue producing Flyers for water users on water sector reforms
- Participate in Community Development Committee meetings
- Use Print and electronic media
- Participate in Public barazas
- Create awareness about metering and enforce the Water Act 2002
- Collaborate with other line ministries to conserve soil and water and rehabilitate gullies and eroded river banks
- Encourage water harvesting and storage techniques
- Collaborate with other agents on pollution control, e.g. NEMA, Municipal Council
- Consult Kenya Forestry Service (KFS) on the way forward regarding eucalyptus
- Issue notices to illegal water abstractors to legalize their water works
- Continue following up on gazettement of wetlands as public lands
- Continue awareness creation on safe use of agro-chemicals in collaboration with the Ministry of Agriculture
- Continue disseminating information on costs and availability of water meters
- Request the Ministry of Water and Irrigation to train on efficient irrigation practices
- Design and recommend appropriate sites and infrastructure for merging of intakes
- Identify a variety of farm enterprises and their economic benefits with farmers
- Liaise with KEFRI, KU, JKUAT, WAF on the topics below and update the data base

5.1.3 Recommendations for Researchers

- Conduct comparative research on water use under different irrigation methods
- Conduct research on issues relevant to water management to be packaged and disseminated to farming communities
- Focus research to the following topics: the role of eucalyptus, water demand, water balance, wetlands, conflicting laws on water management, and so on
- Map key areas, hot spots for concentrated (research) action

5.2. Estimate of Water Resources

5.2.1 Monthly Stream Flow Trends

The monthly water flow of Ngaciuma and Kinyaritha are presented in Table 5.1. The two streams have similar temporal behaviour. Stream flow decreased from November 2007 to February 2008, and increased from June 2008 to October 2008. Kinyaritha had a sharp peak in March 2008, while Ngaciuma stream flow increased from February to April before decreasing in May 2008. It is worthwhile to observe that from November 2007 to January 2008 Ngaciuma had relatively more water than Kinyaritha Minor, though the difference between the flows of the two streams was relatively small. From February 2008 to date the trend is inverted and the flow gap increased linearly with time from May to October 2008 (R^2=0.95). The increment in stream flow between Kinyaritha and Ngaciuma is 205,331 m^3/month on average from May to October 2008. However, discharge measurements for the months of July to September 2008 for both rivers were not available to validate this trend. More extensive discharge data is needed to improve the rating curve and analysis. Since there was no rain in September, the inconsistency reflected by the increase of estimated water flow of Kinyaritha could be attributed to backwater, abstraction patterns or other reasons.

Table 5.1 Computation of the mean monthly stream flow

Month	Kinyaritha minor Vol [m^3/month]	Ngaciuma Vol [m^3/month]	Kinyaritha minor Discharge [m^3/s]	Ngaciuma Discharge [m^3/s]
Nov 2007	979,599.454	1,014,511.32	0.378	0.3914
Dec 2007	647,969.719	675,420.671	0.250	0.2522
Jan 2008	516,063.162	622,013.352	0.199	0.2322
Feb 2008	303,308.258	265,567.398	0.117	0.1098
Mar 2008	986,449.623	381,621.947	0.381	0.1425
Apr 2008	113,1075.81	639,130.896	0.436	0.2466
May 2008	425,913.979	291,711.177	0.164	0.1089
Jun 2008	393,016.774	192,549.067	0.152	0.0743
Jul 2008	755,098.169	168,562.311	0.291	0.0629
Aug 2008	937,545.918	144,501.319	0.362	0.0540
Sep 2008	958,567.925	138,678.352	0.370	0.0535
Oct 2008	1,938,895.87	780,332.678	0.748	0.2913

5.2.2 Annual stream flow volume

The total stream flow volume was 5,288,105 m^3/yr. About 65% of the water is coming from Kinyaritha Minor and 35% from Ngaciuma sub sub-catchment (Figure 5.1).

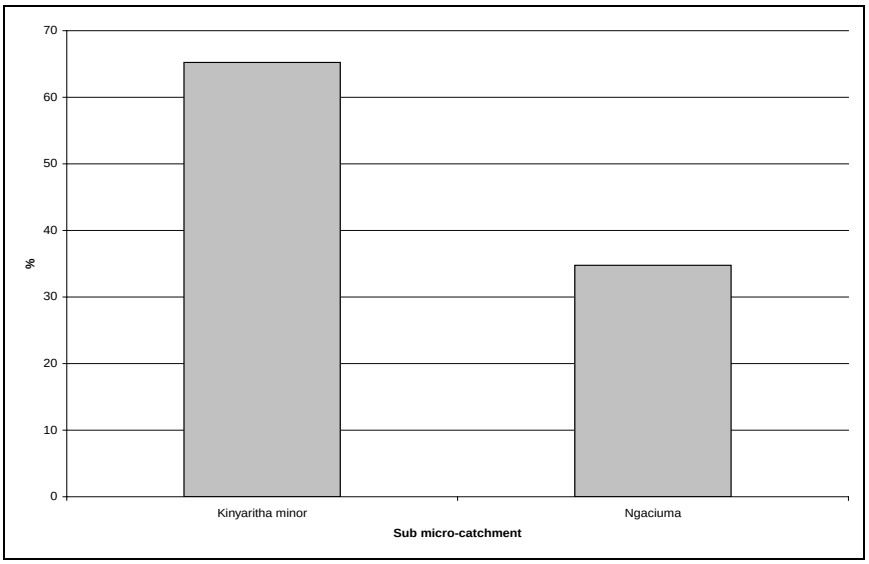


Figure 5.1: Contribution of sub sub-catchment to the stream flow.

5.3. Water Demand

5.3.1 Sub-Catchment Water Demand

The current water demand for the different uses is summarized in Table 5.2. Water for agriculture (79.4%) takes biggest share of the water demand followed by domestic use (15.8%), and the least demand is from institutions and industries.

Table 5.2: Contribution to the water demand in Kinyaritha sub-catchment

Sector	Sub-sector	Water demand (m^3/year)	Sector contribution (%)	Sub sector contribution (%)
Domestic	Rural	1180760.4		54.0
	Urban	1007308.8		46.0
	Subtotal	**2188069.2**	**15.8**	
Institutions	Primary Schools	42290.7		16.9
	Sec. Schools	63800.2		25.5
	Tertiary Institutions	127567.5		51.0
	Health Centers	16425.0		6.6
	Subtotal	**250083.4**	**1.8**	
Industries	Bakeries	29167.5		
	Coffee Factories	380521.3		92.9
	Subtotal	**409688.8**	**3.0**	
Agriculture	*Livestock*			
	Cattle	323638.6		91.1
	Goat, Sheep	31286.3		8.8
	Poultry	311.3		0.1
	Subtotal	**355236.3**	**2.6**	
	Irrigation			
	1263 ha	10651601.0		100.0
	Subtotal	**10651601.0**	**76.9**	
Demand Total		**13854679**		

As summarized in Table 5.2 above, in the agricultural sector, water use for irrigation represents 76.9% of the total water demand. 54.0% of the water for domestic is used in urban areas and only 46.0% in rural areas. In comparison to institutions, industries account for 62.1% of water demand, 92.9% of which is required by coffee factories. The tertiary institutions require 51.0% of the water demand for institutions.

5.3.2 Domestic Water Demand

The domestic water demand for different locations within the sub-catchment is presented in Table 5.3. 56.0% of the domestic water is consumed by urban areas (Municipality and Mulanthakari), with the municipality requiring 41.0% of the water.

Table 5.3: Water demand for rural and urban in Kinyaritha sub-catchment

Location	Category	Demand (m^3/month)	Demand (%)	Total
Naari	Rural	31,06	15	89,72
Chugu	Rural	26,07	13	
Munithu	Rural	19,26	9	
Thuura	Rural	8,72	4	
Giaki	Rural	4,62	2	
Municipality	Urban	82,79	41	113,32
Mulanthakari	Urban	30,53	15	
Total		203,04	100	203,04

5.3.3 Institutions and industries

Figure 5.2 shows the water demand from institutions and industries by location. Municipality (26,057 m^3/month), Chugu (19,070 m^3/month) and Mulathankari (6,750 m^3/month) are the locations requiring the bigger amount of water for institutions and industries.

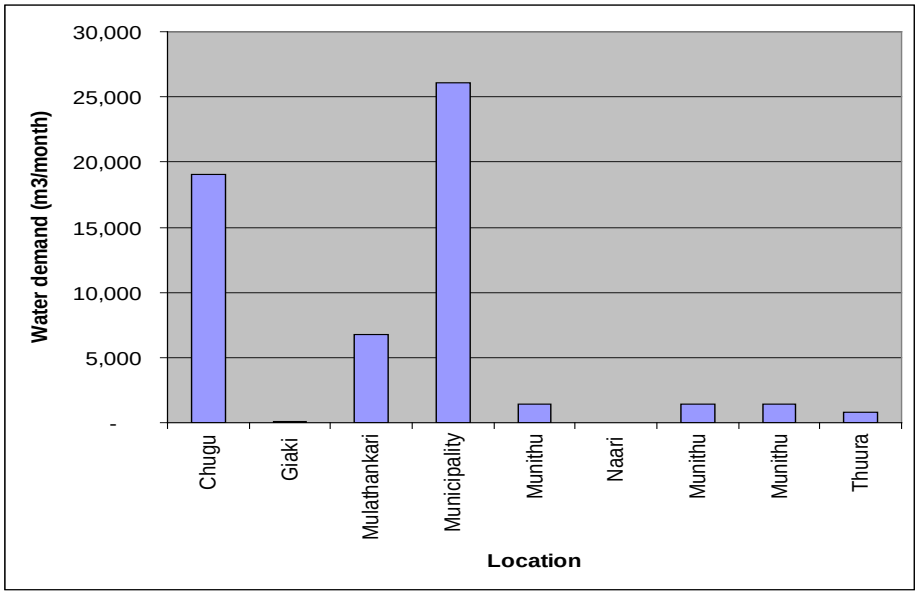


Figure 5.2: Institutions and industries monthly water demand by location

5.3.4 Water Demand for Agriculture – Livestock

The water use for livestock per location is shown in Figure 5.3. The first three leading locations for cattle in terms of water demand for livestock are Chugu (105,831.0 m³/yr), Naari (88,093.0 m³/yr) and Munithu (50,635.1 m^3/yr). For goats and sheep, Chugu (107,773.0 m^3/yr), Thuura (84,458.0 m^3/yr) and Munithu (75,136.0 m^3/yr) are the three first consumer of water; Mulanthakari (148,555.0 m^3/yr), Munithu (84,268.0 m^3/yr) lead in water demand by chicken in the sub-catchment. Globally, Chugu (268,462.0 m^3/yr) leads in terms of water demand for livestock followed by Mulanthakari (230,697.0 m^3/yr), followed by Munithu (210,039.0 m^3/yr).

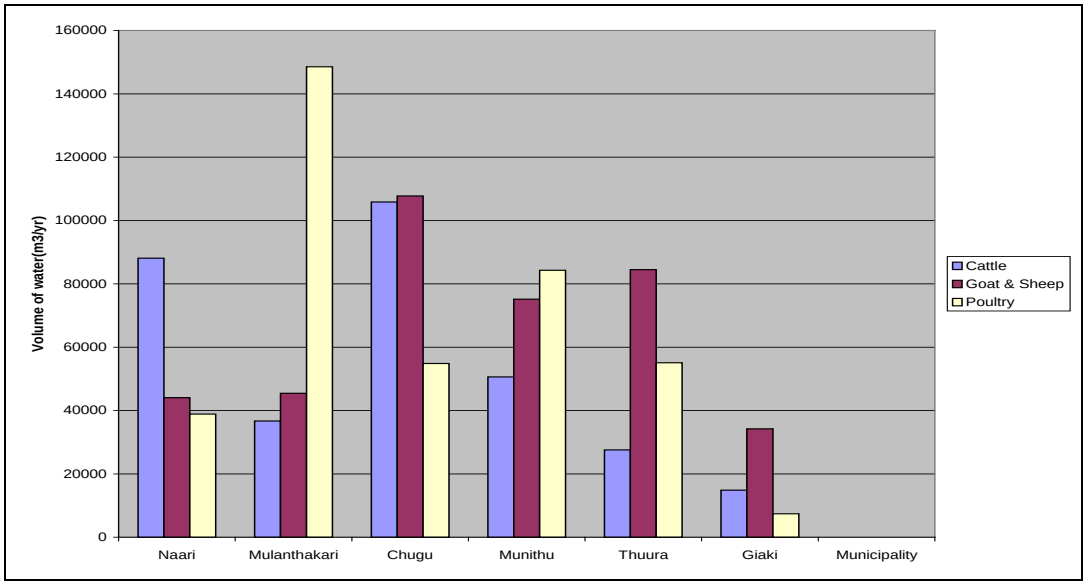


Figure 5.3: Livestock water demand by location

5.3.5 Water Demand for Agriculture – Irrigation

The amount of water demand for irrigation by location is shown in Table 5.4. Most of the water demand for irrigation is from Thuura (44%), Chugu (38%) and Minithu (15%). Mulanthakari and Naari have a small water demand of 2.5% for irrigation. There is almost no irrigation in Giaki and Municipality.

Table 5.4: Irrigated area and water demand by location

Location	Irrigated Area (ha)	Water demand (m^3/yr)
Naari	6.14	51,736
Mulanthakari	27.07	228,249
Chugu	469.05	3,954,787
Munithu	185.25	1,561,981
Thuura	540.87	4,560,407
Giaki	0.00	0
Municipality	0.00	0

5.4 Balance Between Water Demand and Available Stream Flow

5.4.1 Annual Water Balance

The amount of water available at the outlets of the Kinyaritha Minor and Ngaciuma is relatively higher than the water demand. The excess water available is 9.4% of the aggregated stream flows. It is important to observe that the measured flow was not adjusted with the volume of water currently under abstractions and enormous wastage taking place up-stream within the sub-catchment, and does not include the lower section of the sub-catchment representing about 30.0% of the total acreage. However, this figure masks seasonal and monthly disparities between water availability and demand, especially for irrigation. Assuming 30.0% abstraction upstream of the two gauging stations, the total annual volume generated by Kinyaritha Minor and Ngaciuma can be estimated at 22 million m^3. Given the availability and taking the demand into account, 31.0% of the stream flow could have been sustained in 2008.

5.4.2 Monthly Water Balance

Figure 5.4 shows the monthly balance between stream flow, water demand for irrigation, and total water demand. As expected, water availability in the sub-catchment generally exceeds the demand from March to June 2008 and from October 2007 to January 2008. This overlaps with the long and short rainy seasons. At the beginning and the end of each rainy season the total water demand equates the stream flow. The gap generally increases from June to September 2008 before decreasing in October 2008 (September as inflection month). However, during these periods there is also a high demand for irrigation. Once guaranteeing the reserve flow, the amount of water available for irrigation is limited. Best management practices suggest that only a limited area can be irrigated, without affecting other uses of water.

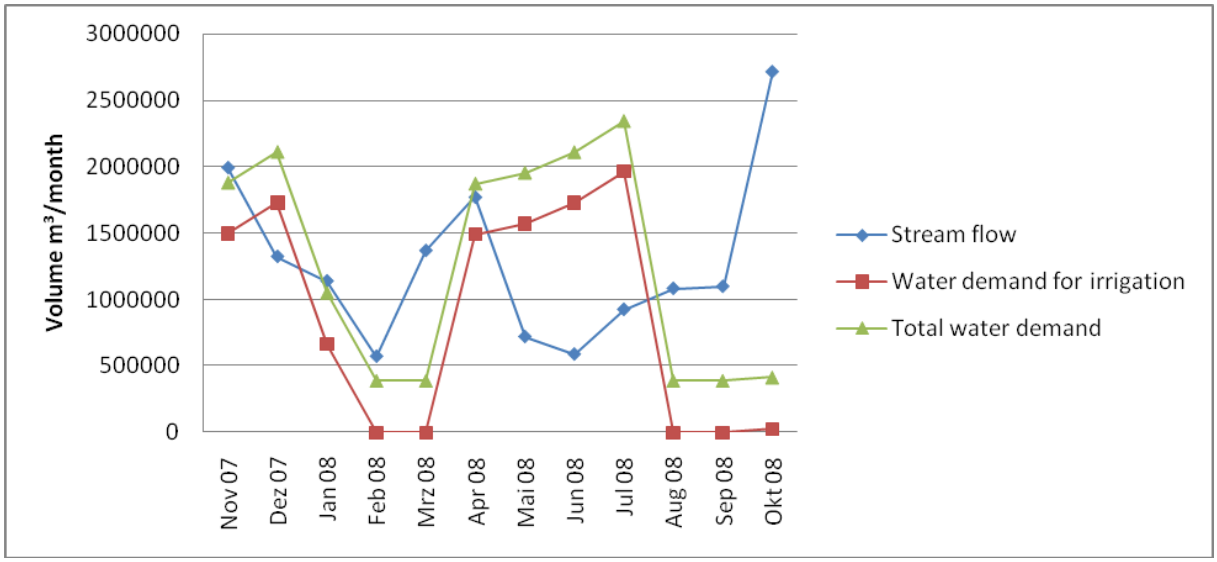


Figure 5.4: Monthly total water demand for irrigation

5.6 Summary of the Results

Given the above data, the following can be concluded:

1. There is enough water available at annual basis to meet the current annual water demand in the sub-catchment. However, there is a temporal variation in water demand that creates a negative balance between demand and supply during the dry season (January-March and June-September), when water is required for irrigation. This is a potential period for water related conflicts.
2. Water demand for irrigation accounts for about 80% of the total water demand.
3. Water is inequitably distributed among the users within the sub-catchment.
4. Water resources are inefficiently managed, as illustrated by poor irrigation practices, limited use of water harvesting methods, high level of illegal abstraction and over-abstraction, high wastage of water, and increasing soil erosion.
5. There is low level of enforcement of policy and regulations within the sub-catchment.
6. Water resource allocation has to be planned based on a more detailed database as this study can provide.

6. Revised Sub-catchment Management Plan based on Water Demand Assessment

Imbalance between the water demand and water availability (supply) during the dry season when irrigation takes place leads to water scarcity in the sub-catchment. Discussions on alternative options of reducing the water demand were conducted in the plenary, and problems which could contribute to water wastage and losses were identified. These included:

- Negative Attitude towards Water Management.
- Poor water infrastructure network
- Inadequate information for planning purposes.
- Conflicts in Water distribution (Some take for Irrigation, Some for domestic use).
- Illegal over-abstraction of water.
- Prohibitive Metering cost.
- Lake of control of water flow.
- Catchment Degradation.
- Inadequate Manpower for enforcement.
- Seasonal variability of water supply and Demand.

Critical Issues were identified and included inefficiency of irrigation methods, lack of awareness, inequitable distribution and use of water within the sub-catchment. Based on the findings of the comparison of Water resource allocation and the demand assessment, the Sub-catchment management plan for Ngaciuma-Kinyaritha has been revised. Improvements concentrated on three areas: awareness creation, efficient water use and equitable water allocation.

This chapter includes a revised version of the Sub-Catchment management Plan, which replaces the version from 2007. The three zones within the catchment are merged to improve the transparency of the plan. Some interventions were merged, esp.the activities concerning irrigation. All activities concerning awareness creation are now bundled within the first intervention, before there were scattered under different interventions. With these changes, plan is now easier to read and understand.

Major Challnges identified in Ngaciuma-Kinyaritha are as Follows:

1. Lack of Awareness on Water Sector Reform
2. Illegal abstraction /over abstraction
3. Encroachment of the Wetland/Springs and Rivers
4. Water Use Conflicts
5. Water Pollution
6. Human-Wildlife Conflict
7. Erosion of Riverbanks and Roadsides
8. Deforestation
9. Limited Access to Water
10. Inefficient Irrigation System
11. Increasing Eucalyptus acreage
12. River Bank Cultivation / Clearing
13. Soil Erosion
14. Gully Erosion
15. Dependancy on one Stream
16. Water Wastage
17. Lack of Fire Wood
18. Forest Destruction

Sub-Catchment Management Plan

All Zones

No	Intervention	Sub-No	Activities	Indicators	Time Frame	Means of Verification	Responsibility (Actors)	Assumptions
1. Lack of Awareness on the Water Sector Reform	– Create Awareness on Water Demand – Awareness creation on irrigation efficiency – Awareness creation on equitable distribution – Awareness creation on Water resource management – Awareness creation on Seasonal	1.1	– Conducting workshop	– Two workshop for 50 stakeholders each conducted	By Aug. 2009	– List of participants – Report on workshop	– WRUA and facilitated by WRMA	– Assistance by WRMA – Community is willing to participate
		1.2	– Inform the public through chief barazas	– Present WRUA activities in one chief baraza per month	By Aug. 2009	– Records from the chief – WRUA report verified by the chief	– WRUA – Provincial Administration	– Provincial Administration is willing to cooperate with WRUA
		1.3	– Prepare Posters for WRUA activities	– One master poster developed and printed	By Feb. 2009	– Site Visit – Poster showing WRUA activities	– WRUA – WRMA – Public works	– Permission from public works – Funds are available
		1.4	– Information distribution through school parents day meetings	– Three WRUA presentations during school parents day meetings	By Aug. 2009	– Parents teacher's associations report	– WRUA – Head teachers	– Teachers are cooperating

	Variability – Monitoring of Awareness creation Awareness is seen as a ongoing process. Above themes will rotate from session to session. Note : A list of topics for above themes is attached to the plan	1.5	– Information dissemination through churches, mosques and related institutions as well as social gatherings	– Perception of WRUA increased	Every week	– List of receipients	– WRUA	– Funds are available – Cooperation of institutions
		1.6	– Information distribution through local media (Muga FM)	– Information materials developed	June 2009	– Radio broadcasts programme once a week	– WRUA committee members	– Committee members will cooperate
		1.7	– Information sharing through Meru Agricultural Show	– One presentation of WRUA activities in Meru Agriculture – Show	By June 2009	– Photographs – Certificate of participation – Letter requesting participation – Display of map	– WRUA – WRMA – ASK	– Funds are available – Cooperation by WRMA and ASK
		1.8	– Prepare a Video/DVD documentary on WRM	– One documentary developed	By Nov 2009	– DVD	– WRUA – WRMA – DAAD Alumni	– Funds are available –
		1.9	– Capacity building of WRUA committee members on finance, proposal writing and data collection	– One training workshop conducted for 25 participants	By Dec. 2009	– Certificates – Report from workshop by participants – Workshop proceedings	– WRUA – WRMA	– Funds are available

2. Illegal Abstraction / Over-Abstraction	– Assistance in Enforcement of the Law	2.1	– Identify unregistered water abstractions and over-abstractions	– Reduced number of illegal abstraction by 30%	By Aug. 2009	– Permits issued – WRUA report	– WRMA – WRUA	– Co-operation by the community
		2.2	– Merging of individual pipelines (new)	– 50% of individual pipelines merged and metered	By Nov 2009	– Water permits – WRUA report	– WRMA – WRUA	– Cooperation by members
		2.3	– Encourage group projects for better management of the resources	– 10 water projects registered	By Nov 2009	– Permits issued	– WRUA – WRMA	– Community co-operation – No conflicts of interest
		2.4	– Exposure visit to the catchment during the dry season	– Two inter-zonal exposure visits of 25 WRUA members conducted	By Nov 2009	– Documentation of the visit	– WRUA	– Funds available – Community cooperation
3. Encroachment of Wetlands, Springs	– Rehabilitation and sustainable utilisation of the wetlands	3.1	– Promote alternative farming methods outside the wetlands, e.g. agroforestry, zero-grazing, bee-keeping	– 10% of land owners consent on the sustainable use on the wetlands – 5 farmers have left the wetlands	By Aug. 2009	– Site visits – Interviews with the community	– WRUA – WRMA	– Land owners are willing to change – Technical expertise available

		3.2	– WRUA recommends for reclamation of wetlands and compensation of land owners	– 2 Reports on recommen-dation for two sites received by WRMA	By Aug. 2009	– WRMA Files – **Done but no reclamation**	– WRUA committee members	– WRUA has the means
		3.3	– Live fencing of wetlands	– 1 wetland live fenced	By Aug. 2009	– Site visits – Photographs	– WRUA – WRMA	– Funds are available – Stakeholder co-operation
4. Water Use Conflicts	– Establish and implement procedures for water conflict resolution	4.1	– Carry out an inventory of all abstractions	– One abstraction report with users compiled	By June 2009	– Report of names of community members and permits	– WRUA – WRMA – Local administratio n	– Funds available – Cooperation from abstractors
		4.2	– Develop allocation plans for water use	– One allocation plan developed for water use	By Nov 2009	– Report and plan showing the allocation for all water users – Points of water use conflict identified on plan – Report of meeting for plan making	– WRUA – WRMA – Abstractors – Local administra-tors	– Funds available – Cooperation of all stakehol-ders

		4.3	– Implementation of allocation plans	– Reduced numbers of reported complaints at WRUA and WRMA	By Aug 2009	– Site visits to area with master meters – Reports from WRUA/ WRMA	– WRUA – WRMA – Abstractors	– Cooperation from abstractors – Funds available
5. Water Pollution	– Enhance water quality in the water sources and prevent water pollution	5.1	– Establish waste bins at market centres and identify a dumping site for burning and composting	– Five waste bins at Kauthene market centre established and one dumping site is operational	By Aug. 2009	– Site visit – Report from market committee	– WRUA – Local Authority – Market committee – NEMA – Public Health	– Cooperation from the local authority and NEMA – Funds available
6. Human-wildlife	– Enhancing management of human-wildlife conflicts	6.1	– Strengthening the partnership of KWS with community (fence committee)	– Number of incidences when ele-phants come out of the forest are reduced by 50%	By Augt 2009	– Records from WRUA, fence committee and KWS	– WRUA – KWS – Fence committee	– Cooperation
7. Erosion of Riverbanks and Roadsides	– Riverbank protection and Roadside protection	7.1	– Establish demonstration sites for river bank protections	– Two demonstration sites established – One group of 20 non-committee members visited the demonstration plots –	By Dec. 2009	– Site visits – Photographs	– WRUA – WRMA – NEMA – MoA	– Funds available

		7.2	– Delineation of the riparian land	– 5 km along the rivers are delineated	By Aug. 2009	– Site visit and report	– WRUA – WRMA	– Co-operation of land owners
		7.3	– Promote regeneration of vegetative cover along the river bank	– 1 km river bank is covered by water-friendly vegetation	By Aug. 2009	– Site visit and report	– WRUA – WRMA – Forest Dept.	– Co-operation of land owners
		7.4	– Report to Roads Department to construct adapted measures along the road	– 2 reports submitted to the Roads Department	By March 2009	– Report – Site visit	– WRUA – Roads Dept.	– Co-operation by Roads Dept.
8. Deforestation	– Promotion of appropriate management of forest and tree resources in the zone	8.1	– Strengthen partnership between Community Forestry Association (CFA) and WRUA	– MoU/MoA signed between WRUA and CFA on conservation of forest and water resources	By Aug. 2009	– MoU/MoA between partners	– WRUA – KFS – CFA – WRMA	– Cooperation
9. Inefficient Irrigation Systems	– Efficient Utilisation of Water	9.1	– Enforce permit conditions (promote use of water meters)	– Installation of 10 water meters on major water abstractors	By Nov 2009	– Inspection reports – Site visit	– WRUA – WRMA	– Cooperation of project owners to install meters
		9.2	– Facilitate meetings on better irrigation methods like overhead and drip irrigation	– 2 training meetings held on model farms	By Nov 2009	– Minutes of the meetings – Improved water use	– WRMA – MWI – DAO – WRUA	– Other stake-holders co-operate

		9.3	– Promote usage of standard pipes	30% pipes networks standardised	By Nov 2009	–	– WRMA	–
10. Increasing Eucalyptus Coverage	– Reduction of eucalyptus coverage and increase of economic and water friendly trees acreage	10.1	– Establish water friendly and income generating tree nurseries	– Five nurseries established on private farms	By Aug. 2009	– Financial reports of the number of trees sold in the nurseries	– WRUA – Farmers – CFA	– Willingness of farmers – Funds are available
		10.2	– Encourage partnership with CFA	– Co-opt CFA committee member in WRUA meetings	By Aug. 2009	– Minutes of WRUA meetings	– WRUA – CFA	– Cooperation
11. Riverbank cultivation/clearing	– Sensitize/ create awareness on riverbank conservation – Establish riparian land boundary – Establish inventory of riparian land owners – Protect and restore the riparian zone (e.g. vegetation)	11.1	– Planning for inventory exercise	– Two stakeholders' meetings to decide on inventory methods	Oct. to Dec. 2009	– List of participants – Report of the meetings	– WRUA – WRMA	– WRMA will facilitate and coordinate stakeholders
		11.2	– Identification of riparian land owners and existing riverbank conditions	– One field assessment along riverbanks conducted	By Aug. 2009	– List of riparian land owners – Report on the status of the riverbank – Site visit	– WRUA – WRMA	WRMA will facilitate and coordinate stakeholders
		11.3	– Delineate the extent of riparian area as per water act	– 5 kilometres length of the river delineated	By Aug. 2009	– Existence of blue pegs along the riverbank	– WRUA – WRMA	WRMA will facilitate and coordinate stakeholders
		11.4	– Characterize the vegetation along the	– 5 kilometres length of the riverbank	By Aug. 2009	– List of water friendly and unfriendly trees and other vegetation	– WRUA – WRMA	– KFS will backstop and coordinate the

			riverbank	vegetation identified and classified into water friendly and unfriendly		along the riverbank	– KFS – Riparian land owners	exercise – Cooperation of the land owners
		11.5	– Regulate agricultural activities along the riverbank	– 5 kilometres length of the riverbank vegetation cover regenerated	By Aug. 2009	– Site visit	– WRUA – WRMA – KFS	– KFS will backstop and coordinate the exercise
		11.6	– Promotion of water friendly trees	– One tree nursery of water friendly tree species established	By Aug. 2009	– Site visit and documentation	– WRUA – WRMA – KFS – KEFRI	– KFS will backstop and coordinate the exercise
12. Soil Erosion	– Promote soil conservation on steep slopes	12.1	– Enforcing the Agricultural Act concerning cultivation on steep slopes	– 10% of the affected farmers comply	By Aug. 2009	– Site visits – Report from MoA	– WRUA – MoA – WRMA – NEMA	– Cooperation – Funds are available
		12.2	– Identifying endangered sites and report to WRMA	– One written report by WRUA to WRMA	By Aug. 2009	– Report from WRUA	– WRUA – WRMA	– Willingness of WRUA
13. Gully Erosion	– Establish gully control and rehabilitation	13.1	– Capacity building on methods of gully erosion control and rehabilitation	– One demonstration site for control and rehabilitation of gully erosion established at	By March 2009	– Site visit – List of participants in the demonstration activities	– WRUA – Ministry of Agriculture – WRMA – KFS – NEMA	– Ministry of Agriculture will facilitate and coordinate stakeholders

			– Rehabilitate gully at Mukundu	Mukundu			– Public works	
14. Dependence on One Stream (Lower Zone)	– Regulate water activities and explore alternative sources of water	14.1	– Analysis of extent of abstraction	– One inventory of all abstractors conducted	By Aug. 2009	– Record of abstractors	– WRUA – WRMA – Provincial administratio n	– People will cooperate
		14.2	– Enforcement of permits conditions	– 50% water abstractors have applied for permit	By Aug. 2009	– Application records	– WRUA – WRMA	– People will cooperate
		14.3	– Promote rainwater harvesting	– 5 roof catchments established at private households and schools	By Nov. 2009	– Site visit – Roof catchments established **Ongoing in 3 schools**	– WRUA – WRMA – Ministry of Education	– People will cooperate
		14.4	– Promote roadside water harvesting	– 5 roadside water harvesting ditches established	By Aug. 2009	– Site visit – Ditches established	– WRUA – WRMA – Ministry of Roads and Public works	– People will cooperate
		14.5	– Promote exploitation of ground water	– One borehole/ well to be sunk	By Aug. 2009	– Authorization documents – Borehole/ well sunk	– WRUA – WRMA – NEMA	– Ground Water is conducive for domestic and agricultural use

15. Water Wastage	– Promote efficient distribution and use of water	15.1	– Enforce permit conditions (promote use of water meters)	– Installation of 10 water meters on major water abstractors	By Aug 2009	– Inspection reports – Site visit	– WRMA – WRUA	– Cooperation of project owners to install meters
		15.2	– Carry out an inventory of all abstractions	One abstraction report with users compiled	By Dec. 2009	– Report of names of community members and permits	– WRUA – WRMA – Local administratio n	– Funds available – Co-operation from abstractors
16. Lack of Firewood (Upper Zone)	– Alternative energy saving technologies for cooking and heating in households promoted	16.1	– Encourage alternative energy saving sources for solar water heating and improved cooking stoves	– Three private homes have adopted energy saving alternatives	**By Aug. 2009 3 are using ongoi ng**	– Site visits and interview with the community members	– WRUA – WRMA	– Cooperation and willingness of community
		16.2	– Encourage households to use biogas (Ecosan)	– Ecosan project started in school	By Aug. 2010	– Site visit	– WRUA – WRMA/GTZ	– Cooperation and willingness of the community – Funds available
17. Forest Destruction	– Appropriate management of forest and tree resources in the zone are	17.1	– Encourage agroforestry (fodder, trees)	– Three private farms establish improved form of agroforestry on their land	By August 2009	– Site visits to the three farms – Photographs of before and after scenario – **Awareness there but not through WRUA**	– WRUA – MoA – Local Administratio n	– Cooperation

	promoted						– WRMA – KFS	
		17.2	– Strengthen partnership between Community Forestry Association (CFA) and WRUA	– MoU/MoA signed between WRUA and CFA on conservation of forest and water resources	By Aug. 2009	– MoU/MoA between partners	– WRUA – KFS – CFA – WRMA	– Cooperation

List of ranked subjects for awareness creation

1. Illegal abstraction / over-abstraction
2. Gender Equity
3. Encroachment of wetlands
4. Metering, maintenance of pipe lines, for efficient water use
5. Need for water allocation and planning
6. River bank protection and conservation
7. Water sector reforms
8. Impact of eucalyptus on water resources
9. WRUA activities (to inform people)
10. Soil and water conservation and gully rehabilitation
11. Appropriate farming practices including irrigation techniques
12. Sustainable use of wetlands
13. Importance of forests in water resource management
14. Composting, solid waste disposal and positioning of pit latrines
15. Safe use of agrochemicals

7. Water Fees as a Tool for Water Regulation

As the introduction of fees and charges is a major issue for WRUA and WRMA, the Summer school stared a intense discussion on above topic and came to following results.

- There is need to create an environment that enhances the acceptance of rules and regulations in connection with the metering and the fees.
- Awareness creation on permits, metering and fees should focus on the community's benefit. The community should be able to appreciate the advantages associated with these water regulation interventions in order to increase acceptance.
- Charges should constitute the cost factor in profit margin calculations (i.e. in order to influence the choice of crop type, production method, increased efficiency) in order to have a higher profit through "more crops per drop".
- Uncoordinated use of efficient irrigation systems on individual irrigation schemes could widen the gap between up-stream and down-stream users.
- The value of any good in the market is not its true value; instead it is defined by its management costs, etc. The understanding should be that fees are used in order to manage the water up to the end tap. This means that it will be managed rationally for the benefit of all users.
- Water metering is helpful in managing equitable supply in order to avoid conflicts; metering guarantees that everyone gets their fair share of water.
- In case of scarcity, water metering will help in ensuring equitable supply through controlled rationing.
- The fee should also be used for catchment management and conservation in order to guarantee the sustainability of the resource – the community needs to see a visible benefit in the payment of water fees.

8. Optimising DAAD Alumni Collaboration

Coming to the end of this summer school – the last out of a series of three, Alumni participants were asked to formulate their ideas about its conceptualisation.

In general the summer schools were seen as unique and very successful.

First of all it enabled the reconciliation of theory and practise, the exchange of ideas and the establishment of informal networks. On the one hand it enhanced the visibility and relevance of universities on the ground by bringing the researcher close to the community to find solutions to existing problems. On the other hand it enabled researchers to interact directly with communities and enhanced their understanding of local contexts. While the scholars helped to build the capacity of the local community, the local community facilitated a realistic framework for the implementation of often too abstract theories. All Alumni recognised the relevance of community knowledge and participation in finding sustainable solutions.

While the strength of identifying issues to be addressed lay with the Alumni, finding actual solutions has proved much more complex. Creating visible change and providing sustainable solutions is a long term process. Moreover there is an urgent need for creating follow-up mechanisms, such as continuous linkages between universities and the communities. For instance, students of respective universities could conduct their research within the communities and share their results – as has already been done by Kenyatta University.

Although the diversity of participants often presented a challenge in communication, understanding and cooperation, it encouraged participants to open up towards other perspectives of given 'realities'. Hence, this aspect is seen as one of the two central aspects of effectively implementing summer schools in future - the second being the need for greater influence of results on policy formulation and change (i.e. through policy briefs).

Moreover, the creation of innovation platforms, including all relevant stakeholders (i.e. politicians, opinion leaders, prominent alumni, researchers, the community), was seen as a creative way to guarantee a greater outreach and impact.

A general consensus existed on the continuation of the summer school concept as it is. In addition expert seminars were suggested to complement summer schools for sharing experiences and exchanging knowledge. In order to guarantee a greater outreach and facilitate diverse outlooks on addressed issues, a rotation of summer schools and expert seminars within the region was recommended.

Last but not least, collected materials and generated documentation should always be shared with the community, decision makers and the broader public.

It was recommended that Makerere University takes the lead in organising the next series of summer schools in the region, that will take place in Uganda. The coordinating team will exist of Joy Obando, Chris Shisanya and Mwangi Gathenya from Kenya; Majaliwa Mwanjalolo and Nicholas Tiyebwa from Uganda; and Richard Kimwaga and John Mangana from Tanzania.

9. Water Conflict Mapping

The stakeholder relations within the Ngakinya-Kinyaritha Catchment are reflected in figure 9.1. The figure not only illustrates relationships and degrees of cooperation between actors, but also offers an excellent tool for identifying entry-points for intervention.

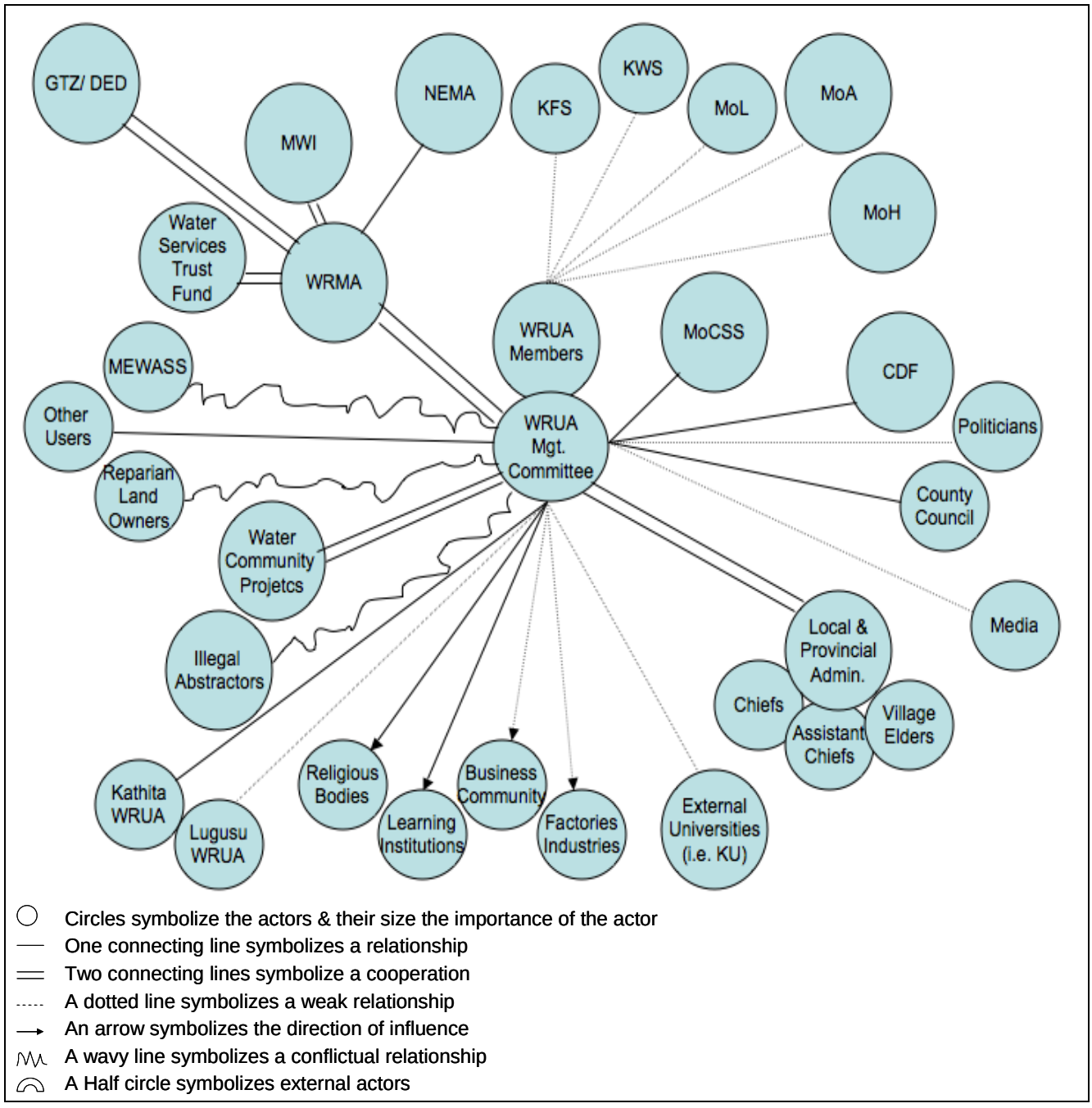


Figure 9.1: Water Stakeholder Relationships in the Ngaciuma-Kinyaritha Catchment

First, it is relevant to mention that the WRUA committee and the members are seen as two separate entities, yet closely cooperate and remain part of the same organisation. A strong cooperation exists between the WRUA and WRMA, the local and provincial administration as well as the Community Water Projects – the most relevant actors for

water resources management within the catchment. Although no direct link is emphasized between the WRUA and the MWI, the Water Trust Fund and external donors, their importance is recognized. Other external actors include the two WRUAs (i.e. Kathita and Lugusu) from two neighboring catchments. They are seen as crucial in facilitating sustainable watershed management, as several water suppliers from the Ngaciuma-Kinyaritha Catchment (e.g. MEWASS) get water from those catchments. Although there is a relationship between Kathita WRUA no contact has been established with the Lugusu WRUA – a relevant next step to take.

During the discussion, most emphasis was given to the weak and conflictual relationships, as they are seen as the major entry points for activities. Weak relationships are highlighted between the WRUA and other relevant ministries, e.g. MoL, MoA, KFS, KWS, and NEMA. All participants recognized their relevance for implementing the activity plan of the WRUA, yet WRMA is seen as the link between them and should establish initial contact.

Further weak relations exist between the WRUA and the private sector, whereas the WRUA wants to strengthen this link in order to efficiently manage water demand as well as pollution. Moreover, the WRUA is keen on strengthening relations with Kenyatta University as some of their students are conducting research within the sub-catchment whose data is seen as relevant. The media is also mentioned as an important medium for dissemination of information and as such an important tool in awareness creation. Finally, a weak relationship is indicated with the local politicians – whereas this excludes the county council and the CDF. Although the WRUA is reluctant in working with politicians, they realize that they are key in influencing public opinion.

Conflictual relationships exist between the WRUA and riparian land-owners, particularly illegal abstractors, absentee land owners and MEWASS, the major water supplier within the sub-catchment. The main conflict within the catchment arises between the WRUA and illegal abstractors, who refuse to accept the water reforms (i.e. new rules and regulations) and continue to abstract water without acquiring permits and in unreasonable quantities wasting a lot of water. Secondly, the main issues regarding the riparian land-owners include the conservation of riverbanks, pollution and land degradation. Difficulties in addressing these issues arise from conflicting policies (e.g. how far from the river you are allowed to cultivate) and the absence of land-owners who can be held responsible. Third, MEWASS is seen as disregarding Ngakinya-Ngaciuma water projects. As MEWASS is a member of the Kathita WRUA, the link with the Ngakinya WRUA is seen as irrelevant and which in turn is negatively perceived by the community.

The above analysis was used as a basis for rethinking priorities set by the WRUA as well as helped the WRUA to identify crucial actors in supporting their activities. Priority is given to addressing issues related to conflictual relationships, whereas special emphasis is given to illegal abstraction. This is partly due to the fact that MEWASS does not fall under their jurisdiction and does not present a direct menace to the water resource as such. Moreover, the riparian land-owners cannot be directly accessed. However, a consensus exists that illegal abstraction is the most pressing issue to be addressed, as it generates other conflicts within the catchment. Moreover, the WRUA recognized the necessity to strengthen their cooperation with actors such as the above outlined ministries in implementing their catchment management plan.