

## Wetland transformation through Water Resource Users Association; The case of Rwamuthambi Sub Catchment area, Kenya

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### Abstract

Many studies conducted in Kenya regarding water resource governance have focused on the mandate of Water Resource Users Associations (WRUAs) with less attention being accorded to their effectiveness in conservation of wetlands. This study assessed the effectiveness of WRUA committees, and challenges faced in conservation of Rwamuthambi Sub-catchment. The study employed exploratory descriptive research design. Data was collected through questionnaires, semi-structured interviews, observations and review of secondary data. Chi square and descriptive statistics was used to analyze the data. The survey results revealed that only 15% of WRUA committee understood water resources management while 35% were aware of relevant legislations. Factors of wetland degradation showed significant association with existence of WRUA ( $\chi^2(4, N=180) = 20.46, p < .01$ ) where ( $\chi^2$ - chi square (degrees of freedom, N = sample size) = chi-square statistic value, p = p value), although WRUA contributions were perceived differently per agro-ecological zone ( $\chi^2(8, N=147) = 15.51, p > .05$ ). Challenges unearthed were inadequate financial and human resources, lack of understanding, ineffective collaborative governance, poor support from county government and private ownership of riparian land reserve. There is need for WRUAs to embrace collaborative governance for effective conservation of wetlands. Integration of sub catchment management plan with county land use plans and policy review is also required.

Key words : Collaborative governance, Degradation, Integration, Non-revenue water, Private land, Rehabilitation

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## 1. INTRODUCTION

The quality of water is highly associated with the character of a catchment area conditioned on inter alia land uses and the climate (Sidoruk and Skwierawski 2006). Globally, sub catchments have a potential to provide a variety of benefits to society including supporting major livelihood activities and economic sectors such as food–energy–water security which contribute in poverty alleviation. These benefits are however dependent on the health of the sub catchment. Sub catchments health is influenced by its condition based upon several factors that include size, hydrology and land and animal species diversity (Cobbaert et al., 2011), catchments processes and their management (Parker and Oates 2016). In spite of their importance, health of wetland ecosystems is drastically getting worse due to deterioration of environmental quality, decrease in biotic diversity, loss of habitats and over–harvesting of wetland resources (Gokce, 2018; Lao 2013; Chapungu, 2013; Kingsford, 2011; Dudgeon et al., 2006). River degradation ranks highest amongst all other world ecosystems (Millennium ecosystem assessment, 2005) causing a toll on biodiversity (Vořrořsmarty et al., 2000) and communities that depend on them (Lemly et al., 2002)

Sub catchment degradation is attributed to natural limitations of availability of freshwater which include effects from natural and biological processes (Khatri and Tyagi 2014), inadequate financing and inappropriate technologies leading to excessive abstraction, pollution from industries and agricultural activities (Loucks and van Beek 2017). However, recent studies have associated failures in water governance with water crisis across both developed and developing countries (Pahl–Wostl & Kranz 2010; UNDP 2004). Kenya in particular has experienced mismanagement of water resources and wanton destruction of catchment areas besides universal challenges including inadequate water, poor water quality, increase in population and climate change (NLUP 2017).

Kenya managed its water resources under Water Act Cap 372 for 28 years (1974–2002). The act centralized all water resource management operations and depicted a top–down approach where the stakeholders were not involved (Richardson, 1996). This legislation emphasized on water services to the expense of water resources management. Its review in 2002 separated service provision and water resources management, and decentralized water sector operations. According to Beyene and Luwesi (2018), the desired outcome of the separation of policy and regulation from service provision and water resources management was to improve the mechanisms of accountability and transparency in the water and sanitation services and resources management subsectors.

The new act also classified all wetlands in Kenya regardless

of their sizes and assigned each of them to a particular sub catchment area. It also established Water Resource Users Associations (WRUAs) through Water Resource Management Authority (WRMA) amongst other supporting institutions (Yerian et al. 2014; Baldwin et al. 2015) in order to foster public participation in the water resources affairs (K’akumu et al., 2016; McCord et al., 2017; GOK, 2002). A WRUA consists of water resource users, land owners abutting the riparian reserve, government and non– state actors who share a common water resource such as a sub catchment and elected committee members from within the sub catchment area (Dipeshi 2016) and are mandated to provide services and interact directly with water users and consumers. The committee recommend applications for water abstraction, ensure cleaner and reliable water supply, work with community to promote integrated water resource management, resolve disputes among water users, and provide storage facilities like water tanks construction of water pans. WRUAs are also expected to provide linkage between the community and regulatory arms that dwelt on policy and customer care.

Management of water resources got more impetus in 2007 when Kenya prepared Vision 2030 plan, which was anchored on political, economic and social pillars. The plan placed water as key requirement that will enable the country to achieve industrialization and urbanization through universal access to water. This was in harmony with UN’s 2030 sustainable development goals (SDGs) (Chepyegon and Kamiya 2018). The role of water resources management and governance was further emphasized in the Constitution of Kenya promulgated in 2010, (GOK, 2010) which provided for access to water as a basic human right. In order for Kenya to achieve the anticipated development agenda envisaged in vision 2030, there was need to face the water resource governance and management challenges (Kibuika and Wanyoike 2012).

This paper is premised on the collaborative governance theory which according to Tomo et al. (2018) was intended for policy implementation between private and public actors so as to formulate new ideas to deal with obstacles that occur to both private and public administrations. The theory emphasizes on efficiency independent of hierarchical structure (Sun, 2017) and stresses on government to consider multi–agencies (Lan, 2015) including social entity which incorporates collaborative mechanisms of operation geared towards achieving a common public purpose (Sun 2017; Emerson et al., 2012).

Drawing from the theory’s ability to provide solutions through negotiations and joint implementation of policies (Cooper et al., 2006), the study views WRUA as the fulcrum that provides the leadership and forum through which support is experienced by identification of the policy problems and their solutions. Ansell & Gash (2008) stressed that for effective collaborative

governance, there has to be forum leadership and support. Corroborating with Ansell (2012) the best approach to dig about stakeholder satisfaction and understanding of procedures would be for WRUA to foster negotiations of regulations in order to assist stakeholders arrive to a consensus towards the sub catchment transformation.

Integrated Water Resource Management (IWRM) combined with public participation was the foundation of sub catchment management upon which WRUAs were formed (Richards and Syallow, 2018). Rwamuthambi sub catchment WRUA was still at its formative stages having operated without registration for more than 15 years until its official registration in 2017. Even though WRUA had prepared a management plan in 2015, the basin was still facing challenges of degradation, population increase (GOK, 2019) leading to water shortage during dry spells and flooding (Mati et al., 2008), land tenure system and poor collaboration amongst relevant grass root institutions (RSCMP, 2015). Therefore, the study investigated efficiency and challenges faced by WRUA in the process of implementing their mandate as decentralized units anchored in public participation. It provides strategies for sub catchment transformation and informs policy review that can apply in other sub catchments

## 2. Materials and Methods

### 2.1 Site description

The study was conducted in Rwamuthambi Sub Catchment area which runs across Kirinyaga and Nyeri Counties, and borders Mount Kenya (Fig. 1). It is a constituent of larger Upper Tana River Catchment which lays North West of Nairobi (UTaNRMP SEA Report 2014). The catchment comprises of Sagana River, also known as Tana River downstream (Geertsma et al., 2009). River Tana is one of the five main water basins in Kenya, beside River Ewaso– Ng'iro, Athi River, Rift Valley and Lake Victoria Basins. Rwamuthambi River is a major tributary to River Sagana (CGK, 2013).

Rwamuthambi Sub Catchment covers an area of about 170km<sup>2</sup>, and stretches from Mount Kenya forest through four districts: Mathira East in Nyeri County, Kirinyaga central, Kirinyaga west and Mwea west in Kirinyaga County. Rwamuthambi River is about 80kms long from its source in Mount Kenya to its confluences (j) with River Sagana at Kwa V (Fig 1). The sub catchment is geographically bound within 0° 37' 6" S, 37° 14' 57" E; 0° 37' 6" S, 37° 24' 34" E and 0° 69' 9" S, 37° 14' 57" E and 0° 69' 9" S, 37° 24' 34" E (MEMR, 2012), as shown in Figure 1.

Study area being on the windward side of Mount Kenya and at close proximity to the Equator experiences tropical climate. Its annual temperatures range between 17° –

20° celcius and has two rainy seasons. Long rains occur between mid–March to May, and the short rains from mid–October to December. Outside these rainy seasons, with dry spells are experienced during the rest of the year. Annual precipitation ranges from 800 – 1200mm (Jaetzold et al., 2007). The sub catchment lies within three agro– ecological zones as indicated in Fig. 1; Upper Midland–I which is humid suited for tea and dairy farming (Riakiania– Kiambagathi– Forest), Upper Midland–II with sub–humid conditions supporting maize, beans, coffee, irish potatoes (Kirimaini– Gathiuururi) and Upper Midland–III an area which is semi–humid ideal for pulses, maize, cotton and cassava (Baricho– Kagio: Kwa V) (Ibid). It has well drained soils which range from extremely deep, dusky red to dark reddish brown, friable clay, with acid humic topsoil (CGK 2013; Farm Management Handbook of Kenya, 2010). The local livelihood is supported through small scale farming where the main cash crops are coffee, macadamia nuts, avocado and horticultural crops, while substituting it with zero grazing cattle farming. Food crop farming includes maize, beans, bananas, arrow roots, amongst others.

### 2.2 Sampling

The three ecological zones were crucial to the study as they formed the basis for management of the sub catchment based on natural conditions and also provided the frame for equitable distribution of WRUA– Management Committee Members (WRUA– MCMs) within the sub catchment (RSCMP, 2015). For ease of this study's data collection coordination and in respect to the ecological zones the study area was further divided into five sections labelled as Kiambagathi Forest, Riakiania, Kirimaini– Gathiuururi, Kagio– Baricho and Kwa V shown in Fig. 1. The demarcation was marked by the tarmac road crossing Rwamuthambi River channel as it drains to River Sagana. Two of the river crossings (c–d) and (e–f) also marked the extent of agro– ecological zones stated above. Primary data collection targeted the community, WRUA–MCMs relevant departmental heads including local administrators. Sample size for the community was obtained through Cochran's formula (Horse, 2018; Rucker, 2017) based on a population of 19,800 households (RSCMP, 2015).

$$n_o = \frac{Z^2 pq}{(e_p)^2} = 196$$

where  $n_o$  = Cochran's sample size recommendation

$Z$  =  $Z$  value (i.e. 1.96 for 95% confidence level)

$p$  = Proportion of the population with direct attribute to the SC Governance

$e_p$  = Desired level of precision–confidence interval  
±7% = (±0.07)

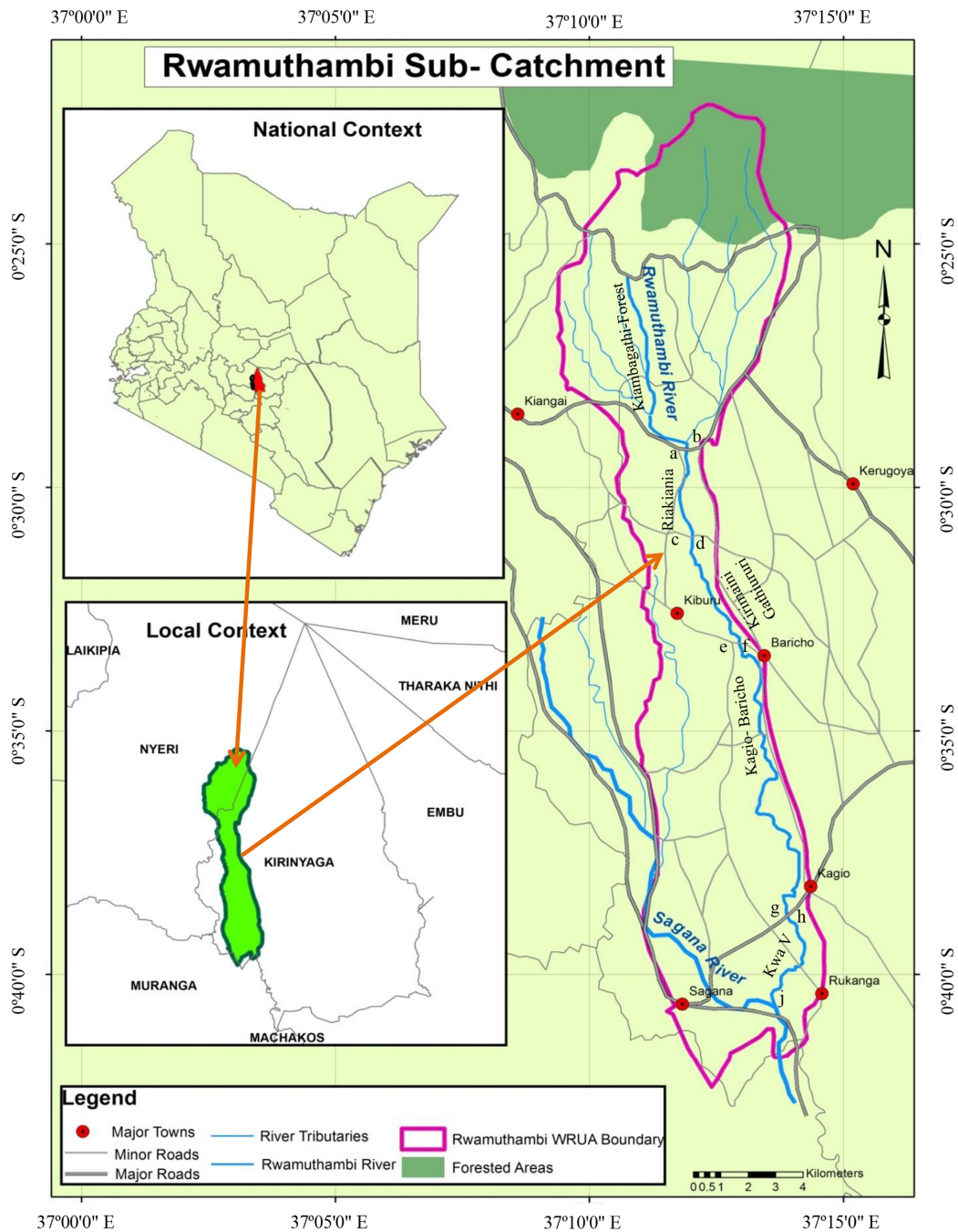


Fig. 1. Map showing the location of the study area: Source MEMR 2015  
 (a-b): Kiangai- Kagumo road; (c-d): Kabonge- Riakiania road; (e-f) Kiburu- Baricho road; (g-h): Sagana- Kagio road;  
 ((a-b), (c-d))- Upper Midland-I, ((c-d), (e-f))- Upper Midland-II, ((g-h), (j))- Upper Midland-III

The respondents also included 21 WRUA-MCMs, 6 government officers; 4 departmental heads and 2 administrators (the senior chief and assistant chief from the area). The total target sample was therefore =223 questionnaires. However, data analysis was based on 203 questionnaires comprising of 180 questionnaires that were filled and returned from the community, 17 from WRUA committee and 6 questionnaires from government officials. A pretest was conducted over a small sample. The results assisted the research in refining the

final question based on the information and comments gathered during the trial survey, besides familiarizing with the tool instrument (Marambanyika and Beckedahl 2016a; Saunders et al., 2003).

### 2.3 Data collection and analysis

The questionnaire collected information on the status of governance in local wetlands, effects of existing governance on the sub catchment, governance scenarios that influence future

sustainable utilization of the sub catchment, and bio-data of the respondents. Questions were framed with answers provided on a numeric scale whereby the respondent ranged based on priority, weight or order of preference and an option a space for an additional opinion.

The questionnaires were administered to the household heads or in their absence, the senior most adult available. Stratified systematic sampling procedure was applied whereby transects were drawn and every 5<sup>th</sup> household considered (Gorard, 2013; Leedy and Ormrod 2013; Pearson et al., 2012). There were two strata formed by identifying and segregating the land owners along the riparian from the rest of the community within the catchment area. 24 key informants were purposely selected whereby 7 community opinion leaders and a WRUA-MCM represented each agro-ecological zone. The identified were subjected to open ended questions including management and utilization scenarios before establishment of WRUA, matters of surveillance, involvement of land owners and role of politicians. Generally, the questions were meant to validate data collected from the questionnaire (Jawuoro et al., (2017). These interviews were conducted in person at points convenient to the interviewee. Relevant observations were recorded through transect walks.

Primary data was collected during the dry season in the months of July and September, a time when river water consumption was at its peak and most farming was irrigation dependent. This data aimed at gathering raw relevant information that explored into the research question. Field work was conducted after seeking and being issued with a research permit. This ensured compliance with research ethics principles and participants rights. Secondary data was obtained through review of varied documents in order to establish what existed in relation to the area of study in order to justify the gap being filled by this study. The documents included relevant local legislations, journals, books, authorised publishers from the internet and relevant international conventions.

The data that required ranking was analyzed through Stata software (StataCorp LLC, USA) for comparison between variables and between groups and plotting frequency distribution (Youssef 2012). MS Excel software was also used (Schoenbach, 2004) and at 95% confidence level chi square test of independence was applied to test differences in distribution of responses based on null hypothesis against alternate hypothesis (Cohen, 2010; Kao et al., 2007).

### 3. Results

The respondents consisted of 62% males and 38% females. The total responding rate was 91% for the community and

WRUA-MCM (17 questionnaires were returned out of 21). Being an agricultural zone, many homesteads were busy in the fields thus vacant during morning hours thus, 42% questionnaires were conducted in the morning and 58% in the afternoon.

WRUA management committee membership was such that for one to qualify to be a committee member, one must be above 18 years, fully paid up member of the society and elected at an annual general meeting as provided for in the water act of 2002 (GOK,2002) and the WRUA constitution. The level of education or technical orientation was not an attribute for qualification. More than two thirds of WRUA-MCMs (82%) had post-secondary certificate, while the rest held primary certificate. 88% of the interviewed committee members were aware of existence of laws related to wetland governance. The selection of WRUA membership was fairly distributed throughout the sub catchment and ideally elected democratically based on the three agro-ecological zones (Fig. 1). To ensure equity, each of the three ecological zones has a representation of 7 members making a total membership to 21.

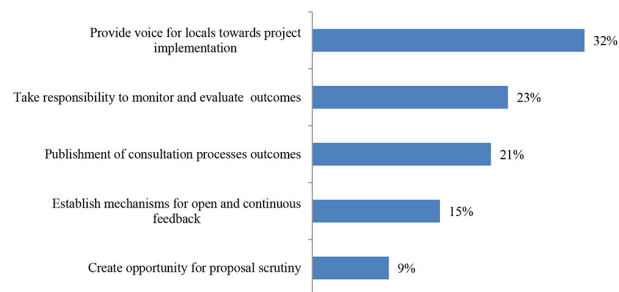
#### 3.1 Governance issues since establishment of WRUA

The community got involved in activities that supported conservation and sustainability through the intervention of WRUA-MCMs. The main activities accorded priority were soil erosion control (46%) and re-afforestation (33%). Field transects evinced planted bamboo and other wetland friendly vegetation along the riparian reserve. This study established that WRUA committee collaborated with Community Forest Association (CFA) to provide and plant ecological friendly seedlings along the riparian reserve especially in the areas of Riakiania- Kiambagathi- Forest and Kirimaini- Gathuiruri areas (Fig. 1) which lay at a higher altitude. This was achieved either through engaging the land owners or at most times without the land owners' consent. The results indicated that 35% of the land owners destroyed the seedlings.

Three out of every five members of WRUA-MCM against two out of every five members of the community indicated that the riparian reserve was set apart from the title deed and survey maps. A reference to both the title deed and the survey map in the land office however indicated that the riparian reserves were not detached from private parcels during demarcation. More than two thirds of the key informants owning land abutting the riparian reserve alluded that WRUA committee was fully involved in riparian reserve rehabilitation and conservation activities in spite of the reserves being part of their private land. Furthermore, regardless of lack of a clear format on delineation of the riparian reserve in Rwamuthambi sub catchment management plan (RSCMP), WRUA jointly

with CFAs had demarcated and set apart 85% of the riparian reserve. This was followed by planting Bamboo, *Vitex keniensis* (Muhuru), *Calodendrum capense* (Muraracii), *Prunus Africana* (Muiri), *Wurragia Ugandensis* (Muthiga) and *Vernonia auriculifera* (Muthakwa) seedlings amongst others. During this exercise the committee members recommended extirpation of Eucalyptus trees. Key informants compared this approach to the former river management system that was before establishment of WRUA which did not involve the public. The community asserted that land demarcation conducted by Survey office used the centre line of the river as the boundary and subsequently granted the beneficiaries the right to the riparian reserve. In light of this more than 50% of the community stated that this approach by WRUA was tantamount to trespass since the land was private. Consequently, the land owners uprooted the seedlings while others absconded WRUA meetings in reiteration. WRUA asserted that there lacked a laid-out procedure on ensuring that their recommendations were adhered to. However, most of the community (65%) indicated that there was improvement in rehabilitation of the riparian reserve since establishment of WRUA in spite of their approach.

The study found that the community was barely consulted during project identification or implementation in the sub catchment. There was evidence that WRUA held meetings. However, such meetings were random and deliberations



Source: Field survey 2018

Fig. 2 Community preferred sequence of strategies for governance improvement in percentage

tailor-made without giving the community a chance to deliberate on agenda projects. Yet the proposed wetland conservation programs still got underway. It was on this backdrop that the research inquired on how community in Rwamuthambi sub catchment would sequence measures towards improvement of governance in the sub catchment. The results were as illustrated in Fig. 2. 31% indicated that governance would be enhanced by giving the locals a voice during project implementation and expenditure. 23% suggested that taking responsibility to monitor and evaluate project outcomes would improve on the sub catchment governance. The least proposed strategy (9%) for governance improvement was on scrutiny of proposals suggested for consideration.

In some cases, the local community received information regarding wetland degradation from WRUA. Degradation had adverse effects on wetland management. Interrogation was done on perceived causes of degradation. At a significant value (p) of 5%, a chi square test of independence was done to determine the relationship between community responses and that of WRUA in order to rate the level of understanding gained from sensitization. The relationship was significant ( $\chi^2(4, N=180) = 20.46, p < .01$ ) as shown in Table 1 where 4 are the degrees of freedom and N is the sample size. Notwithstanding, the study revealed that 77% of the community was not aware of RSCMP While 23% confessed to know of its existence but not its contents. Besides the county department of physical planning which is mandated to prepare and guide implementation of physical development plans admitted that there lacked incorporation of RSCMP into their land use plans and the county government did not consider this plan as part of their projects. The sub catchment area had no water allocation plan.

The study also interrogated the understanding of the community and land owners towards the main causes of degradation. Although overexploitation of wetland resources and unsustainable use of wetland resources were very close

Table 1 Perception on factors affecting wetland degradation in percentages (%)

Social and behavioral factors	Community and land owners.		WRUA and government officers		Chi square test of independence
	Frequency	Per cent	Frequency	Per cent	
Overexploitation of wetland resources	50	28%	2	9%	$\chi^2(4) = 20.46a$ $p < .01$
Unplanned and haphazard implementation of development	42	24%	5	22%	
Land fragmentation/ subdivision	39	22%	6	26%	
Persistent use of organic pesticide	31	17%	3	13%	
Unsustainable use of wetland resources	18	10%	7	30%	
	180	100	23	100	

a: -2 cells (20%) have expected count less than 5. The minimum expected count is 2

Source: Field survey 2018

factors leading to degradation, responses were sought so as to establish whether the community interpreted them as interrelated. The responses had a big disparity. Key informants indicated that overexploitation was not fully associated with unsustainable utilization.

The study further established that WRUA committee engaged in selected community projects such as provision of branded water tanks to institutions for water conservation, installation of master meters and construction of water pans. WRUA managed these activities through funding from Water Services Trust Fund (WSTF) substituted by revenue collected from water supply projects. WRUA-MCMs (Management Committee Members) stated that these finances were inadequate to support all essential conservation activities. It was also alluded that there was hardly any support from other relevant government sectors save for Community Forest Association (CFA) who contribute seedlings and sometimes labor. According to WRUA-MCMs there was neither financial nor technical support received from the county government, while the input from other departments including departments of agriculture, energy and survey were dismal. The community asserted that monitoring of water resources from agriculture extension officers and public health officers as it used to be previously before introduction of WRUA was no longer witnessed. This was supported by 25% of WRUA-MCMs who confirmed that there was low to very low monitoring and enforcement compared to what was experienced before WRUA took office. WRUA key informants blamed poor surveillance and monitoring to inadequate staffing and lack of support from relevant sectors.

More than 98% of water abstraction was tapped from upstream. This was most viable as it took advantage of gravitational flow to individual farm lands and to those reservoirs constructed through projects funded by WRUA or non-state actors. The main areas that relied on such projects were within Upper Midland-II (Kirimaini) and Upper Midland-III (Kagio-Baricho; Kwa V). The study observed that WRUA community-based water project abstractors, who had benefited from the master water meters paid for water services as per their consumption. More than 95% of the 48 stand-alone water legal abstractors had neither meters nor taps on their pipes thus leaving water unattended to run throughout into their farms. But the effect of this scenario of water wastage was mostly felt during the dry spell when there was clear scarcity of water for those downstream. WRUA explained that although flat rate charges were introduced for those without meters, these consumers evaded all payment with an excuse that river water was God given and therefore should be free of charge.

Besides the water meters, WRUA had made other contributions to the sub catchment area. The study sort to gauge how the community and land owners categorized based on the three ecological zones; Upper Midland-I (Riakiania-Kiambagathi- Forest), Upper Midland-II (Kirimaini-Gathururi) and Upper Midland-III (Baricho-Kagio-Kwa V) prioritized each contribution. The response options were sensitization and education on functions of wetlands, provision of incentives to those members of the community involved in conservation, uniting resource users and water Resource Management Authority, provision of funds to improve water infrastructure and creation of a sense of ownership to wetlands and their products as shown in Table 2 and 3.

A chi square test of independence at a significance level of 5% was used to test the distribution of responses across the three ecological zones. The general null hypothesis was that the responses from the zones were dependent or related. Responses in regard to sensitization and education on wetlands functions rendered the null hypothesis false ( $\chi^2$  (8, N=147) = 1.19,  $p > .05$ ) thus rejected. For instance, while Riakiania-Kiambagathi- Forest area and Baricho-Kagio-Kwa V region registered high priority of 29% and 33% respectively Kirimaini-Gathururi area had only (17%) towards WRUA provision of information about the catchment through education and sensitization. Kirimaini-Gathururi sub catchment area engaged the most in irrigation.

Similarly, the perception towards provision of incentives to those who were involved in conservation was varied ( $\chi^2$  (8, N=147) = 5.77,  $p > .05$ ). Riakiania-Kiambagathi- Forest area and Kirimaini-Gathururi area had 31% and 22% responses as essential priority while Baricho-Kagio-Kwa V area had only 18%. WRUA provided community with incentives especially free seedlings which were distributed equitably in the ecological zones and offered assistance in planting them. However, the survival rate of seedlings at Riakiania-Kiambagathi- Forest was high owing to its high altitude while Kirimaini-Gathururi viewed every activity from an economic value thus considering tree growing along the riparian as a waste of highly productive agricultural land. This was different from Baricho-Kagio-Kwa V where tree planting required special attention as the climate was tending to semi-aridity. Those from Baricho-Kagio-Kwa V an area prone to floods during the rainy season stated that in the 1980's and early 1990's incentives were offered in monetary form, farm equipment and even recognition for participants who led in soil conservation famous known as "kuzuia mmonyoko wa udongo".

Further, the response on uniting resource users and water resource management authority also failed the null hypothesis

Table 2. Comparison of preferred priorities by community and land owners

WRUA contribution	Ecological zone	Essential priority	High priority	Moderate priority	Low priority	Not a priority	Chi square test of independence
Sensitize and educate on wetlands functions	Riakiania–Kiambagathi–Forest	14	15	11	7	5	$x^2(8) = 1.19a$ $p > .05$
	Kirimaini–Gathiururi	13	8	12	8	5	
	Baricho–Kagio–Kwa V	12	16	10	6	5	
Provide incentives to conservators	Riakiania–Kiambagathi–Forest	16	8	7	12	9	$x^2(8) = 5.77b$ $p > .05$
	Kirimaini–Gathiururi	10	11	12	7	6	
	Baricho–Kagio–Kwa V	9	11	11	12	6	
Uniting users and water management authority	Riakiania–Kiambagathi–Forest	10	15	13	7	7	$x^2(8) = 6.24a$ $p > .05$
	Kirimaini–Gathiururi	14	13	8	6	5	
	Baricho–Kagio–Kwa V	6	9	9	12	13	
Provide funds for water infrastructure	Riakiania–Kiambagathi–Forest	5	6	7	16	18	$x^2(8) = 1.85a$ $p > .05$
	Kirimaini–Gathiururi	5	6	14	11	10	
	Baricho–Kagio–Kwa V	5	6	9	13	17	
Create a sense of ownership	Riakiania–Kiambagathi–Forest	12	8	12	10	10	$x^2(8) = 4.75b$ $p > .05$
	Kirimaini–Gathiururi	14	11	8	6	7	
	Baricho–Kagio–Kwa V	15	8	7	8	11	

a, b 0 cells (0%) have expected count less than 5. The minimum expected count is a=5; b= 6

Source: Field survey 2018

Table 3. Responses on priorities over WRUA contributions in percentages

WRUA contribution	Ecological zone	Essential priority	High priority	Moderate priority	Low priority	Not a priority
Sensitize and educate on wetlands functions	Riakiania–Kiambagathi–Forest	27%	29%	21%	13%	10%
	Kirimaini–Gathiururi	28%	17%	26%	17%	12%
	Baricho–Kagio–Kwa V	25%	33%	20%	12%	10%
Provide incentives to conservators	Riakiania–Kiambagathi–Forest	31%	16%	13%	23%	17%
	Kirimaini–Gathiururi	22%	24%	26%	15%	13%
	Baricho–Kagio–Kwa V	18%	23%	23%	24%	12%
Uniting users and water management authority	Riakiania–Kiambagathi–Forest	19%	29%	26%	13%	13%
	Kirimaini–Gathiururi	30%	28%	17%	13%	12%
	Baricho–Kagio–Kwa V	12%	18%	18%	24%	28%
Provide funds for water infrastructure	Riakiania–Kiambagathi–Forest	10%	12%	13%	30%	35%
	Kirimaini–Gathiururi	11%	13%	30%	24%	22%
	Baricho–Kagio–Kwa V	10%	12%	18%	26%	34%
Create a sense of ownership	Riakiania–Kiambagathi–Forest	23%	16%	23%	19%	19%
	Kirimaini–Gathiururi	30%	25%	17%	13%	15%
	Baricho–Kagio–Kwa V	31%	16%	14%	16%	23%

Source: Field survey 2018

as differences were portrayed through the zones ( $x^2(8, N=147) = 6.24, p > .05$ ). While 30% of the responses in Kirimaini–Gathiururi area indicated that this was essential priority, only 19% and 12% supported it from Riakiania–Kiambagathi–Forest area and Baricho–Kagio–Kwa V area respectively. Key informants from Kirimaini–Gathiururi area were concerned about restrictions imposed on water abstraction. Responses in regard to provision of funds for water infrastructure also showed independence in the zones ( $x^2(8, N=147) = 1.85, p > .05$ ) thus rejecting the null hypothesis. Further

interrogation showed that Kirimaini–Gathiururi who had 30% as moderate priority were the areas that relied most on horticultural production as a source of livelihood, therefore most of the water pans were personal initiative. Riakiania–Kiambagathi–Forest area and Baricho–Kagio–Kwa V area both gave only 13% and 18% respectively as moderate priority. More than 90% of the community–based water supply projects were self–sponsored. Further, responses on rating of priority on creation of a sense of ownership was also independent ( $x^2(8, N=147) = 4.75, p > .05$ ) against the null hypothesis that



the responses were related. For instance, while 25% responses from Kirimaini– Gathururi registered moderate priority, Riakiania– Kiambagathi– Forest area and Baricho– Kagio– Kwa V area both tied at 16%.

### 3.2 Challenges encountered by WRUA

Although WRUAs were established through the guidance offered by Water Resource Management Authority (WRMA), all the WRUA Management Committee Members (MCMs) agreed to have inadequate capacity and technical background on water resource governance. None of them had training oriented to environmental and natural resources fields or had prior experience in wetland conservation. This was in spite that from the survey all WRUA–MCMs were literate with 6% and 35% having attained university and college levels respectively. Only 35% of WRUA–MCMs were aware of existence of water management legislations of which 21% knew the contents of the various policies. The study also noted that 6% WRUA–MCMs were aware of the water act while 13% were privy to Environmental Management and Coordination Act (EMCA). Only 15% of WRUA–MCMs knew the basic content on water resources management. However, the committee played an effective role in dispute resolution.

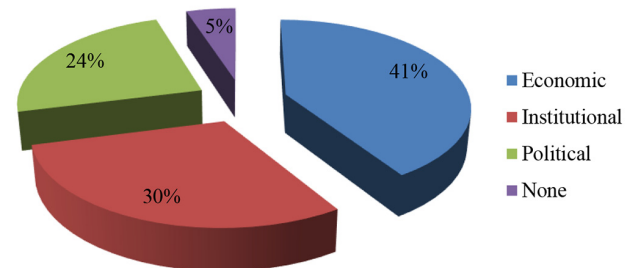
### 3.3 Prevailing dimensions of water governance in the sub catchment

A large number of activities in the sub catchment area were orchestrated towards income generation since the main economic base for the area was agriculture. The community reverted to irrigation for market production of horticultural crops following slump in coffee prices during mid–1990s. Based on census reports, the study area had experienced an increase of more than 50% in household population since 1990s. Consequently, this increased demand for food and other water resource–based services leading to changes in the ecosystem. The substitute crops included among others tomatoes, French beans, kales, gorget capsicum and fruit crops. More than 85% of the respondents were self–employed and mainly engaged in farming generating monthly incomes ranging from 50–200 USD. The study established that most of the stakeholders (41%) perceived the sub catchment governance from an economic dimension (Fig 4).

Another 30% of the respondents indicated that the dimension for sub catchment governance was institutional. This was supported by the existence of civil societies who collaborated with Community Based Organizations (CBOs) to construct water pans which would act as storage of storm water and source of water for irrigation during the dry spell. The system was embraced by 15% of farmers. Most of the key respondents

(63%) indicated that the selection of the leaders was not democratic since the entire community within the sub catchment was not involved. It was alleged that committee members were hand–picked rather than the choice of the people being represented. Further, WRUA lacked institutional capacity for proper management of the sub catchment. WRMA officials indicated that the office was under–staffed to adequately serve all the 6 sub catchments that are in Kirinyaga County side of the larger Upper Tana Catchment area adequately. In addition, training offered by WRUA–MCMs to the community was limited to farmers abutting the river and those engaged in water projects.

Although 24% of the respondents gave the sub catchment area governance dimension to be political, local sub county and ward representatives were not involved in management matters. More than 90% of the key informants asserted that politicians did not play any role in influencing policy formulation. In Rwamuthambi sub catchment area, politicians only featured during launch of tangible items like water tanks or commissioning water pans. This was attributed to fear of losing popularity by the politicians if involved in controlling or stopping activities hurting water resources against the wish of potential voters. 5% of the respondents did not align the sub catchment governance to any dimension.



Source: – Field survey, 2018

Fig. 3. Prevailing dimensions of governance in Rwamuthambi sub catchment area

## 4. Discussions

### 4.1 Effect of capacity building WRUA–MCMs to community wetland perception and attitude

More than 15 years have passed since the establishment of Rwamuthambi WRUA and over two years since its official registration and before conducting this study. It emerges that WRUA–MCMs have encountered challenges in handling technical matters and also educating the community on best practices which are some of the activities under their mandate. This could not be attributed to illiteracy as most of members had attained secondary education level and above, surpassing

the country's 7.8% overall documented average of population with similar level of education (CGK, 2013). In a similar finding Rebelo et al. (2010) indicated that one of the major restrictions against sustainable use of water resources for food production was lack of information on benefits and strategies that can be employed to achieve sustainability. WRUA-MCMs admitted that there was need for requisite know-how in regard to contents on relevant legal frameworks and information related to water resources conservation. This finding as corroborated by Omolo, (2010) emphasized upon policy implementers to beware of rights and responsibilities besides getting armed with an understanding on how to exercise them. If WRUA-MCMs managed to drive appropriate local conservation measures and uphold effective institutional structures then the sub catchment cannot get degraded through cultivation as was confirmed by (Marambanyika et al., 2016b). Another study by Oremo et al. (2019) also revealed that when the community is knowledgeable on issues of water management, it has effect to their attitude and practices. Thus, for there to be a shift towards wise use of wetland resources WRUA therefore needs to educate the community on benefits and sustainable use of wetland resources.

#### 4.2 Water conservation through introduction of water tariffs

Rwamuthambi WRUA encouraged the community to account for water drawn and tried to reduce water wastage by imposing payment for water abstraction through standing charges or metered charges as one way to regulate water abstraction. The move was meant to control and minimize the looming water scarcity exacerbated by ever reducing water quantities from being wasted. This finding was supported by Ukumu (2019) that for sustainability, human abstraction of renewable resources should be systematically planned. Wastage of the resource was abated through reduction of Non-Revenue Water (NRW). The revenue collected was used to supplement the sub catchment funding that WRUA received from Water Sector Transfer Fund (WSTF). This finding was similar to Mati and Mugo (2018) that the main objective for financing the water sector should be to maximize the public investment's social return and make the institutions sustainable. However, the benefits of charging water resources were minimal based on the high rate of payment defaulters due to unwillingness to pay since water was viewed as a free public resource. A similar finding was also arrived at by Noga and Wolbring (2013) that in water abundant areas water is regarded as a human right and thus could not be equated to monetary worth. This perception and attitude could however be changed through educating the public on water resources issues and promoting

management for sustainability. This conclusion is supported by Chee et al. (2015) that NRW can be reduced by teaching the public and promoting interest on benefits of reducing NRW through community led strategies. Notwithstanding, a related finding by Rampa in 2011 revealed that increase in financial resources and technical support are not short-term solutions to improved governance. WRUA required support from the community and the county government in order to monitor and reduce non-revenue water. This explains why there is need for empowerment of WRUA-MCMs in technical and conservation skills so that capacity gained could trickle to the community as custodians of the sub catchment.

As an additional way to conserve water, the study evinced that WRUA used the funding received from Water Sector Trust Fund (WSFT) to provide water tanks for roof rain water harvesting and construction of water pans with the latter achieved through collaborative governance with Non-Governmental Organizations (NGOs). This is in congruence with the findings by Mati and Mugo (2018) that government resources invested in public goods like water resources could attract private funding.

#### 4.3 Effects of land tenure policies to wetland governance

The study results further established that the entire riparian reserve was adjudicated under freehold tenure which is absolute proprietorship that accords the holder unlimited rights of use, abuse and disposition (Land Registration Act, 2016). But the Constitution of Kenya (GOK, 2010) provides that water resources are held in trust for the people by the National Government (GOK, 2016). Bondi et al. (1996) and KLR (2006) reiterated that the state holds power in regulation of private land use and may revoke any land rights in an effort to ensure conservation of the environment. These facts did not resonate well with the findings from the study on matters of rehabilitation and conservation of the riparian reserve as the study established that the land owners along the riparian reserve were not in acceptance of dominance over their presumed private land which was used mainly for farm produce, considering that it was held under absolute ownership rights registered during land demarcation process of 1960s. The rights included sub division of land and from the results the community views on degradation were not influenced by the existence of WRUA. In a related finding Johanna et al. (2015) stated that there was a strong historical linkage of ecosystem degradation to land demarcation and lost commonality whose consequence culminated to its privatization resulting into preference towards agricultural production against wetlands and rivers conservation. In addition, Manzungu (2004) noted that

stakeholder participation without restructuring ownership and access rights run the risk of tokenism. Furthermore, Babcock (1991) attested that in as much as the economic benefits for wetland conservation cuts across the entire society, the land owners endure the conservation cost through lost opportunities for investment making most property owners abutting the wetlands form attitudes against their conservation. In addition, Oremo et al. (2019) unearthed that attitudes and practices were determined by land tenure and distance of the farm to the water resource. In the face of these findings, there is need to review the issue of riparian reserve ownership as legislated against the current private land interest for sustainability in posterity.

#### 4.4 Sub catchment area sustainability through public participation

Further, more findings portrayed WRUA to be applying an approach that was near top-down in the process of riparian reserve rehabilitation and conservation. This faced resistance from the land owners which manifested through defiance and uprooting of tree seedlings planted by WRUA jointly with CFA. In a similar finding Rambonilaza et al. (2015) established that most of individuals imposed with compulsory maintenance ended up defaulting. But in contrast to this finding Huntington et al. (2017) noted that when faced with any form of change communities join with others to form collaborative response space which therefore calls for consideration of local responses as a basis for adaptive policies which would be supportive to the community instead of pressing limitations. Most of the community stated the need to get a voice in project implementation and responsibility to monitor and evaluate sub catchment projects. This portrayed the willingness of the community to participate in sub catchment area management projects. This finding supports what Alexiu et al. (2011) posited that reduced community participation inhibits community involvement in social activities with citizens perceiving it not for their individual benefit but for the benefit of WRUA as a government agency. Thus, it is the collaborative actions of WRUA and the community that yields to improved economic status and availability of clean water amongst other wetland relate benefits.

The study established that WRUA worked closely with CFAs through provision and planting of ecologically friendly seedlings. In a similar finding by MCPFE (2009) indicated that there was need for integrated approach and cooperation amongst water and forest authorities since forests contribute to water supply by maintaining high water quality through minimizing erosion by soil stabilization and regulating flows. But contrary to this finding Mamoon (2018) asserted that rather than upland

forests serving as sponges, forests retain more water than other surfaces therefore their clearing would reduce the surface area that contribute to over 80% evapotranspiration which returns the excessively absorbed water to the atmosphere, instead of adding this water to the stream flow. In addition to this contrast, Mamoon was also supported by Salih (2001) that conservation and re-vegetation caused displacement. This claim was disputed by Luwesi and Barder (2013) and Mathenge et al. (2014b) who reported success in rehabilitating degraded wetlands in Kenya through planting of trees. Further, Parker and Oates (2016) averred that an interdisciplinary approach was required for a sustainable management of a river ecosystem so that the ecosystem is viewed as water security rather than as consumers of water. According to GOK (2017) this is an area of dilemma for Kenya on how to balance the ever-expanding agriculture as the main stay to the economy yet it flourishes best in catchment areas compared to forest conservation.

The sub catchment was being utilized extensively by the community for cultivation and other activities through incorporating some conservation measures promoted by WRUA committee during sensitization as confirmed by the Chi square results from level of understanding acquired through sensitization. In support of this finding Yang et al. (2006) alluded that consistent provision of information from science and ideas regarding environmental protection compared to economic development removes contrasts in adjustment and attitudes toward using water for agriculture or other economic activities. This was also consistent with what Marambanyika et al. (2016b) outlined that wetland sustainability can only be achieved if there was a simultaneous focus on protection of the environment, promotion of socio-wellness and effective institutional structures under a wetland committee. Also, Boschet and Rambonilaza (2015) noted that some decisions towards conservation could be torn between preservation of peripheral natural landscape and protection of farming activities.

The results established that conservation activities undertaken by the land owners were voluntary and benefit driven purely from an economic angle. This conclusion was attested by (Liniger et al., 2011) and Stringer et al. (2007) who proffered that success of conservation depended on local socio-economic benefits and household specific goals. WRUA provided conservation incentives equitably and generally rehabilitated the reserves across the ecological zones but these were rated differently by the community. The responses were related to prevailing activities practiced along the riparian reserve. For instance, it emerged that the community from these upper zones noted issues involving blocking the river channels by individuals denying downstream neighbors from getting sufficient water or at times dykes constructed by some farmers upstream would

overflow to other farmlands destroying their crops. This finding was consistent with Ngowi & Mwakajea (2018) that incentive policies and implementation can improve conservation and livelihood. Therefore, as long as the dimension of conservation was economic, adoption of the strategy was likely to be easy.

#### 4.5 Sub catchment area management through intersectoral collaboration

The study also demonstrated that there was a challenge of sectoral integration as each related ministry was confined to its territorial and operation boundaries with each sector developing its plan without considering integrating with the others. The relationship between agriculture and irrigation water usage cannot be ignored yet the department of agriculture was not much concerned with riparian encroachment since agriculture act permitted only a reserve of 3m (GOK 2012a). A similar finding by Yang et al. (2006) inferred that effects of irrigation to rivers, and ecosystems could only be remedied through rehabilitation. At the same time the department of survey sustained that the centre line of the river was the parcel boundary (GOK 2012b). The ministry of energy was concerned only when issues related to hydro power generation along Rwamuthambi River arose but was distance on matters of sustainable utilization of the water resources. Oremo et al. (2019) conveyed a similar finding that sub catchment area governance is influenced by varied multi-level actors whose interests were varied, conflicting and had arrangements that were not context-specific leading to lost synergy in governance. This explains why Johanna et al. (2015) advocated for enhancement of inter sectoral management while Carlsson and Berkes, (2005) and Folke et al. (2005) indicated that the complexity of environmental governance required co-management by multi-level governance institutions and embracing adaptive, flexible strategies to deal with change and uncertainties. A similar suggestion is stipulated in Water Resource Users Association Development Cycle (WDC) in that water resources management could only be achieved through multi-sectoral collaboration and coordination of integrated institutional capacity, technical knowledge and stakeholder participation (WSTF 2009).

The success of a county government is attained through working with grass root institutions like WRUAs who had direct interaction with the community which was the essence of devolution. An observation from the study area indicated that county ward representatives seldom involved themselves with riparian reserve conservation activities and WRUA operations. The local representatives kept at bay in regard to riparian reserve affairs which were mainly privately owned as the politicians were wary over any unpopular decisions that

would reduce their prospect for re-election when their term lapsed. On the same note, the same effect could be transferred to WRUA committee members off whom Water Resources Management Authority (WRMA) regulations provided that in order for the committee to meet institutional framework threshold, it was mandatory to select committee members through fair elections. This finding was consistent with Giordano et al. (2005) that political uncertainty may have ramifications to institutions managing resources. Additionally, WRMA regulation should set out a performance evaluation so that there are thresholds for WRUA committee members once elected to keep them in office, rather than by expiry of their term. In this regard it is concluded drawing from Jorge and Ignacio (2015) that new policies are not panacea to water resource management but there's need to adopt collaborative governance and take into account common practices, inertia and hysteresis in order to develop new practices.

The study unveiled that Rwamuthambi WRUA had managed to prepare a Sub Catchment Management Plan (SCMP) which more than two third of the community had declared were unaware of. This was the same plan from where the activities by WRUA were derived. But based on the study results the main factors leading to degradation in Rwamuthambi sub catchment were mainly unsustainable use of wetland resources and their over-exploitation which arose from unplanned development and chaotic implementation of development activities as was asserted by (Zuquette et al., 2002). Implementation of RSCMP did not receive any funding or technical support from the county government since the plan was not integrated with county physical and land use development plan, whose mandate and authority for preparation is vested with the county government (GOK 2019). This finding was similar to Rodríguez et al. (2015) who stated that effective water resource management could only be achieved through coordinated strategies established between land use planning and water resource management in order to generate land use scenarios which would limit the uncertainty, mitigate impacts of water infrastructure, guide in decision-making and cater for deviations from the envisaged proposal. Boschet and Rambonilaza (2015) corroborated that there exists a powerful political component in the process through which a local government makes a decision whether to support or ignore a sub catchment plan.

Furthermore, Patrick and Heymans (2015) stated that there was need for county governments to take up the role of sector specific policy making under the new governance dispensation of devolution including the water sector in order to ensure proper legislative framework and institutional operations. As such, WRUA committee should also take the initiative to establish a working relationship with the members of the county

assembly because any proposed policies or budgetary allocation for WRUA could only be ratified through the county government assemblies because politicians are instrumental in driving policy review. These findings therefore show that WRUAs require supported from the county government through adoption of the sub catchment management plans for integration with the county land use plans and consequent funding for their implementation.

Although WRUA had not prepared a water allocation plan, the committee managed to solve conflicts of water allocation and others between land owners' utilization and value of conservation towards wetland resources. This finding was supported by Henle et al. (2008) and Guzman Ruiz et al. (2011) that conflicts can be resolved through integration of water organizations to the benefit of socio economic and ecological reasons. In addition, Namvua (2019) reported that land use planning could holistically address resource management by ensuring sustainable resource utilization and conflict control. The study finding agrees with Saleth and Dinar (2008) that successful resolution of conflicts is an indication of genuine institutional reforms while Masifia and Sena (2017) asserted that the greatest concern for water resource governance is their sustainability for current and future allocations.

## 5. Conclusion

Public participation and education on the benefits of wetland conservation especially on control of wastage of water through imposing tariffs on water consumption is crucial for sustainability of a wetland. Economic benefits were motivational to sub catchment conservation. Further, WRUA needed to embrace collaborative governance amongst stakeholders and other water related government sectors and non-state actors. The challenges include inadequate financial and human resources, low participation from water related government sectors and elected leaders, dismal support from the county government and management of the riparian reserve while it is under private tenure. For a transformation of the sub catchment area, the study therefore recommends multi-sectoral collaboration and cooperation, empowerment of WRUA management committee members, integration of the sub catchment management plan with county land use plans and review of policy in order to unravel the question of management of riparian reserve still registered under private tenure.

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## Compliance with ethical standards

The research was carried out under WMI of the University of Nairobi. Consent of participants in interviews and questionnaire survey was sought before each individual participant. Permission was sought from and granted by National Commission for Science, Technology and Innovation (NACOSTI) Ref: No. NACOSTI/P/18/10767/23007

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