Journal of Sustainable Development Studies
ISSN 2201-4268
Volume 12, Number 2, 2019, 184-222

INFINITY PRESS
www.infinitypress.info

Adaptive Capacity in Watershed Governance for Food Security in the Lower Sio River Basin, Busia County, Kenya

Namenya Daniel Naburi

BRECcIA Post-Doctorate Research Fellow, Masinde Muliro University of Science and Technology, Kenya (MMUST)
P. O. Box 190-50100 Kakamega

Corresponding Author: Tel: +254 720 904 160; Email: namenya08@gmail.com

https://doi.org/10.28924/ip/jsds.1857

Adaptive Capacity in Watershed Governance for Food Security in the Lower Sio River Basin, Busia County, Kenya

Abstract:

Watershed systems with high adaptive capacity are able to re-configure themselves when subjected to change without significant declines in crucial socio-ecological functions. This study assessed adaptive capacity variables in watershed governance for sustainable food security at the household level in the Lower Sio River Basin, Busia County, Kenya. A total of 387 households were sampled using a combination of multi-stage and simple random sampling. Questionnaires, interview guides, observation and focus group discussion guides were employed to collect primary data. Results indicate that the need to increase or sustain food production was ranked first by 86.8% as a factor that contributed to public involvement in watershed management activities. The results further revealed that creating social resilience to adapt to a changing climate, and clarifying roles and responsibilities at p-value=0.000; enhancing water-use efficiency and improving management at p-value=0.010 were significant governance aims that determined households' food security. Watershed governance structures such as water resources, management policies and plans p-value=0.000, and water resource institutions p-value=0.001 were also significant to households' food security status. Therefore, enhancing adaptive capacity of institutions towards watershed governance is a fundamental condition towards households' food security in the Lower Sio River Basin.

Key words: *Adaptive Capacity, Household Food Security, Watershed Governance Structures, Watershed Institutions, Sustainable farming practices*

1. Introduction

Watershed systems with high adaptive capacity are able to re-configure themselves when subjected to change without significant declines in crucial functions of the socio-ecological system (Koontz *et al.,* 2015). Promoting resilience at watershed level is concerned with the knowledge required to facilitate robust governance systems that can cope with environmental changes and social, demographic and democratic transitions (Adger, 2003). Institutions organize and structure human behaviour towards collective ends (Ostrom, 2005; Bussey *et al.,* 2012). They can promote or hinder individual actions to adapt to changing conditions (Koontz *et al.,* 2015). In most cases, adaptation activities are more local (sub-county, county, regional or national) issues rather than international (Parry *et al.,* 2005). This is because different communities in different geographical locations and scales are exposed to different levels of vulnerability and possess varying adaptive capacities, thus they tend to be impacted differently, and thereby exhibiting different adaptation needs (Ndesanjo, 2009). Moreover, Majule *et al*. (2007) noted that adaptive capacity varies within communities due to various factors including the variation in wealth among social groups, age, gender and sex. It is, therefore, necessary to understand what influences the ability of institutions to adapt to socio-ecological change. As such, ability is one main factor affecting adaptive capacity of other actors in the water and food sector to climate (Adger *et al.,* 2007; Gupta *et al.,* 2010). This is because even when institutions appear to possess or create adaptive capacity, this does not automatically mean that society will use this capacity and be able to successfully adapt as it merely indicates that the institutions provide a higher likelihood of allowing for adaptation (Gupta *et al.,* 2010). Adaptive institutions are intended to cope with multiple objectives inherent in social-ecological systems (Pahl-Wostl, 2009). Komakech, (2013) argued that an effective coordinated management of the water resources of a river basin as stipulated in IWRM depends on the presence of an institution whose regulatory

mandate and tasks are known and accepted by a majority of stakeholders. Stakeholders can then be considered those who have a legitimate claim to the water resources (Komakech, 2013).

Foerster (2011) advanced that adaptive institutions are necessary to move towards sustainability outcomes because of their ability to adjust participation from multiple stakeholders with multiple interests that evolve over time. More so they are important for adaptive governance (Koontz *et al.,* 2015) whereby they are thought to help a governance system cope with uncertainty and complexity (Huntjens *et al.,* 2012). Furthermore, Koontz *et al.* (2015) also noted that in order to adjust systems to environmental issues, make and implement the right decisions, institutions need to be changed, adjusted, expanded, or created. Hence adaptive institutions have been highlighted by researchers studying water resource systems, wetlands, climate change, flood infrastructure, and more generally the ''tragedy of the commons'' dilemma facing many social-ecological systems (Huntjens *et al.,* 2012). River basins such as the Lower Sio comprise several smaller catchments ranging from the scale of trans-boundary, sub-national or regional to local scale, nested within one another, each presenting unique water management problems and affecting the choice and functioning of water management structures (Bohensky and Lynam, 2005). Therefore, multi-level institutions at the national and county levels of governance in Kenya were formed with the mandate of fostering adaptive capacity at the household level. Although researchers have focused on adaptive capacity of households, local communities and nations; there is little research on assessing institutions on their ability to enhance the adaptive capacity of society (Gupta *et al.,* 2010). It is on this premise that this study assessed the adaptive capacities created in watershed governance for sustainable food security in the Lower Sio River Basin, Busia County, Kenya.

2. Research Materials and Methods

2.1 The study area

The Lower Sio River basin lies between latitudes 0^0N and 10^0N and longitudes 30^0E and 36^0E (Figure 2.1) along the Kenya- Uganda border (Wanjogu, 2004). The mainstream of Sio River stretches approximately 78 km from the source in Kenya to the mouth in Uganda (Albinus *et al.,* 2008). The sampled study sites included: Funyula, Matayos and Nambale Sub-counties in Busia County. The basin has continued to experience land use and land cover changes which have exerted negative ecological impacts affecting the community livelihoods (Obando *et al.,* 2007). In addition, 54% of the households in the basin were reported to be food insecure (GoK, 2013).

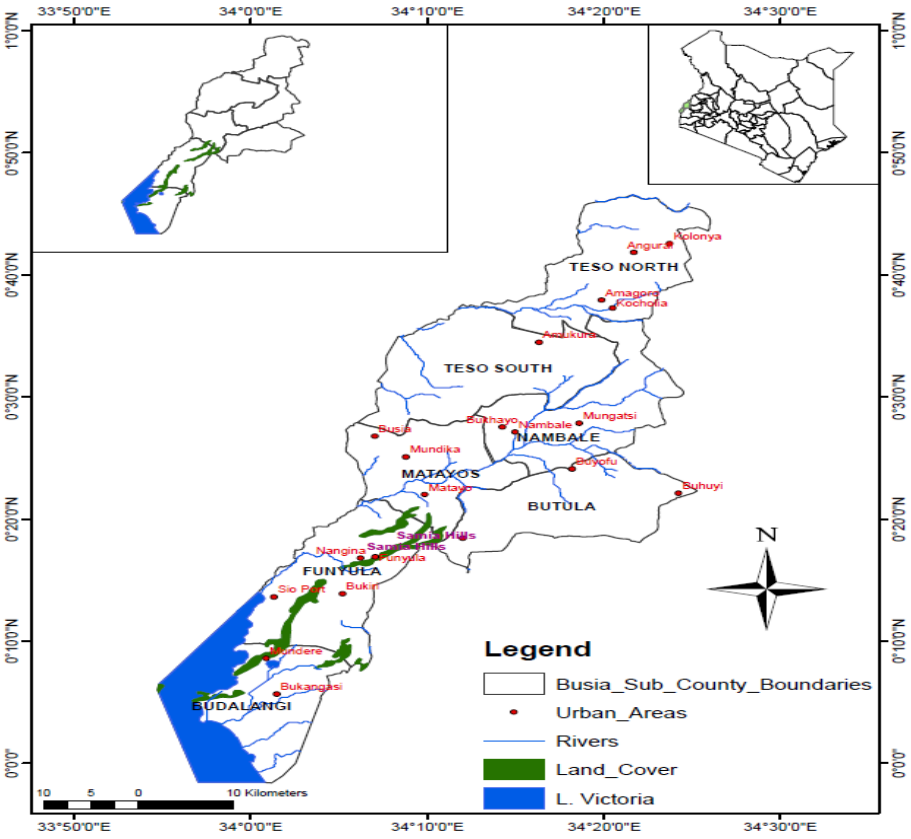


Figure 2.1: Map of the Lower Sio River Basin

Source: Researcher, 2018

2.2 Research Design

The study adopted cross-sectional survey designs combined with both qualitative and quantitative methods, and probabilistic and non-probabilistic sampling techniques were used in the study (Stringer, 2009). According to Serem *et al.* (2013), survey studies are used to obtain information about existing phenomenon. Therefore, this design was found useful in gathering, summarizing, presenting and interpreting data.

2.3 Sampling Methods

The sampling procedure involved use of quota sampling to select respondents who constituted focus group discussion teams. Primary quantitative data was basically drawn at the individual household level. Purposive sampling was used to select the three sub-counties; Nambale, Matayos and Funyula through which River Sio traverses thus forming a common hydrological basin. A two-level multi-stage sampling was conducted. In the first level, simple random sampling techniques were used to select at least 10% (Mugenda and Mugenda, 1999) of the locations from each of the sub-counties whereas, in the second level two sub-locations from each selected location were identified using simple random sampling technique.

Proportionate sampling was used to distribute the samples in the sub-locations based on their population in the sample frame. The list of households from each sub-location obtained from Kenya National Census of 2009 Census was updated using the list of households at the respective chief's offices. Finally, a simple random technique was used to select the households that formed the unit of analysis while the household heads formed the unit of observation during data collection process. The sample size was obtained using Yamane (1967) formula for small populations (Equation 1):

$$n = \frac{N}{1 + N(e)^2} \quad \text{.....Equation 1}$$

where:

n = the desired sample size

N= Population of households in the watershed from the sample frame 11,988

e = Margin of error 5 %

$$n = \frac{11{,}988}{1 + 11{,}988(0.05)^2}$$

From the formula: n = 387

2.4 Data collection

The procedure for qualitative data collection was done using a focus group discussion guide administered in various community groups in the basin. The quantitative data collection essentially necessitated semi structured questions, open and closed ended questions. Households' socio-demographic variables were used as determinants of the association between watershed governance and food security. To test the validity of data collection instruments, a pre-test study was conducted in thirty-nine (39) households of the total calculated sample size (10% of 387) in Esikulu Sub-location, Matayos Sub-county which was excluded from the main study. The Cronbach's alpha reliability coefficient (Cronbach, 1990) obtained using Statistical Package for Social Sciences (SPSS) version 20 for internal consistency was 0.9 which was acceptable since $\alpha \geq 0.7$.

2.5 Data Analysis

There were no statistical measurements for qualitative data. However, analysis was done based on each thematic area provided for data triangulation with quantitative data for coherent results. Quantitative data were analyzed using SPSS version 20 and excel spreadsheet. Frequencies were run to all variables to check for missing cases if any as well as for explanations. The constructs of dependent variables (food security) were recorded whereby a higher score meant a correct or more positive answer (0-1 for binary; (yes, no). For each of the items measured for the food security variable as the dependent was summed up to compute for an index score of food security. The index food security score, Modified Bloom's cut-off point was created for the purpose of performing

inferential statistics. Further, independent variables' concept values were summed up and computed to form different independent index scores for the specific concept. All the 17 variables used to measure food security were included in the calculation of index score of food security. This is because the variables showed tight coherence with a Cronbach's alpha 0.9 or higher was considered sufficient. Depending on the number and nature of independent variables (for the dependent, all the 17 variables), index scores were summed up and recalculated to a score of 0-100 through multiplying by 100 and dividing with the number of variables. Further, a binary food security variable was generated on a scale of 0 to 1 where '0' indicated households that scored 0-49%' and '1' indicated households that scored 50-100%.

Bivariate analysis was done to ascertain the association and level of significance between the generated groups of households with food security and food insecurity and each variable for the household background/ watershed governance determinant factors. In running chi square tests by the groups for households' watershed governance determinant factors, p values were used to show the level of significance/differences between the groups of food secure and food insecure households.

3. Results and Discussions

3.1 Households Socio-demographic Characteristics

Descriptive analysis of the demographics of the study respondents showed that out of 387 targeted households, 52.5 % (203) were female while 47.5% (184) were of male gender. The study found that majority (46.3%) (179) had attained the basic primary level of education, 33.9% (131) had the secondary education while 8.8% (34) had attained the tertiary level of education respectively. However, it was also noted that a large portion of the respondents, 11.1% (43) did not have formal education. Further, majority (68.7%) (266) of the households depended on farming as their main occupation, 4.1% (16) and 5.4% (21) were on-farm and off-farm labourers respectively, while 12.7% (49) practiced small businesses, 4.1% (16) were civil servants and 2.3% (9) were employees in the private

sector respectively. Furthermore, the majority (89.9%) (348) of the households practiced Christianity while 2.3% (9) practiced Islam and 0.3% (1) practiced Traditional African religion.

3.2 Watershed Governance Goals

The results in Table 3.1 illustrate that majority 40.3% (156) of the households identified water for nature while 20.2% (78) identified the whole system approaches as the main watershed governance goal. In group discussions, it was indicated that there was no collective and shared watershed governance goal. As a result, 33.1% (128) of the households did not know or have any goals for watershed governance. Individual watershed governance goals guided household initiatives that were informally formulated by the heads of households from experience gained out of the soil resource management challenges to ensure that the family land remained productive for food crops. Adaptive governance and institutions at watershed level are expected to generate the desired end goal of adaptive capacity. This finding clearly illustrate- lack of adaptive governance in the study area.

Table 3.1: Watershed Governance Goals among the households

Watershed Governance Goals	Frequency (N=387)	Percent
Water for Nature	156	40.3
Don't Know	128	33.1
Whole-Systems Approaches	78	20.2
Transparency and Engagement of Affected Parties	9	2.3
Clear Roles for Decision-Making	7	1.8
Sustainable Financing and Capacity	6	1.6
Accountability and Independent Oversight	3	0.8
Total	**387**	**100.0**

The respondents attributed lack of collective and shared watershed governance goal to leadership challenges in the county government that did not have the vision for watershed management to boost food security a factor that was blamed for increased food insecurity. Another reason given was that the respondents were neither involved in state -planned nor have the capacity to invest in watershed management activities. During community group discussions, specifically in Musokoto and Nang'oma sub locations, respondents reported that for those households with polygamous families, the male who was perceived to be the landowner dictated household soil management activities and monitored the utilization of land by wives and children for a common good. Watershed governance goals determine how the public perceives the environmental issue at hand and their opinions and attitudes on it that identify main problems and priorities with respect to watershed management (Borecki *et al.,* 2016). According to Adger (2003), promoting resilience in any socio-ecological system means changing, in particular, the nature of decision-making to recognize the benefits of autonomy and new forms of governance in promoting social goals, self-organization, and the capacity to adapt. Therefore, ensuring that national and county government department's watershed management goals owned at the household level translate to adaptive behaviour.

3.3 Aims for Watershed Governance and Households Food Security

With respect to the aims of watershed governance, 40.1% (155) of the households identified enhancing water-use efficiency, conservation and improving management. On the other hand, 36.4% (141) reported protecting and enhancing ecological health and functions including food production as the aim that guided household activities in the basin. Moreover, 25.1% (97) of the households reported that the aim of watershed governance was to create social resilience to adapt to a changing climate as illustrated in Figure 3.2. According to Pahl-Wostl (2009) an adaptive institution is able to cope with multiple ambiguous objectives inherent in such social-ecological systems. It is evident

that lack of a clear collective aim in the basin resulted in fragmented interventions that could not result in cumulative positive impact.

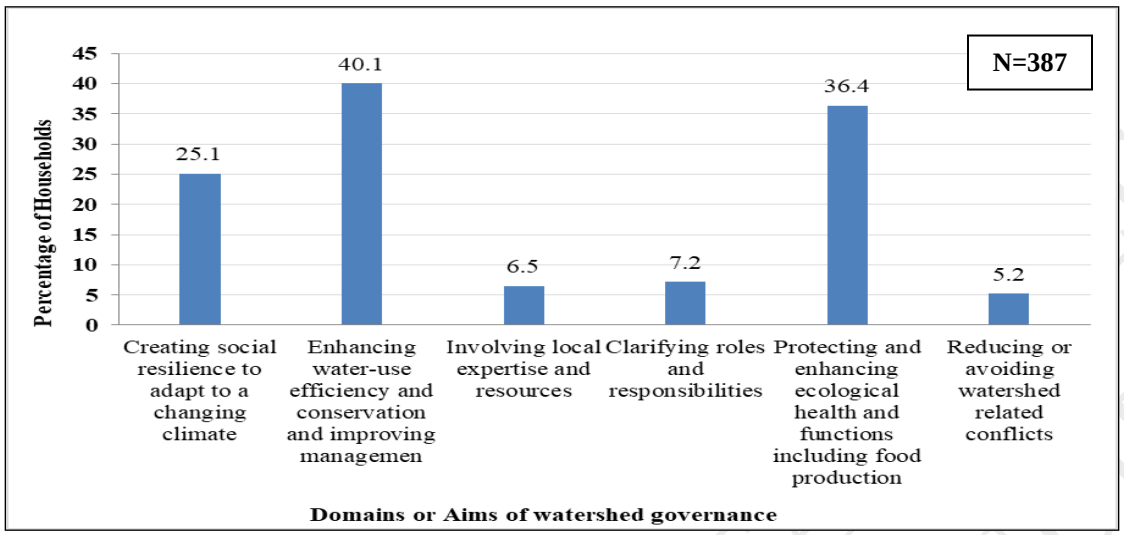


Figure 3.2: Aims for watershed governance in the Lower Sio River Basin

A Chi-square test shown in Table 3.2 indicated that there was a highly significant variation among the responses of households with food security and households with food insecurity on the following aims of watershed governance: creating social resilience to adapt to a changing climate, and clarifying roles and responsibilities at p-value=0.000; enhancing water-use efficiency and conservation and improving management at p-value=0.010. This implied that the three watershed governance aims according to the households were important predictors of the status of food security in the basin. Having a collective watershed governance aim is inherent since the public might underestimate the value of watershed protection because they cannot physically see all the aspects related to it (Borecki *et al.*, 2016). On the contrary, the aims of watershed governance including; involving local expertise and resources, protecting and enhancing ecological health and functions including food production, and reducing or avoiding watershed related conflicts forming one of the main functions that WRUAs are mandated to

perform, under the Water Act of 2016 were found to be insignificant to households' food security status in the Lower Sio River Basin.

Table 2: Food security and insecurity of households' measurement comparison association amongst the domains /aims for watershed governance

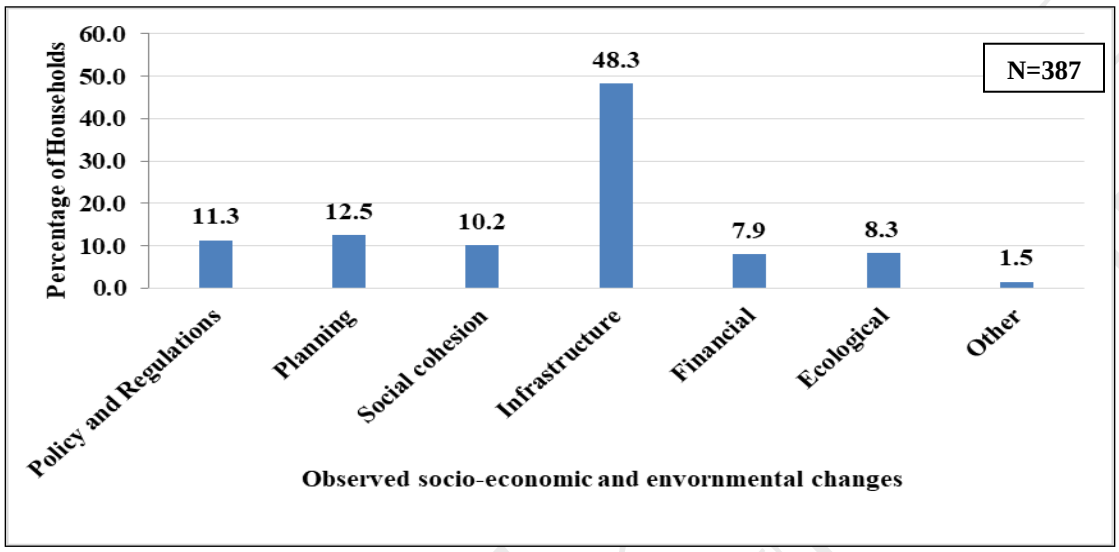
Domain/aims	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value
Creating social resilience to adapt to a changing climate	15	37.6	22.6	26.058	0.000***
Enhancing water-use efficiency and conservation and improving management	45.8	32.9	-12.9	6.575	0.010***
Involving local expertise and resources	7.5	5.2	-2.3	0.819	0.366
Clarifying roles and responsibilities	11.7	1.7	-10.0	14.106	0.000***
Protecting and enhancing ecological health and functions including food production	39.3	32.9	-6.4	1.642	0.200
Reducing or avoiding watershed related conflicts	5.1	5.2	0.1	0.001	0.978

***p< 0.01 statistically significant difference between the households with food secure and insecure

3.4 Socio-economic and Environmental Changes

Based on the findings from the study, 68.5% (265) of the households reported that there were observed socio-economic and environmental changes in the watershed governance after 2010 when Kenya changed its system of governance from a centralized national government system to a multi-level national and county government systems. On contrary, 31.5% (122) of the household reported that there were no observed socio-economic and environmental changes in the basin.

Figure 3.3 depicts socio-economic and environmental changes that the households observed since 2010 in the Lower Sio River Basin. A percentage, 11.3% (30), of the households reported having observed changes in watershed management, food policies and regulations while 12.5% (33) noted that changes had been observed in watershed and food planning.



Note: Other includes; Reduced harvests, increased awareness on local leadership (MCAs)

Figure 3.3: Observed Socio-economic and environmental changes since 2010

Moreover, the study noted that 10.2% (27) had reported changes in social cohesion; the majority, (48.3%) (128), realized that there were changes in infrastructure in the watershed. Further, 7.9% (21) of the respondents indicated that there were observed changes in financial assistance for investments in watershed activities while 8.3% (22) noted that there were observed ecological changes. Comparatively, a small proportion 1.5% (04) of the respondents reported that there were other changes which included increased use of farm inputs such as fertilizers, lime, improved seedlings and use of tractors for ploughing. These on-farm changes were attributed to increased investments

in subsidized farm inputs by both the national and county governments as well as activities of non-governmental organizations such as Programme for Agriculture and Livelihoods in Western Communities (PALWECO), Western Kenya Community-Driven Development and Flood Mitigation, One Acre Fund and Hand in Hand East Africa. These organizations were reported to offer inputs to farmers' groups on credit.

According to Cooper *et al.* (2011), farmers in East Africa have continued to experience rainfall variability thus the farming systems have not been static. Therefore, farmers have been testing and adopting new agricultural practices some of which have contributed to soil and water conservation with the aim of addressing the negative impacts of climate change. Patt *et al.* (2012) noted that changes in agricultural practices among the farmers in East Africa include: improved crop, soil, land, water and livestock management systems, such as introducing crop cover, micro-catchments, ridges, rotations, improved pastures, planting trees, and new technologies such as improved seeds, shorter cycle varieties, and drought tolerant crop varieties. Unlike in the Lower Sio River Basin, the study expected similar socio-ecological changes to be reported by the households, since there has been a major shift in socio-ecological governance in Kenya since the year 2010 occasioned by constitutional reforms.

3.5 Watershed Governance Conditions

The results in Table 3.4 show that 30% (116) of the respondents acknowledged that collective grassroot by-laws were absent. Only 21.2% (82) recognized the presence of collective grassroots by-laws while 17.8% (69) acknowledged the presence of traditional and cultural value systems that were vital in the households' adaptation to social, economic and environmental conditions.

Table 3.4: Watershed Governance Conditions Present

Watershed governance conditions	% reported present n=285	% reported absent n=410
Grass-root by-laws	21.2 (82)	30.0 (116)
Traditional/cultural value systems	17.8 (69)	8.0 (31)
Continuous peer to peer learning and capacity building	8.5 (33)	4.7 (18)
Co- management with other international actors	6.2 (24)	4.4 (17)
Independent oversight and public reporting	4.9 (19)	4.1 (16)
Support from and partnership with local government	4.1 (16)	13.4 (52)
Enabling powers in county/national legislation for watershed entities	3.9 (15)	8.8 (34)
The mechanism for interaction between upstream and downstream water users	1.8 (07)	6.5 (25)
Availability of data, information and monitoring	1.8 (07)	5.9 (23)
A functional legal framework for sustainable watershed management	1.3 (05)	7.2 (28)
Sustainable long-term funding	1.0 (04)	8.0 (31)
Assessing cumulative impact	1.0 (04)	4.9 (19)

Note: Reported present weighted average = 0.211886305; Reported absent weighted average =0.299741602

On the other hand, 6.2% (24) of the respondents identified the presence of co-management with other international actors in watershed management while 8.0% (31) reported the absence of traditional/cultural value systems. Moreover, 7.2% (28) observed that a functional legal framework for sustainable watershed management was lacking in the study area. According to listed watershed governance conditions, none of the conditions was identified to be present by 50% and more respondents. Consequently, examination of Brandes and O'Riordan (2014) nine winning conditions for watershed

governance systems showed the Lower Sio River Basin lacked watershed governance to enhance households' adaptive capacity towards food security. According to Candel (2014), governance systems characterized by conflicts, lack of institutional capacity, poor policy design, and lagging implementation can trigger serious harm to the production and distribution of healthy food.

3.6 Knowledge on Watershed Governance Structures and Households Food Security

The findings show that a small portion 25.3% (98) of the households understood that there were water resources management plans while 12.9% (50) understood that there were water resource laws and regulations that guided the households' activities (Table 3.5). However, only 1.6% (06) of the total households understood that there were water resources monitoring frameworks in the basin. On the contrary, 17.3% (67) acknowledged that cultural values such as community norms and beliefs guided households' watershed management activities. Further, 27.9% (108) understood that other non-formal structures such as household heads rules and religious values existed to guide utilization of watershed resources such as land. Kagombe *et al.* (2018) concluded that lack of awareness among the community members on the importance of conservation of catchment areas negatively influenced farmers' utilization of watershed resources.

Table 3.5: Food security and insecurity of households' measurement comparison association amongst the watershed governance structures

Governance structure	Food Insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value
Water resources management plans	7.9	46.8	38.9	76.459	0.000***
Water resources laws and regulations	13.6	12.1	-1.5	0.170	0.680
Water resources monitoring frameworks	0.9	2.3	1.4	1.189	0.275
Water resources financial budgets	3.3	2.9	-0.4	0.046	0.830
Water resource institutions	4.7	13.9	9.2	10.104	0.001***
Water resources policies	18.2	4.0	-14.2	18.361	0.000***
Transparency and accountability means	2.3	2.3	0.0	0.000	0.987
Cultural values systems	17.3	17.3	0.0	0.000	0.989
Other specify	40.2	12.7	-27.5	35.881	0.000***
The overall score for the watershed governance structure					
Mean(SD)	12.05 (3.92)	12.72 (4.75)	0.7 (0.8)	F=8.636	0.003***

***p< 0.01 statistically significant difference between the households with food secure and insecure

Note: Others include; Household head (family) rules and religious values

The findings in Table 3.5 indicated that, out of the nine watershed governance structures, items that were tested, only four showed positive statistically significant difference between the households with food security and insecurity. They included: water resources management plans (p-value=0.000); water resource institutions (p-value=0.001); water resources policies (p-value=0.000); and other (family rules and religious values) (p-value=0.000). This is despite the fact that households in focus group

discussions had indicated that failure in implementation of formal laws and regulations, left them to rely on indigenous knowledge in maintaining the farms for food production. The mean score difference among food secure households and food insecure households was enough to conclude that watershed governance structures were significant in ensuring the adaptive capacity of households towards food security in the Lower Sio River Basin. Food security cannot be realized by means of idealistic plans or new technologies only; It requires advanced steering strategies that involve governments as well as companies, NGOs and citizens, as well as social information to understand and segment target households to develop effective messages and policy tools to support behaviour change (Kropff *et al.,* 2013: Kristin *et al.,* 2015).

3.7 Drivers to Watershed Destruction and Households Food Security

The study results showed that there were several drivers of watershed destruction in the study area. About, 68.2% (264) of the households were aware that unsustainable farming practices were responsible for watershed destruction. This was emphasized during key informants' interviews, focus group discussion and review of plans; a paradox where households' unsustainable farming practices meant to increase food production resulted to the destruction of soil and water resources in the basin. Low public knowledge on watershed management was identified by 53.7% (208) whereas non-implementation and enforcement of existing laws were identified by 34.1% (132) of the households. Lack of information and early warning system was identified by 32.0% (124) of the respondents while lack of financial resources for investment in watershed management activities was mentioned by 28.2% (109). Moreover, the collapse of the traditional watershed management systems was a driver to watershed destructions identified by 9.6% (37) of the respondents. Other causes of watershed destruction reported by 6.7% (26) included conflicts between neighbors and lack of ownership of watershed resources management among community members in the watershed.

Table 3.6: Food security and insecurity of households' measurement comparison association amongst the drivers to watershed destruction

Drivers to watershed destruction	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value
Unsustainable farming practices	60.3	78	17.7	13.91	0.000***
Non-implementation and reinforcement of existing laws	35.5	32.4	-3.1	0.421	0.517
Low public knowledge in watershed management	60.3	45.7	-14.6	8.220	0.004***
Lack of information and early warning systems	29.9	34.7	4.8	1.002	0.317
Lack of financial resources for investment in watershed management	32.7	22.5	-10.2	4.887	0.027**
The collapse of traditional systems	32.7	22.5	-10.2	1.515	0.218
Others specify	9.8	2.9	-6.9	7.316	0.007***

**p<0.05 ***p< 0.01 statistically significant difference between the households with food secure and insecure

Note: Other includes; lack of means of ensuring social accountability, negligence from the public

Further, Chi-square test shown in Table 3.6 indicated significant variation in the responses among the households with food security and food insecurity and the three drivers of watershed destructions namely: unsustainable farming practices at p-value=0.000; low public knowledge in watershed management at p-value=0.004, and lack of financial resources for investment in watershed management at p-value=0.027. These implied that the three drivers of watershed destruction were important in determining

the status of households' food security in the basin. The study found out that non-implementation of existing laws, lack of information and early warning systems to weather changes and the collapse of traditional systems drivers to watershed destruction were insignificant in determining households' food security status in the study area. Watershed destruction hinders the adaptive capacity of ecosystems and rural poor communities whose livelihoods are largely dependent on ecosystem services for agricultural production.

Research indicated that reduced water flow, watersheds and catchment forest degradation were mainly due to failures in watershed governance (Makarius *et al.,* 2015). It is necessary that adaptation is undertaken by governments on behalf of society, sometimes in anticipation of change, but, again in response to individual events. At any level, adaptation proceeds through two main steps: facilitation and implementation (Klein, 2004). Whereas the former involves raising awareness, removing barriers and making funds available for adaptive strategies, the latter involves making physical operational changes in practice and behaviour (Paavola and Adger, 2005; Parry *et al.,* 2005). Furthermore, watershed governance focuses on improving decision-making in a more inclusive framework, achieving sustainable healthy watersheds and the flow of benefits from them (Makarius *et al.,* 2015).

3.8 Factors that Contribute to Public Involvement in Watershed Management

Based on the findings the need to increase or sustain food production at the household level was highly ranked as an important factor for watershed management by 86.8% (336) of the households. Availability of financial resources was ranked second important by 79.6% (308) of the households while adequate knowledge and expertise were ranked as important by 70.0% (271) of the interviewed households. Effective leadership that promotes watershed management activities ranked as important by 69.8% (270), local watershed policies, laws and plan ranked as important by 67.2% (260), and collaborations

and partnership with other actors ranked as important by 60.2% (233) as shown in Table 3.7.

Table 3.7: Factors that contribute to public involvement in watershed management activities

Watershed Management factors	Ranking scale (Percentage (N=387)			
	Not Important	Important	Rank	Don't Know
Need to increase or sustain food production	2.3 (09)	86.8 (336)	1	10.9 (42)
Availability of financial resource	0.8 (03)	79.6 (308)	2	19.6 (76)
Adequate knowledge and expertise	1.0 (04)	70.0 (271)	3	28.9 (112)
Good leadership that promotes activities	2.8 (11)	69.8 (270)	4	27.4 (106)
Local watershed policies, laws, plans	3.1 (12)	67.2 (260)	5	29.7 (115)
Collaborations and partnership with other actors	1.6 (06)	60.2 (233)	6	38.2 (148)
Traditional/cultural values systems	7.0 (27)	57.9 (224)	7	35.1 (136)
Local political will and support	7.2 (28)	57.6 (223)	8	35.1 (136)
Working with research institutions	2.8 (11)	50.1 (194)	9	47.0 (182)
Availability of early warning systems	7.2 (28)	49.9 (193)	10	42.9 (166)
Clear conflict resolution framework	3.6 (14)	49.6 (192)	11	46.8 (181)

The absence of the listed factors would mean that households in the basin could not effectively participate in watershed management and food security activities. Makarius *et al.* (2015) noted that for effective and efficient watershed governance at any level, there were a number of management components that must be fulfilled. These included actual integration of economic and environmental objectives within the watershed context; integration of policies, programs and protocols which guide outcome-based planning, monitoring and enforcement; and, effective and efficient delivery of watershed services through the development of high-performance public and private organizational structures. A number of physical, social and cultural factors influence the watershed management (Young 1999). Institutions as a patterned behaviour of the social group over

a period of time constitute a cross-cutting factor and a particular driving force in watershed decision making (Young, 1999; Namenya, 2012).

3.9 Public Participation in Watershed Governance Structures

The results in Figure 3.4 illustrate stages of households' participation in watershed management policies, plans, and programmes at the grassroot level. The findings indicate that majority 87.3% (338) of the households did not participate in any way in watershed and food security policies, plans and programmes organized by either state or other non-state actors. On the contrary, 4.7% (18), and 4.9% (19) of the households indicated to have participated in the policy and plans formulation and implementation level respectively while 3.1% (12) indicated that they were involved in monitoring and evaluation of the policies, plans and programmes related to watershed management and food security.

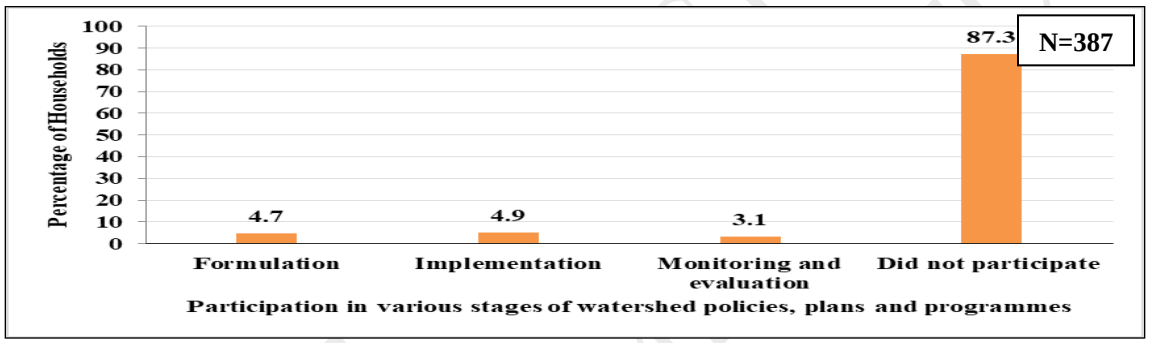


Figure 3.4: Stages of participation in watershed management plans, policies and Programmes

A Chi-square test shown in Table 3.8 revealed that there was a significant variation at p-value=0.047 among the households with food security and households with food insecurity with the households' involvement in monitoring of watershed policies and plans. This implied that households' involvement in the monitoring of the watershed policies and plans contributed significantly to the status of households' food security in the basin. However, the study did not establish any significant variation between the food secure and food insecure households and their involvement in the formulation and

implementation of watershed management and food security policies, plan and programmes.

Table 3.8: Food security and Insecurity households' measurement comparison association amongst the stages of participation in various watershed policies and plans

Stage of Policy/plan	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value
Formulation	45.5	72.2	26.7	2.078	0.149
Implementation	72.7	61.1	-11.6	0.408	0.523
Monitoring	18.2	55.6	37.4	3.932	0.047**

**p<0.05 statistically significant difference between the households with food secure and insecure

A study by Joshua *et al.* (2015) on changes in the adaptive capacity of Kenyan fishing communities, revealed that people with least participation in decision making had lower occupational multiplicity, trust and social capital making them socially and politically marginalized with the lowest adaptive capacity. Further, the study established that, the households who did not participate in decision-making had limited chances to influence soil and water resource governance, in addition to being least able to respond to negative effects. It is important to involve the beneficiaries at different levels of the watershed governance programmes to enhance adaptive capacity. Even during this era of the national and county governments in Kenya, as earlier observed by Lemma *et al.* (2011), the approach to watershed extension service delivery remains top-down with issues of accountability mainly flowing upwards.

During focus group discussions, it was reported that those who were involved either at formulation, implementation or monitoring and evaluation were either grassroots, national and county government staff, local administrators or leaders representing civil society organizations and the households who were closely related to the county government staff. The discussion further revealed that the mode of public participation

used by the county government was not inclusive since community avenues such as worshipping centres, burial and funeral ceremonies, weddings and market days were neglected as avenues to involve most people in the processes of policy making and planning. However, interviews with the county government officers indicated that most households in the basin did not participate in meeting fora called and organized by the county government departments because people expected monetary reimbursement which was not offered. The public labeled the meetings as Member of the County Assembly (MCAs) meetings and not their public meetings.

A study by Schwilch *et al.,* (2009) showed that through the policy-making workshops, different stakeholder groups have the opportunity to express their opinions and learn about others' opinions. This is an important step towards building a common vision of what needs to be done. Through participation, social learning necessary for individual adaptive capacity is stimulated, the participants realize that it is possible to collectively agree on the best way to manage their watershed resources and importantly involve different stakeholders in decision making because they have much to learn from one another (Fiona *et al.,* 2013). Furthermore, participatory approaches are considered an important aspect of improving extension services provided to farmers to improve accountability and increase transparency in organizational performance (Elias *et al.,* 2015).

3.10 Governance Values observed and Household Food Security

Based on the results in Figure 3.5, majority 50.6% (196) of the households did not know any governance values, only 8.8% (34) were aware that there were governance values in the basin. On the other hand, 40.6% (157) indicated that there was lack of governance values in the basin. Majority 78.1% (302), 75.0% (290), 64.3% (249) and 69.6% (269) of the households acknowledged that there were efforts to ensure that watershed, as well as food security policies, were inclusive at policy formulation, implementation, monitoring and evaluation respectively.

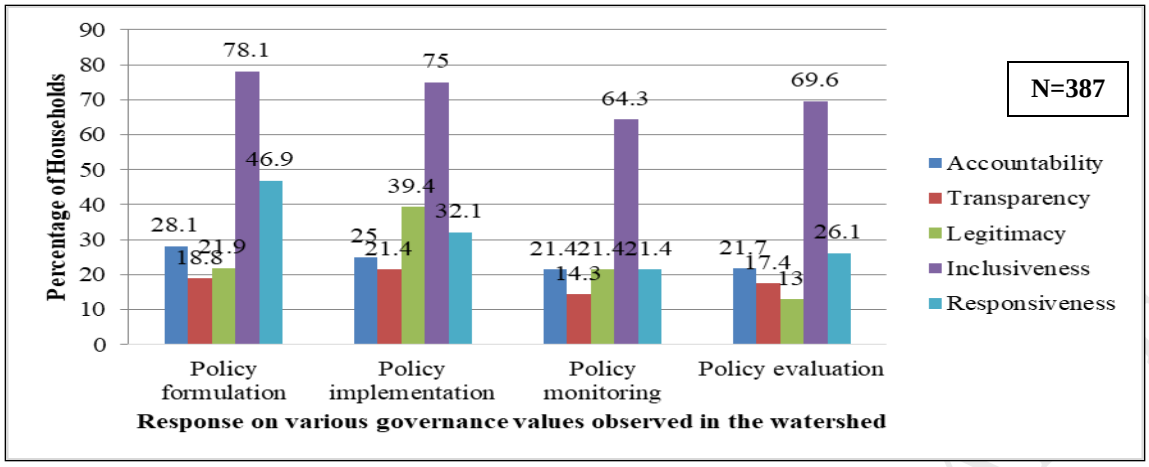


Figure 3.5: Governance Values observed at different levels of Watershed and Food policies

On the contrary, the findings showed that other governance values were observed by a small portion of households: 18.8% (73), 21.4% (83), 14.3% (55) and 17.4% (67) of the total household heads observed transparency as a critical value in governance was observed in policy formulation, implementation, monitoring and evaluation respectively.

On the same note, 28.1% (109), 25.0% (97), 21.4% (83) and 21.7% (84) respectively observed that there was accountability in policy formulation, implementation, monitoring and evaluation; while, 46.9% (182), 32.1% (124), 21.4% (83) and 26.1% (101) respectively indicated to have observed efforts to ensure that watershed management and food security policies were responsive to the local needs during policy formulation, implementation, monitoring and evaluation respectively. Furthermore, 21.9% (85), 39.4% (152), 21.4% (83) and 13.0% (50) of the respondents observed that there was legitimacy in watershed management and food security policies at policy formulation, implementation, monitoring and evaluation processes respectively. Failure to realize the governance values in the study area is an indication of ineffective watershed governance that results in a low adaptive capacity of stakeholders.

A Chi-square test presented in Table 3.8 indicated that there was a significant variation among households with food security and households with food insecurity with accountability at policy and plan formulation phase at p-value=0.002 and legitimacy at policy and plan implementation phase at p-value=0.001.

Table 3.9: Food security and Insecurity households' measurement comparison association amongst the governance values at stage of policy and plan

Governance values at phases of Policy/Plan	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value
Formulation					
Accountability	66.7	13.0	-53.7	9.201	0.002***
Transparency	33.3	13.0	-20.3	1.748	0.186
Legitimacy	44.4	13.0	-31.4	3.732	0.053*
Inclusiveness	55.6	87.0	31.4	3.732	0.053*
Responsiveness	44.4	47.8	3.4	0.030	0.863
Implementation					
Accountability	50.0	18.2	-31.8	2.545	0.111
Transparency	33.3	18.2	-15.1	0.643	0.423
Legitimacy	100.0	22.7	-77.3	11.802	0.001***
Inclusiveness	50.0	81.8	31.8	2.545	0.111
Responsiveness	16.7	36.4	19.7	0.839	0.360
Monitoring and Evaluation					
Accountability	0.0	26.1	26.1	1.660	0.198
Transparency	0.0	17.4	17.4	1.014	0.314
Legitimacy	20.0	21.7	1.7	0.007	0.932
Inclusiveness	40.0	69.6	29.6	1.564	0.211
Responsiveness	40.0	17.4	-22.6	1.247	0.264

*p<0.1, ***p< 0.01 statistically significant difference between the households with food secure and insecure

The findings did not establish any significance between governance values tested and households' food security status at monitoring and evaluation phase of watershed governance policies, plans and programmes. This implied that observing accountability

at watershed management policy and plans formulation phase and legitimacy at policy and plan implementation phase contributed significantly to the households' food security in the basin.

Evidence showed that a watershed governance system that provides an opportunity for inclusiveness enhances the adaptive capacity of actors. Political will, leadership, prioritization, knowledge and values such as accountability, transparency, legitimacy, inclusiveness, and responsiveness are inherent to enhance food security (FAO, 2011). On the other hand, Koc *et al.* (2008) emphasized that participation of civil society provided the policy-making process with valuable information, brings watershed and food security governance closer to the people therefore enhancing the legitimacy of, and public support for, food security interventions, which, together with the resources that CSOs can bring in, stimulate effective implementation. Studies carried out by FAO recommended that careful consideration must be given to designing mechanisms that ensure social inclusiveness and equitable representation of all watershed stakeholders, including socially and economically disadvantaged groups in planning and decision making processes (FAO, 2017).

3.11 Watershed Management Expertise and Households Food Security

The findings in Table 3.9 showed that majority (34.4%) (133) of the households depended on traditional expertise for their involvement in watershed management activities, 34.4% (133) of the households also indicated that land management expertise existed. However, during group discussions respondents agreed that the land management expertise was dependent on traditional skills, knowledge and experience (fencing homes with live fences and using farm manure) that the respondents had accumulated for a long period of time in the basin. Other watershed management expertise was identified by very few households, a clear indication that government and non-governmental actors did not promote the expertise.

Table 3.9: Watershed Management Expertise Present

Watershed Expertise	Frequency(N=387)	Percentage of HH
Traditional expertise	133	34.4
Land management	133	34.4
Watershed planning	62	16.0
Farmers coordination	48	12.4
Information and communication	42	10.9
Sustainable Agricultural production	39	10.1
Water quality monitoring	17	4.4
Stream restoration	22	5.7
Forest Management	19	4.9
Wetland restoration	13	3.4
Law enforcements	7	1.8
Fund raising	6	1.6
Research and Training	6	1.6
Advocacy and lobbying	4	1.0
Policy making and influencing decisions	2	0.5

Additional results in Table 3.10 illustrated the Chi-square test values for comparison of means of association between the watershed management expertise variables and households' food security in the basin. Watershed planning (d=27.5), stream restoration (d=8.5) and farmers' coordination (d=14.1) were found to be significant in determining households' food security at p-value =0.000 while traditional watershed expertise (d=15.2; p-value=0.002), implying that consideration of these watershed management expertise in watershed governance resulted in enhanced status of households' food security in the study area. On the other hand, the statistical analysis showed that land management and wetland restoration expertise were also significant to households' food security at (d=12.0; p-value=0.013) and (d=3.3; p-value=0.070) respectively. Further, statistical analysis indicated that sustainable agricultural production, information and communication expertise were significant to households' food security at (d=6.9; p-

value=0.026) and d=6.6; p-value=0.041 respectively. Watershed research and training expertise was found to be significant to households' food security at d=2.4; p-value=0.055, however, forest management and fundraising watershed expertise were insignificant to households' food insecurity.

Table 3.10: Food security and Insecurity households' measurement comparison association amongst the watershed expertise variables

Watershed expertise variable	Food Insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value
Watershed planning	3.7	31.2	27.5	53.677	0.000***
Traditional expertise	27.6	42.8	15.2	9.805	0.002***
Land management	29.0	41.0	12.0	6.177	0.013*
Water quality monitoring	3.7	5.2	1.5	0.488	0.485
Stream restoration	1.9	10.4	8.5	12.999	0.000***
Law enforcements	1.4	2.3	0.9	0.446	0.504
Wetland restoration	1.9	5.2	3.3	3.274	0.070*
Forest Management	5.1	4.6	-0.5	0.055	0.815
Fund raising	1.9	1.2	-0.7	0.319	0.572
Sustainable Agricultural production	7.0	13.9	6.9	4.973	0.026**
Information and communication	7.9	14.5	6.6	4.187	0.041**
Farmers coordination	6.1	20.2	14.1	17.646	0.000***
Policy making and influencing decisions	0.0	1.2	1.2	2.487	0.115
Research and Training	0.5	2.9	2.4	3.679	0.055***
Advocacy and lobbying	0.9	1.2	0.3	0.046	0.830
Other	34.6	0.6	-34.0	70.786	0.000***
The overall index score for watershed expertise					
Mean(SD)	8.32 (4.98)	12.39 (8.29)	4.1 (3.3)	F=51.709	0.000***

*p<0.1 **p<0.05 ***p< 0.01 statistically significant difference between the households with food secure and insecure

Note: Others included: Use of inorganic fertilizers and preparation of manure and watershed conflict management

The mean score difference among food secure households and food insecure households was enough to conclude that watershed management expertise of the sixteen tested variables at (d=4.1; p-value=0.000) was significant in ensuring the adaptive capacity of households towards food security in the basin. Colonelli and Simon (2013) postulate that households' food security is a highly complex and multi-dimensional issue that is impacted by a broad range of drivers and food system activities which stretch across various scales, and involves multiple sectors and policy domains that calls for various expertise. This indicated that consideration of watershed expertise in watershed governance at the household level contributes to enhanced households' food security in the basin.

3.12 Sources of finances for Watershed Management and Food Security Activities

Results in Figure 3.6 illustrate that majority 95.9% (371) of the households depended on household income to implement watershed management and food security activities. This is despite the fact that household income for the majority (54.3%) of the household was less than KES.3000= (USD 30) per month (Namenya *et al.,* 2018). Therefore, distributed to various household needs, little incomes left little or no funds to invest in watershed management activities. Moreover, 1.3% (05) households indicated that funds were obtained from line ministry budgets while 6.5% (25) households indicated that the county government departmental allocations were the source of funds for watershed management and food security activities. On the other hand, 13.4% (52) and 10.6% (41) households reported that civil societies and non-governmental organizations and Constituency Development Fund (CDF) were among other devolved funds which also acted as sources of funds for household watershed management and food security in the basin.

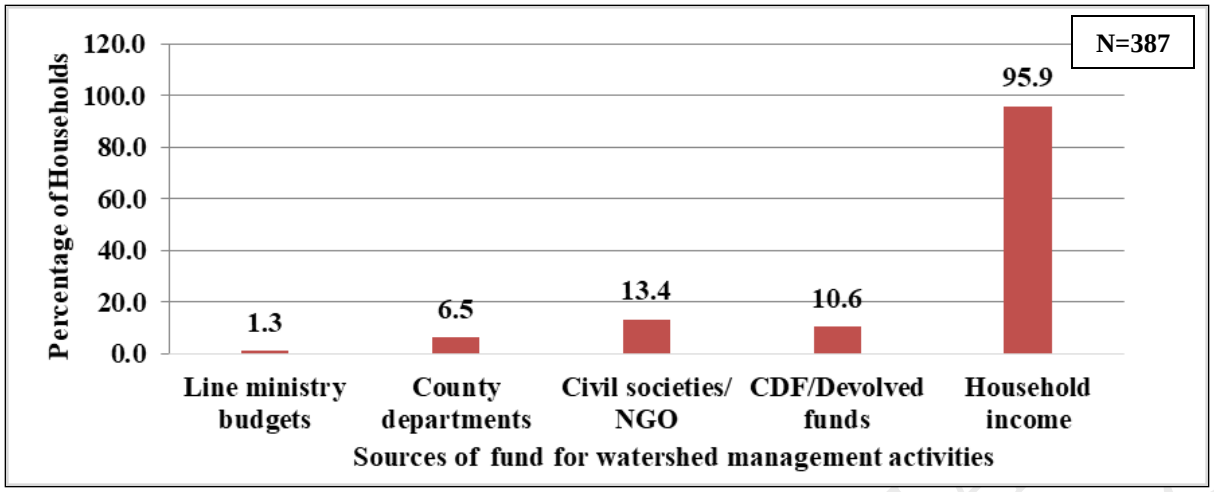


Figure 3.6: Sources of finances for Watershed Management and Food Security Activities

Availability and accessibility to financial assistance are necessary conditions for watershed governance and food security that contributes to high adaptive capacity. On the other hand, households with funds may be better able to convert human, social, financial, natural or physical resources that exist into successful adaptation outcomes (Joshua *et al.,* 2015).

Multiple sources of funding for watershed management activities is one of the key indicators for good watershed governance. However, the study by Namenya (2012) found that in Funyula, the Constituency Development Fund (CDF) was not used to finance watershed management approaches for sustainable development projects. A study by Shitote (2013) in Siaya County found that there was a significant variation among fish farmers and the use of household income that accrued from fish farming activities. Among the uses highlighted were paying school fees, building and construction of houses, medical services, farming, procurement of household goods, travelling and entertainment. There was no evidence that income from fish farming was used for soil and watershed management activities. This was similar to the situation in Lower Sio River Basin.

3.13 Source of Watershed Management Information

The findings indicate in Table 3.11 that 63.3% (245) of the households mostly preferred grass root chiefs' *barazas*, whereas 38.0% (147) of the households did not prefer faith-based fora. County-wide watershed conferences were not preferred by 51.9% (201) of the households while open outreach and education training were most preferred by 22.0% (85) of the households. Further, the study revealed that the newly created Ward Agricultural Extension offices were not preferred by 41.9% (162) of the total households. This is despite the fact that under the county government structure, ward officers are important in the dissemination of watershed governance and food security information. This finding is consistent with the research findings by Adomi *et al.,* (2003) in Nigeria, Castella *et al.,* (2006) in Vietnam and Lwoga *et al.,* (2011) in Tanzania who found that extension officers were important sources of information and knowledge, though farmers were dissatisfied with the frequency of their interactions.

Table 3.11: Sources for Watershed Management Information

Source of information	Most preferred	Moderately preferred	Least preferred	Not preferred
	Percentage (No. of HH)			
Grass-root chiefs barazas	63.3 (245)	23.5 (91)	8.5 (33)	4.7 (18)
Faith-based forums	25.1 (97)	20.2 (78)	16.8 (65)	38.0 (147)
County-wide watershed conference	24.5 (95)	8.0 (31)	15.5 (60)	51.9 (201)
Open outreach /education training	22.0 (85)	24.8 (96)	18.6 (72)	34.6 (134)
Other	21.4 (82)	2.6 (10)	3.9 (15)	72.1 (280)
Ward agricultural offices	14.0 (54)	14.0 (54)	30.2 (117)	41.9 (162)

Note: Others included: Neighbours, friends and farmers' groups

During the focus group discussions, it emerged that there was limited dissemination of relevant extension information to farmers. On the other hand, 72.1% (280) of the households did not prefer other sources of information including television, newspapers,

and social media. The main reason given in focus group discussions was low affordability of the sources due to low levels of income among the households. Elsewhere, a study by Lwoga *et al.,* (2011) indicated that village leaders, livestock headers, agricultural shops, NGOs, cooperative unions, farmer groups, religious bodies, and middlemen were important sources of knowledge in some local communities. The findings suggest the need to have a flexible, more participatory and adaptive means of accessing information on watershed governance and food security in the Lower Sio River Basin.

Conclusions and Recommendations

Despite the existence of institutions at the national, county and community levels of governance in the Lower Sio River basin, watershed governance structures, expertise, capacities created, satisfaction towards watershed governance and food security did not contribute to the adaptive capacity at the household level. There was need for multi-level government actors to enhance adaptive capacities of households towards sustainable food security. This could be done through collective formulation and implementation of policies and plans towards improving and integrating watershed governance goals and aims; Developing synergies for watershed governance to enhance adaptive capacity through structures, expertise, knowledge in governance arrangement, land use, ecological and climate dynamics to enhance food security in the Lower Sio River basin.

References

Adger, W.N. ,(2003). Building Resilience to Promote Sustainability; an Agenda for Coping with Globalization and Promoting Justice, International Human Dimensions Programme on Global Environmental Change (IHDP).

Adomi,E.E.,Ogbomo,M.O. and Inoni,O. E.(2003). "Gender factor in crop farmers' access to agricultural information in rural areas of Delta State, Nigeria". *Library Review,* Vol. 52 No. 8, pp. 388-393.

Albinus M.P, Makalle, Obando. J., Yazidhi B., (2008). Effects of land use practices on livelihoods in the Trans boundary sub-Watersheds of the Lake Victoria. *African Journal of Environmental Science and Technology* Vol. 2 (10). pp. 309-317, October, 2008 Available online at http://www.academicjournals.org/ AJest ISSN 1996-0786 © 2008 Academic Journals. Accessed on 05/05/2015.

Bohensky, E. and Lynam, T. (2005). Evaluating responses in complex adaptive systems: Insights on water management from the Southern African Millennium Ecosystem Assessment (SAFMA). *Ecology and Society*, 10 (1), 11.

Borecki,J.,Dunlop,R.,Kerford,A.,Wang,J.(2016).*Public Perception of Water Management and Understanding of the Watershed: A Case Study on Calgary, Alberta.* Faculty of Science, Environmental Science Program, University of Calgary, Alberta, Canada.

Brandes, O., and O'Riordan, J. (2014). *A blueprint for watershed governance in British Columbia. Victoria, Canada:* POLIS Project on Ecological Governance, University of Victoria.

Bussey, M., Carter, R., Keys, N., Carter, J., Mangoyana, R., Matthews, J., Nash, D., Oliver, J., Richards, R., Roiko, A., (2012). Framing Adaptive Capacity through a History-Futures Lens: lessons from the South East Queensland Climate Adaptation Research Initiative. *Futures* 44 (4) 385–397.

Candel, J.J.L., (2014). Food security governance: a systematic literature review. *Springer Science Business Media Dordrecht and International Society for Plant Pathology* 20:14

Castella, J., Slaats, J., Quang, D. D., Geay, F., Van Linh, N. and Tho, P. T. H. (2006), "Connecting marginal rice farmers to agricultural knowledge and information systems in Vietnam Uplands". *The Journal of Agricultural Education and Extension*, Vol. 12, No. 2, pp. 109–125, available at: http://dx.doi.org/10.1080/13892240600861625 (accessed 12 June 2016).

Colonelli, E., & Simon, G. (2013). Food Security Governance: History, Definitions and Institutions. Available at http://www.jeanmonnet.it/public/Food%20Security%20Governance%20Catania%202013.pdf. Accessed 5 June 2015.

Cooper, P. J. M., & Coe, R. (2011). Assessing and addressing climate induced risk in sub-Saharan rain fed agriculture. *Experimental Agriculture*, 47(02), 179–184.

Cronbach, L., (1990). *Essentials of psychological testing*. Harper & Row, New York.

Elias. A, Nohmi. M., Yasunobu. K. and Ishida. A. (2015). Farmers' Satisfaction with Agricultural Extension Service and Its Influencing Factors: A Case Study in North West Ethiopia. *J. Agr. Sci. Tech*. (2015) Vol. 18: 39-53

Fiona P. M, A. Kessler, Katia L., and Saskia V., (2013). The Use of Stakeholder Analysis in Integrated Watershed Management: Experiences From the Ngenge Watershed, Uganda. Mountain Research and Development, 33(2):122-131 *International Mountain Society*. http://www.bioone.org/doi/full/10.1659/MRD-JOURNAL-D-12-00031.1 Accessed on 24/02/2018.

Foerster, A., (2011). Developing Purposeful and Adaptive Institutions for Effective Environmental Water Governance. *Water Resource Management*. 25, 4005–4018.

Food and Agriculture Organization (FAO) (2011). *Good Food Security Governance*: The Crucial Premise to the Twin-Track Approach - Background paper. http://www.fao.org/fileadmin/templates/righttofood/documents/other_documents/2011_od_food_security_gov/FoodSecurityGovernanceWorkshop_backgroundpaper.pdf. Accessed 5 June 2015

Food and Agriculture Organization (FAO) (2017). *Watershed Management in Action: Lessons Learned from FAO field projects.* Food and Agriculture Organization, United Nations. Rome.

Government of Kenya (GoK) (2010). *Kenya National Census Report of 2009.* Nairobi; Government Printers.

Government of Kenya (GoK) (2002). *Water Act of 2016.* Nairobi; Government Printers

Government of Kenya (GoK) (2013). *County Government of Busia: First Busia County Integrated Development Plan (CIDP) 2013-2017* Nairobi; Government Printers.

Gupta, J., C. Termeer, J. Klostermann, S. Meijerink, M. van den Brink, P. Jong, S. Nooteboom, and E. Bergsma. (2010). The Adaptive Capacity Wheel: a method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science and Policy* 13:459-471. http://dx.doi.org/10.1016/j.envsci.2010.05.006

Huntjens, P., Lebel, L., Pahl-Wostl, C., Rshulze, R., Camkin, J., Kranz, N., (2012). Institutional Design Propositions for the Governance of Adaptation to Climate Change in Water Sector. *Glob. Environ. Chang* 22, 67-81.

Joshua E. C, Cindy H, Christina C. H, Tim M. D, Nadine M, Andrew W and Edward H. A (2015). Changes in adaptive capacity of Kenyan fishing communities. *Nature Climate Change* DOI: 10.1038/NCLIMATE2690 Available at www.nature.com/natureclimatechange accessed on 5/6/2018

Kagombe J.K., Kungu J., Mugendi D., and Cheboiwo J. K. (2018). Evaluating the Willingness to Pay for Watershed Protection in Ndaka-ini Dam, Muranga County, Kenya. *Civil and Environmental Research.* ISSN 2224-5790 (Paper) ISSN 2225-0514. Vol.10, No.1, 2018. (Online) www.iiste.org accessed on 6/6/2018.

Klein, R.J.T., (2004). "Approaches, Methods and Tools for Climate Change", Keynote Lecture to the In Session Workshop on Impacts of, and Vulnerability to Climate

Change, 21st Session of the UNFCCC Subsidiary Body for Scientific and Technological Advice, Buenos Aires, 8 December 2004.

Koc, M., Macrae, R., Desjardins, E., & Roberts, W. (2008). Getting civil about food: The interactions between civil society and the state to advance sustainable food systems in Canada. *Journal of Hunger and Environmental Nutrition*, 3(2–3), 122–144.

Komakech. C. H. (2013). *Emergence and Evolution of Endogenous Water Institutions in an African River Basin:* Local Water Governance and State Intervention in the Pangani River Basin, Tanzania. Leiden, The Netherlands. CRC Press/Balkema.

Koontz. T.M., Gupta. D., Mudliar. P., and Ranjan. P. (2015). Adaptive Institutions in Social-ecological Systems Governance: A Synthesis Framework. *Environ. Sci. Policy*. http://dx.doi.org/10.1016/j.envsci.2015.01.003 Accessed on 01.05.2015

Kristin F, Kofi A, Kathleen E. H, Andrew T. K, and Mae D. (2015). The Role of Social Science in Successfully Implementing Watershed Management Strategies. Universities Council on Water resources. *Journal of Contemporary Water research & education issue* 154, pages 85-105, April 2015.

Kropff, M. J., Van Arendonk, J. A. M., & Löffler, H. J. M. (Eds.). (2013). *Food for all: Sustainable Nutrition Security.* Wageningen UR: Wageningen.

Lemma, T., Sehai, E. and Hoekstra, D. (2011). Status and Capacity of Farmer Training Centres (FTCs) in the Improving Productivity and Market Success (IPMS) Pilot Learning Woredas (PLWs). Retrieved from: http://cgspace.cgiar.org/handle/10568/16899. Accessed on 01.06.2015

Lwoga, E. T., Stilwell, C., & Ngulube, P. (2011). Access and use of agricultural information and knowledge in Tanzania. *Library Review*, *60*(5), 383-395.

Majule, A.E., Gibson, R. and Chiwatakwenda, A. (2007). Climate Change Adaptations in Low Potential Area of Tanzania: Local perceptions, vulnerability, current adaptations and in future strategies in Sanjaranda Village, Manyoni, Singida, CCAA-Tanzania, Malawi Working Paper No. 2

Makarius C.S. L, Meire, P., and Yonika M. N., (2015). Exploring watershed conservation and water governance along Pangani River Basin, Tanzania. *Land Use Policy.* Elsevier. www.elsevier.com/locate/landusepol.

Mugenda. M.O &Mugenda A.G. (1999). *Research Methods Qualitative and Quantitative Approaches*. African Centre for Technology Studies (ACTS), Nairobi.

Namenya Daniel Naburi, Edward M. Mugalavai and John F. Obiri (2018). Determinants of Watershed Governance and Food Security among Households' in the Lower Sio River Watershed, Busia County, Kenya. *International Journal of Agriculture, Environment and Bioresearch* Vol. 3, No. 05; 2018, ISSN: 2456-8643 Page 30-55.

Namenya, D. N (2012). *Watershed Management. For Sustainable Constituency Development Fund Projects in Funyula, Kenya*. Saarbrucken, Germany. Lambert Academic Publishing.

Ndesanjo, R., (2009). Climate Change Impacts and Adaptive Strategies in the Rufiji Delta, MSc. Dissertation (Unpublished), Dar es Salaam, University of Dar es Salaam.

Obando, J. A., Bamutaze, Y. and Makalle, A. (2007) (In prep), The Impact of Land Use Changes on Community Livelihoods of Sio sub-Watershed in the Lake Victoria Basin. *Watershed Lake Research*

Ostrom, E., (2005). *Understanding Institutional Diversity.* Princeton University Press.

Paavola, J., and T.W. Adger., (2005), "Analysis of Fair Adaptation to Climate Change", *Journal of Ecological Economics* Volume 56, (2006), Norwich, UK, pp 594-609.

Pahl-Wostl, C., (2009). A Conceptual Framework for Analyzing Adaptive Capacity and Multi-level Learning Processes in Resource Governance Regimes. *Global Environ. Chang.* 19 (3) 354–365, http://dx.doi.org/10.1016/j.gloenvcha.2009.06.001. Peterson, P.E., 1995. The Price of Federalism. R.R. Donnelley & Sons Co. Press, New York.

Parry, J., A, Hammill., and J, Drexhage., (2005). Climate Change and Adaptation, Manitoba, Canada, http://www.iisd.org/ retrieved on, 23/05/2015.

Schwilch G, Bachmann F, Liniger HP. (2009). Appraising and selecting conservation measures to mitigate desertification and land degradation based on stakeholder participation and global best practices. *Land Degradation and Development* 20:308–326.

Serem, D. K., Boit, J. M., & Wanyama, M. N. (2013). *Understanding Research: A Simplified Form.* Eldoret: Utafiti Foundation.

Shitote Z., (2013). *Fish Farming Household Food Security and Livelihoods in Siaya County Western Kenya*. PhD Thesis School for Disaster Management and Humanitarian Assistance, MMUST.

Stringer L.C (2009). Testing the Orthodoxies of Land Degradation Policy in Swaziland. *Land Use Policy,* Vol. 26, p157-168.

Wanjogu, S.N (2004). *The Distribution, Characteristics and Utilization of wetland Soils in Sio Basin, Western Kenya*. Lake Victoria Environmental Management Project. http://hdi.handle.net/11671/811 Downloaded from EAC IRC Respiratory, Accessed on 8/9/2016.

Yamane, T. (1967). Statistics, An Introductory Analysis, 2nd Ed, New York: Harper and Row.

Young,O.R.(1999).*Institutional Dimensions of Global Environment Change*. International Human Dimensions Program Report 9, Bonn, Germany