WATERSHED GOVERNANCE AND ITS IMPLICATIONS ON FOOD SECURITY IN THE LOWER SIO RIVER BASIN BUSIA COUNTY, KENYA

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A thesis submitted in partial fulfillment for the requirements of the award of the Degree of Doctor of Philosophy in Disaster Management and Sustainable Development of Masinde Muliro University of Science and Technology

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DECLARATION

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DECLARATION BY STUDENT

This thesis is my original work prepared with no other than the indicated sources and has not been presented for a degree or any other award in any other university or any other institution.

-- 14/11/2018 --

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CERTIFICATION

We the undersigned certify that we have read and hereby recommend for acceptance by Masinde Muliro University of Science and Technology, a thesis entitled "**Watershed Governance and its Implications on Food Security in the Lower Sio River Basin Busia County, Kenya**".

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DEDICATION

I dedicate this thesis to my wife Roseline, son, Baraka, daughters; Ziza and Tunu, my mum Maximilla Nangira and the entire Naburi family for the continued support, encouragement and prayers.

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ABSTRACT

Efforts to implement Integrated Water Resource Management are often hampered by inefficient political and institutional environments. As a result, Lower Sio River basin has experienced land use and land cover changes which have exerted negative ecological impacts on local livelihoods. It is unclear how much watershed governance is integrated into policy across the county levels to promote food security. Therefore, the study aimed at determining the status of watershed governance and its place in enhancing food security in the Lower Sio River basin; Nambale, Matayos and Funyula Sub-counties in Busia County, Kenya. The specific objectives were to: determine the perceptions of households on changes in rural watershed governance; examine the adaptive capacity of state and non-state institutions to enhance watershed governance for food security; evaluate the impacts of watershed governance structures on rural food security; and evaluate the effectiveness of adaptive co-management of watershed governance for food security. Cross-sectional and evaluation research design; qualitative and quantitative approaches, and probability and non-probability sampling techniques were used to ensure triangulation and cross-checking the research process. A structured questionnaire, interview guide, focus group discussion guide and observation checklist were tools used to collect data. Two-level multi-stage sampling was combined with simple random and proportionate sampling to select a sample of 387 households for quantitative data. Purposive, convenient and snowball sampling procedures were used to select a sample for key informants' interviews and focus group discussions. Descriptive statistics, bi-variate, Chi-square and T-test, context and qualitative analysis were done. The study found that 75.2% of the households' depended on farmlands for food while 81.9% agreed that watershed governance determined food security. Consequently, 86.3% needed changes in watershed governance systems. 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 at 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. Majority 86.8% blamed low farm yield as a key driver for households' food insecurity. Low supply of food in the market, incidences of prolonged droughts and low levels of income p-value=0.000 and ineffective government policy p-value=0.007 drivers of food insecurity were significant in determining households' food security status. On average 55.3% of households were food insecure. Regression analysis results showed that religion, watershed expertise, level of satisfaction towards watershed governance and co-management of watershed could only explain 20.8% variations in households' food security status. Generally, watershed governance structures did not affect households' food security. Further, the study found that there were collaborations among actors without coordination and monitoring framework. Furthermore, 70.0% and 85.8% of households indicated that they did not offer support to National Environment Management Authority and Water Resources Authority respectively. The study concluded that watershed governance did not enhance sustainable food security thus it was recommended for deliberate policy changes and efforts towards watershed governance through building actors adaptive capacities, co-management, households' satisfaction and participation for sustainable food security in the basin.

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LIST OF ABBREVIATIONS AND ACRONYMS

AM	Adaptive Management
ADB	African Development Bank
ADF	Agriculture Development Fund
ADS	Anglican Development Services
AFC	Agriculture Finance Corporation
ASDSP	Agricultural Sector Development Support Programme
BCIDP	Busia County Integrated Development Plan
BUWASCO	Busia Water and Sewerage Company
CAAC	Catchment Area Advisory Committee
CBD	Convention on Biological Diversity
CBO	Community Based Organizations
CDALD	County Department of Agriculture and Livestock Development
CDEWNR	County Department of Environment, Water and Natural Resources
CDF	Constituency Development Fund
CEC	County Executive Committee Members
CEO	Chief Executive Officer
CFA	Community Forest Association
CGB	County Government of Busia
CIDA	Canadian international Development Agency
CIG	Common Interest Group
CMS	Catchment Management Strategies
CPR	Common Pool Resource

CSO	Civil Society Organization
CWFS	Committee on World Food Security of (FAO)
DFRD	District Focus for Rural Development
DRRESP	Disaster Risk Reduction and Extensions Services Providers
DRR	Disaster Risk Reduction
DTSC	District Technical Steering Committees
DWO	District Water Officers
EIA	Environmental Impact Assessments
EMCA	Environment Management and Coordination Act
ERC	Ethical Review Committee
EWS	Early Warning Systems
FAO	Food Agriculture Organization
FBO	Faith Based Organizations
FGDs	Focused Group Discussion
FNSP	Food and Nutrition Security Policy
GEF	Global Environmental Facility
GFFSN	Global Forum on Food Security and Nutrition of (FAO)
G.o.K	Government of Kenya
GWP	Global Water Partnership
HH	Household
IAD	Institutional Analysis and Development
IEA	Institute of Economic Affairs
IFRC	International Federation of Red Cross and Red Crescent Societies

IPCC	Intergovernmental Panel on Climate Change
IMF	International Monetary Fund
IWRM	Integrated Water Resource Management
IWUA	Irrigation Water Users Association
KAFFA	Kenya Agriculture, Fisheries and Food Authority
KALRO	Kenya Agricultural and Livestock Research Organization
KCB	Kenya Commercial Bank
KES	Kenya Shillings
KEFRI	Kenya Forestry Research Institute
KeRRA	Kenya Rural Roads Authority
KFS	Kenya Forestry Service
KMD	Kenya Meteorological Department
KNBS	Kenya National Bureau of Statistics
KWFT	Kenya Women Finance Trust
KWS	Kenya Wildlife Service
LATF	Local Authority Transfer Fund
LVBA	Lake Victoria Basin Authority
LVNCMS	Lake Victoria North Catchment Management Strategy
LVNCA	Lake Victoria North Catchment Area
LVNWSB	Lake Victoria North Water Services Board
MCA	Member of County Assembly
MDG	Millennium Development Goal
MP	Member of Parliament

MSPNDV	Ministry of State for Planning, National Development and Vision 2030
NASA	National Super Alliance
NEMA	National Environment Management Authority
NGMoA	National Government Ministry of Agriculture
NGMoENR	National Government Ministry of Environment and Natural Resources
NGO	Non-Governmental Organization
NBI	Nile Basin Initiative
NIB	National Irrigation Board
NRM	Natural Resource Management
NTEAP	Nile Tran boundary Environment Action Project
PALWECO	Programme for Agriculture and Livelihoods in Western Communities
PMT	Programme Management Team
PSC	Programme Steering Committee
PSP	Participatory Scenario Planning
PSU	Programme Support Unit
SAP	Structural Adjustment Programmes
SDGs	Sustainable Development Goals
SIDA	Sweden International Development Agencies
SPSS	Statistical Package for Social Sciences
USAID (KAVES)	Kenya Agriculture Value Chain Enterprises Project
TAC	Technical Advisory Committee
UNDP	United Nations Development Programmes
UNEP	United Nations Environment Programmes

UNFCCC	UN Framework Convention on Climate Change
WB	World Bank
WDF	Ward Development Funds
WEF	World Economic Forum
WHO	World Health Organization
WKCDD/FMP	Western Kenya Community-Driven Development and Flood Mitigation
WRA	Water Resources Authority
WRUA	Water Resources Users Associations
WSB	Water Services Boards
WSP	Water Services providers
WUA	Water Users Associations
SAP	Structural Adjustment Programmes
SPA	Service Provision Agreement

OPERATIONAL DEFINITION OF TERMS

Adaptive capacity: The ability of a human system to adjust to changes (including social, economic, political, institutional climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Adaptive co-management: is an institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organized process of learning by doing.

Adaptive governance: Changing rules and norms of institutions to steer policy interactions and guide management of resources in a manner that is able to recover or adjust to change so as to maintain or improve to a desirable state. It involves devolution of management rights and power-sharing that promotes participation.

Adaptive institutions: Those institutions that actors are able to adjust to encourage individuals to act in ways that maintains or improve to a desirable state.

Adaptive management: A systematic process for continually improving management practices. It involves learning by doing; using feedback mechanisms from the environment to shape policy, followed by further systematic experimentation, in a never-ending cycle (Engle *et al.,* 2011).

Governance: The interactions among structures, processes, rules, and traditions that determine how people in societies make decisions and share power, exercise responsibility, and ensure accountability, and how stakeholders have a say in the management of natural resources. Governance thus includes the development and application of the principles, rules, norms, and enabling institutions that guide public and private interactions (Lebel *et al.,* 2006).

Integrated Water Resources Management: This is an approach that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. It recognizes the interdependence of social, political and economic systems with biological and ecological ones within the hydrological limits of the watershed.

Institution: Enduring regularities of human action in situations structured by rules, norms and shared strategies. Created by people, institutions organize and structure human behaviour towards collective ends.

Watershed: A hydrological defined unit, an area of land draining into a common body of water such as a lake, river, or ocean. Or a topographically limited area from which all water is drained by a common water course/outlet. Watershed is also known as catchment or basin.

Watershed governance: a field of action research that emphasizes attention to important questions of governance when considering integrated water resource management. It addresses issues such as institutional and legal reform to reinvigorate the role of government – transforming governments from top-down managers to facilitators of local action in the context of a broader public trust. Watershed governance specifically recognizes the critical importance of civil society as the key facilitator of change and innovation while embracing the idea that the watershed is the starting point for sustainable water management – addressing the challenges of integration and holistic resource management at the watershed scale.

Watershed management: the integrated use of land, vegetation and water in a geographically discrete catchment or drainage area for the benefit of its residents, with the objective of maintaining the hydrological services that the watershed provides and of reducing or avoiding negative downstream or groundwater impacts. This implies also monitoring other ecological services such as soil productivity, biodiversity, carbon cycle and climate change adaptation and mitigation as well as the socio-cultural services such as aesthetics, recreation, tourism, heritage, etc.

Food security: Situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

CHAPTER ONE

INTRODUCTION

1.1: Background to the study

Watershed management challenges in river basins of Sub-Saharan Africa and in other parts of the world are increasing due to rapid urbanization, poverty and food insecurity, growing energy demands, and climate change (Komakeoch, 2013). To make it worse, increased consequences of climatic alteration are becoming more visible as climatic conditions and ecosystems change (Yanda and Mubaya, 2011). Climate variability and climate change contribute to land and natural resource degradation by exposing soils to extreme conditions and straining the capacity of existing land management practices to maintain resource quality (Malo *et al.*, 2012). Further, droughts, floods, and storms pose a risk to human livelihoods across the globe (IPCC, 2012). The growing pressure on natural resources leads to loss of livelihood, food insecurity and widespread poverty (Shisanya, 1996; Shisanya, 2005). As a result, rain fed-areas in the developing world are the hot spots of poverty, malnutrition, water scarcity and severe land degradation. Farmers' crop yields in the rain fed areas are lower by two to five folds of the achievable yields (Rockstrom *et al.*, 2007).

In Sub-Saharan Africa, livelihoods and food security of the small-scale farmers are particularly threatened by climate change, which impacts directly on agricultural production and productivity (Malo *et al.*, 2012). Although small-scale farmers continuously adapt to climate change, it is widely acknowledged that climate change has the potential to overwhelm the adaptive capacity of vulnerable populations, (IPCC, 2007).

Despite all these risks, the international communities have failed to limit the emission of greenhouse gases (IEA, 2012) and to prevent unsustainable land use changes thereby accelerating the rate at which watershed degradation affects food security. African governments are now placing top priority on adaptation, while at the same time recognizing the co-benefits and synergies with mitigation (Dejene and Malo, 2010). Integrated Water Resource Management (IWRM) has evolved over decades in promoting the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP-TAC, 2000). IWRM approach has continuously evolved in countries through new guidelines, policies, institutions, and expanding the scope (Wani *et al*., 2008) and promoted as an appropriate strategy for improving productivity and sustainable intensification of agriculture in the rain-fed, drought-prone regions in Kenya.

Watershed governance as a field of action research has been used in Australia, Canada among other states to help prepare for climate change, bolster water system reliance and strengthen drought resilience (Dietz *et al.*, 2003 and Kendall, 2013). It specifically emphasizes attention to important questions of governance in IWRM and addresses issues such as institutional and legal reform as well as the critical importance of the civil society as key facilitators of change and innovation (Brandes, 2006). It also provides a means of forestalling problems in food insecurity. Watershed governance is emerging as a paradigm shift essential to fill the gaps in IWRM, traditional governance, climate change adaptation and mitigation, and management approaches that failed to reflect public expectations and were insufficiently responsive to changing social and environmental conditions within key watersheds (Kendall, 2013). It also provides a more resilient governance framework capable of evolving along with changes in local conditions by including mechanism to ensure social and policy learning (Dietz *et al.*, 2003).

According to FAO (2014), protected and well-managed watersheds generate multiple positive effects on communities' livelihoods, the environment and the overall economy. However, climate change and watershed resources degradation are major challenges to food security (GoK, 2011). Recent studies indicate that in Kenya, changing climate impacts on food security and environmental changes of individuals, households as well as regions and the whole nation (Gregory *et al.*, 2005; Patel *et al.*, 2012; Waithaka *et al.*, 2013). It is believed that solutions to socio-ecological problems are well addressed in the Constitution of Kenya, 2010, and the County Government Act of 2012 which gave way to transformations and institutional re-organization through a devolved system of governance (GoK, 2010). However, the Water Act of 2016 addresses conservation of water catchments and development of water resources (Kagombe *et al.*, 2018). Consequently, it is unclear how much watershed governance is present in river basins in Kenya under devolution. Therefore, this study aimed at determining the status of watershed governance and its place in enhancing food security in the Lower Sio River basin.

1.2: Statement of the problem

Agriculture and food security largely depend on the quality of surface water and sediments, collected and transported by the slopes of watersheds (FAO, 2007; GoK, 2011). As a result, watershed management approaches have been main target in food security policy (GoK, 2011). However, effective watershed management depends on sustained political commitment and investment by the national governments (FAO, 2017). Despite the fact that IWRM has been widely accepted in managing watershed resources, at all levels efforts to implement IWRM are often hampered by inadequate or inefficient political and institutional environments (Ballweber, 2006). To address the hindrances in IWRM, watershed governance approach has been used to promote political, institutional and legal reforms, and refocus the role of government transforming governance from top-down managers to facilitators of local action (Brandes, 2006).

In Kenya, decentralization as a political and institutional tool has been expected to strengthen the mandate of county governments in watershed governance and facilitate the involvement of stakeholders at different levels in the food sector. However, it has often been easier for the central government to decentralize powers to the county governments than to ensure that the county governments have needed resources, capabilities and accountability necessary for watershed management. Consequently, devolved development efforts such as Constituency Development Fund Projects (CDF) have not adopted watershed management approaches to ensure sustainability (Namenya, 2012). Further, failure to recognize the economic value of water has resulted in its unsustainable use and degradation of its natural base (GoK, 2010; Kagombe *et al.*, 2018).

In western Kenya, a recent study in the Upper Sio River catchment in Bungoma County showed that despite the existence of several stakeholders necessary to enhance food security under the county governance system, food insecurity remained a challenge to human development (Wabwoba, 2017). In Busia County, the Lower Sio River 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 watershed were reported to be food insecure (GoK, 2013a). At the national level, there is the need for strong evidence from field experiences and implementation of oriented research to influence policy dialogue, decision making and investment priorities in the watersheds (Liniger *et al.,* 2017; FAO, 2017). It was on this premise that the study determined the status of watershed governance and its place in food security in the Lower Sio River basin.

1.3: Research objectives

The study aimed at determining the status of watershed governance and its place in enhancing food security in the Lower Sio River basin, Busia County, Kenya. The specific objectives of the study included to:

i. Determine the perceptions of households on changes in rural watershed governance in the Lower Sio River basin.

ii. Examine the adaptive capacity of state and non-state institutions to enhance watershed governance for sustainable food security in the Lower Sio River basin.

iii. Evaluate the impacts of watershed governance structures on rural food security in the Lower Sio River basin under devolved governments in Kenya.

iv. Evaluate the effectiveness of adaptive co-management of watersheds for sustainable food security in the Lower Sio River basin.

1.4: Research questions

i. What are the perceptions of households on changes in rural watershed governance in the Lower Sio River basin?

ii. What is the adaptive capacity of state and non-state institutions to enhance watershed governance for sustainable food security in the Lower Sio River basin?

iii. What are the impacts of watershed governance structures on rural food security in the Lower Sio River basin under devolved governments in Kenya?

iv. How effectiveness is adaptive co-management of watersheds for sustainable food security in the Lower Sio River basin?

1.5: Justification to the study

There is limited scholarly work developed on watershed governance and food security at a watershed level in Kenya. The findings of the study are expected to contribute to the implementation of watershed management and food security policy at household, village, ward, sub-county, county and national levels. The study recommendations focus on a shift in priorities, improvement in capabilities, and filling institutional and organizational gaps left by the implementation of IWRM at a river basin in the Lower Sio River basin. The study is also expected to contribute to scientific knowledge on hindrances to adaptive watershed governance at household and organizational level thus unsustainable food security interventions in the watersheds of Lake Victoria Basin and Sub-Saharan Africa.

As well as contribute to the ongoing debate on Global Sustainable Development Goals (SDGs); Water, Energy and Food Nexus, and the Sendai Framework on Disaster Risk Reduction at county and national levels in Kenya.

1.6: The scope of study

The study focused on the Lower Sio River basin that lies in Busia County, Kenya. The area falls under Lake Victoria Basin and forms part of the wider Nile basin and is located at the border between Kenya and Uganda. The study assessed variables on adaptive governance, adaptive capacity, adaptive institutions and adaptive co-management of both the state and non-state actors, formal and informal institutions in the study area. The data collection period was from September, 2017 to February, 2018.

1.6.1: Inclusion criteria

While analyzing actors and institutions, the structures or tools that have been put in place to govern the behaviour of human beings in the watershed were considered. The structures and tools did not operate in a vacuum but were exercised in groupings that came into being to achieve some shared goals of individuals and collective larger groups. Therefore, existing community organizations formed the basis for achieving the study objectives.

The study was carried out at a multi-level; at the village level, male and female household heads and individuals from 18 years and above of age was targeted as respondents. Only one respondent either female or male represented a household. Village elders were interviewed while the biophysical environment was observed and recorded. At the ward, sub-county and county levels the representatives of the national and county governments and non-governmental organizations were interviewed, these included: Assistant county commissioners, environment, water, social services, cooperative and agriculture sub-county officers, ward administrators, chiefs and assistant chiefs, County Kenya Forest Service officer, County Kenya Meteorological Department Officer, County department of irrigation and fisheries, Water Resources Management Authority, Busia Water and Sewerage Company, Coordinator of Western Kenya Community-Driven Development and Flood Mitigation, Programme for Agriculture and Livelihoods in Western Communities, Simpact Kenya, One Acre Fund, Anglican Development Services and County NEMA officer. In addition, community groups including; Farmers Common Interest Groups, Community Forest Associations and Water Resources User Associations were targeted. The relevant policies and legal frameworks that institutionalized the functions of the actors in watershed governance and food security were also analyzed based on the study objectives.

1.6.2: Exclusion criteria

The study excluded state and non-state actors who were at entry level in the sub-county and county such as KIWASH (Kenya Integrated Water Sanitation and Health) project. Similarly, actors in the county, sub-county and working with institutions not directly or not indirectly related to watershed management, environment and food security sector nor consented to the research were excluded from the study. However, in the Lower Sio River basin, there were no active WRUAs and CFAs as confirmed by County Director of Forestry and Principal Environment Officer.

CHAPTER TWO

LITERATURE REVIEW

2.1: Introduction

This chapter reviews literature from the existing works of other similar or related studies alongside introducing key variables in watershed governance and food security. It also integrates theories that provide guidance to this study. The theories applied not only to facilitate interpretation of the specifics of the research but also to assist in forming a general understanding of the themes involved in the socio-ecological study by maximizing the usage of the existing theoretical frameworks. To understand how watershed governance affects food security, these theories were reviewed: Common Property Resources, The Tragedy of the Commons, and Institutional Theories. All these theories originated within sociology and natural resource management studies. These perspectives view the interaction of humans with the environment or natural resources as the outcome of human behaviour that need to be regulated. Finally, it outlined the conceptual framework that indicates how the study variables are interconnected. All these provided the necessary insight and helped in the conceptualization of the study problem, and identified gaps that the study intended to address and the variables assessed.

2.2: Watershed governance and integrated water resource management

In the twenty-first century, watershed management has increasingly become a forum for public engagement in discussions about water and soil management issues. This is after the realization that no one actor or institution can make very significant inroads into the complex and multifaceted issues related to water resources (Parkes *et al.,* 2008).

Therefore, a wide range of engaged and empowered partners are needed at the smallest scales of a village and household.

Most watersheds are comprised of both public and private land, and so the active participation of landowners is needed to help implement watershed management plans, particularly in more heavily developed watershed areas such as those dominated by agricultural, urban and/or peri-urban interests (Parkes *et al.,* 2008). Integrated Water Resources Management (IWRM) approach has undergone several interconnected shifts, resulting in the current paradigm. Studies in the Lake Victoria Basin indicated that the basin has been deforested as demand for human settlements, agriculture and grazing land increases leading to land degradation that is characterized by fertility losses, soil erosion by water, wind as well as increased sediment load as they drain in Lake Victoria (Ogutu *et al.,* 2005). Lower Sio River has experienced land use and land cover changes which have exerted negative ecological impacts affecting the livelihoods of communities (Obando *et al.,* 2007). FAO (2017) identified gaps in the implementation of IWRM such as: First, identifying the appropriate scale for interventions and delineating boundaries. Second, selecting technical and methodological elements to define what constitutes integration. Third, handling uncertainties that iterative negotiation processes among stakeholders may bring about; and fourth, measuring multiple benefits and impact. Therefore, there is need to identify the gaps left with the implementation of IWRM in the Lower Sio River Basin by focusing on watershed governance and its place in determining households' food security.

Recent literature on watershed management indicates demands for new approaches, which emerged in the last decade (Benson *et al.,* 2015). One such significant change has been the movement towards adaptive water management, which emerged in the United States of America and Australia. Adaptive management (AM) has been understood as a systematic process for continually improving management practices (Engle *et al.,* 2011). This approach involves learning by doing; using feedback mechanisms from the environment to shape policy, followed by further systematic experimentation, in a never-ending cycle (Allen *et al.,* 2011). Further, it also features stakeholder input and knowledge generation, objectives setting management planning, monitoring implementation and incremental plan adjustment in the face of uncertainty.

Another more recent development has been in integrating governance as a key pillar in watershed management. Governance refers to the interactions among structures, processes, rules, and traditions that determine how people in societies make decisions and share power, exercise responsibility, and ensure accountability, and how stakeholders have a say in the management of natural resources (Lebel *et al.,* 2006). According to Dietz *et al,* (2003) governance provides a social context that allows the collective action, rule making, and institutions for social coordination at different watershed management scales. Recently researchers have advanced the concept of adaptive governance arguing that it is responsive to emerging problems and knowledge surrounding complex ecological systems (Heikkilia, 2010). It is argued that adaptive governance can foster effective management and use of shared assets such as common pool resources and environmental assets that provide ecosystem services (Hatfield- Dodds *et al.,* 2007). Other researchers emphasize the complementary government and community-based institutional arrangements that work together in adaptive governance (Nelson *et al.,* 2008). Therefore, adaptive governance aims at providing for collaborative, flexible, learning-based approaches to managing ecosystems (Olsson *et al.,* 2006).

Globally, the involvement of diverse stakeholders in watershed management is not unique. The quality, nature and processes for multi-stakeholder involvement have been seen as critical to the success of watershed management (Mullen and Allison, 1999) and have provided new insights into the value of an integrated understanding of social and ecosystem dynamics in watersheds (Sneddon *et al.,* 2002). On the other hand, there has been a growing perception developed amongst water professionals globally that a new paradigm was required to better reflect the multidimensional nature of water management (Biswas, 2008). Although key functions of IWRM identified by researchers include; stakeholder participation, water allocation, basin planning, information management, flood and drought management, pollution control, monitoring and financial management adds, Biswas, (2008). According to Brandes (2006), watershed governance is emerging as a viable approach to achieving long-term ecological and economic sustainability and better engagement of local communities, including both rights holders and stakeholders, in critical decisions that affect all communities living upstream and downstream. Further, Brandes, (2006) argued that, a key factor for watershed governance success is improved collaboration and connections between citizens, and decision-makers at the watershed scale. This is in contrast to IWRM which forwards 'good governance' principles such as transparency, collaborative decision-making and the use of specific policy instruments (Benson *et al.,* 2012; Gain *et al.,* 2013). The watershed governance approach is gaining momentum in Canada, Sweden and Australia among other developed nations. Brandes and O'Riordan (2014) assert that the six critical watershed governance principle that informs institutional architecture include; water for nature, whole systems approaches transparency and engagement of affected parties, subsidiarity and clear roles for decision making, sustainable financing and capacity, and accountability and independent oversight. These formed the basis for the study assessment in the Lower Sio River watershed.

Watershed governance approach has many benefits, including building resilience to adapt to change and enable innovation; leveraging expertise and a diverse range of resources; clarifying roles and responsibilities, thus increasing accountability; creating opportunities for shared learning and capacity building; and reducing conflict and increasing public confidence (Brandes and O'Riordan, 2014). According to Baltutis *et al.*, (2014), it needs not be yet another layer of government or bureaucracy rather; the overarching goal is to provide an alternative to current systems of governance and planning that focus too narrowly on single sectors, thereby isolating water and watershed resources from their broader interactions across communities and within ecosystems. Brandes and O'Riordan (2014) identified nine winning conditions for a watershed governance system. These include: enabling powers in legislation for watershed entities; co-governance with other international; support from and partnership with local government; sustainable long-term funding; functional legal framework for sustainable water and watershed management; availability of data, information and monitoring; independent oversight and public reporting; assessing cumulative impact; and continuous peer to peer learning and capacity building.

2.3: Food Security and Governance

Globally, attainment of food security is described as a situation in which all people, at all times have access to adequate, affordable, safe and nutritious food to meet their dietary requirements and food preferences for a productive and healthy life (FAO, 1996). Key indicators for food security include food availability, accessibility and utilization and to sum it up to food stability (Schmidhuber, 2007). While food availability refers to the physical presence of food where it is needed, food accessibility is the means by which people acquire the food they need, food utilization refers to the way in which people make use of food and finally food stability is how the three indicators balance at equilibrium in a particular community (IFRC, 2007). Therefore, food security requires the interaction of factors such as food prices, agricultural trade, poverty reduction, infrastructure, watershed management, education, and crisis management.

In addition to these interactions aimed at improving food security, food security governance is about managing the context in which these interactions take place (Jessop, 2003). "The Rome declaration identifies poverty and environmental degradation as the main causes of food insecurity. Further, The Heads of State and their governments also recognized the need for urgent action to combat natural resource degradation, including desertification and erosion of biological diversity as means towards the attainment of food security. They recommended that poverty eradication and food security must be achieved without putting additional stress on natural resources. In many situations, therefore, food security and natural resource protection go together" (FAO, 1996).

In developing countries, there are a number of key challenges that undermine food security such as rapidly growing demand and changes in consumption patterns, competition for agricultural lands for other uses, the effects of global environmental change, serious degradation of agricultural soil, erosion of the genetic base of agricultural biodiversity, water scarcity (Pretty, 2009). It was proposed that prescriptions for meeting the identified challenges range from the need to increase productivity, through the development and diffusion of different forms of technologies, to an integrated system for meeting challenges of soil degradation, loss of biodiversity, efficiency in agricultural water and energy use. Studies concluded that generating and sustaining agricultural growth is seen as an important element in reaching and sustaining food security especially in developing countries (Pingali, 2007). On the other hand, Kropff *et al.* (2013) indicated that food security cannot be realized by means of idealistic plans or new technologies only, but it needs advanced steering strategies that involve governments as well as companies, NGOs and citizens at a watershed level.

Further, recent studies reveal econometric substantiation on the relationship between institutions, human capital, and agricultural productivity growth in developed and developing countries while other studies found no evidence that political institutions could necessarily cause growth in agricultural productivity (Candel, 2014). As a result, researchers have expressed that human capital accumulation emerges as an important factor in driving the process towards food security (Fulginiti, 2010). On the other hand, Candel, (2014) noted that within the recent food security debates, the role of governance has been attracting increasing attention for both researchers and policy makers.

The reason advanced for this course is that food security solutions or approaches should not only address the technical and environmental dimensions of the issue, but also take social, economic, and political aspects into account (von Braun, 2009; FAO, 2012;

Wahlqvist *et al.,* 2012; Maye and Kirwan, 2013). However, Candel, (2014) argued that there may be changes over time as global institutions, regions, national governments and communities attempt to make use of different resources within their reach to attain agricultural growth objectives. Further, added that in spite of various calls for food security governance, it is not very clear yet what food security governance entails, what its essential characteristics or features, and how it could be enhanced. The study looked at watershed governance as a prerequisite for food security conceding also that food security governance also contributes to watershed management.

2.4: Perceptions influencing watershed governance and hence food security

Kristin *et al.* (2015) pointed out that human behaviour is the driving force underlying many resource management concerns, but is often the component that is given the least amount of attention in the development of management plans. Moreover, Werg *et al.* (2013) argued that social factors like perceptions of risks have a particular importance for reducing vulnerabilities and building social capacities because they can be changed easily and faster than other social factors like economic, technological or infrastructural development, which often need longer timeframes to be altered.

Studies in social science theories that describe and predict the relationships among these factors and watershed projects include, but are not limited to, attitudes, value orientations, perceptions of social capital, trust, risk, and awareness (Kristin *et al.,* 2015). Therefore, the role of institutions in the watershed governance is central in impacting and sustaining natural resources behaviour change (Heberlein, 2012; Kristin *et al.,* 2015) since institutions are responsible in determining these factors. According to Ajzen (1991), the influence of attitudes, subjective norms, and perceived behavioural control on the intentions of individuals to undertake particular actions, also holds promise for understanding the social determinants of human behaviour related to water resources, and for informing policies on watershed management.

On the other hand, perceived behavioural control in watershed management can have several components, including ones' understanding of opportunity, knowledge, skills, time, or perception of financial resources necessary to carry out the behaviour (Ajzen, 1991; Ajzen, 2002; Fishbein and Ajzen, 2010). In addition, Kristin *et al.* (2015), observed that watershed plans that assume the main barrier to changing behaviours of individuals or lack of knowledge regarding issues impacting water and the actions that can be taken to solve them. Behaviour choices are predicated on a variety of social, psychological, institutional, and economic factors that need to be understood for successful watershed plan implementation (Kristin *et al.,* 2015). Watershed managers may work with risk perceptions revolving around water quality, water quantity, flood control, and the impacts of water development on other values, such as biodiversity or scenic views to effect on food security (Robles *et al.*, 2011; 2014). Therefore, the changeability of factors such as perceptions of risk associated with watershed destructions, knowledge, experience, habitual behaviour, norms and values is important in adaptive watershed governance.

2.5: Resilience and adaptive capacity of institutions in a social ecological change impacts

The literature on resilience and adaptation indicates that adaptive capacity is one of the determinants of vulnerability, in addition to exposure and sensitivity. Hence systems with high adaptive capacity are able to re-configure themselves when subject to change without significant declines in crucial functions of the socio-ecological system (Koontz *et* *al.,* 2015). In various discussions, authors have used the term resilience, while others have focused 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). Elsewhere, adaptation has been found useful in disaster risk reduction; environment and climate change because it recognizes that the same climate change might produce different impacts due to variations in the stability and vulnerability of different social or ecological systems. According to Pelling, (2011) resilience "is not simply synonymous with adaptation." This is illustrated by an example where (short-term) risk management can lead to (longer- term) institutional inertia, which highlights the need to understand the "social processes shaping resilience".

Successful adaptive approaches in any ecosystem will; first require building knowledge and understanding of resource and ecosystem dynamics (Schultz, 2009). These will include mechanisms to detect and respond to environmental feedback in a way that resilience is created as well as ecological knowledge and understanding of ecosystem processes and functions. Second, feed ecological knowledge into adaptive management practices which will require continuous testing, monitoring, and re-evaluation to enhance adaptive response factoring in uncertainty in complex systems (Schultz, 2009). Therefore, local watershed governance systems need to adapt to new knowledge and build this into management plans rather than striving for optimization based on past records (Berkes *et al.,* 2003). Third, the adaptive system will support flexible institutions and multilevel governance systems through operationalization of the adaptive governance framework (Olsson *et al.,* 2004). The dynamic learning characteristic of adaptive management is combined with the multilevel linkage characteristic of co-management.

There will be the sharing of management power and responsibilities which involve multiple and polycentric, cross-level institutional and organizational linkages among user groups and communities, government agencies, and nongovernmental organizations (Schultz, 2009).

Gupta *et al., (*2010) stressed on adaptive capacity by arguing that it should include; the characteristics of institutions (formal and informal; rules, norms and beliefs) that enable society (individuals, organizations and networks) to cope with climate change and the degree to which such institutions allow and encourage actors to change these institutions to cope with climate change. Adger (2003) noted that promoting resilience 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.

Promoting resilience 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). According to Gupta *et al.,* (2010), institutions that promote adaptive capacity should be assessed based on their ability to; encourage the involvement of a variety of perspectives, actors and solutions; enable social actors to continuously learn and improve their institutions; allow and motivate social actors to adjust their behaviour; mobilize leadership qualities; mobilize resources for implementing adaptive measures; and support principles of fair governance. In most cases, adaptation activities are more local (that is a district, regional or national) issues rather than international (Paavola *et al.,* 2005; 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 to climate change 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 climate change (Adger *et al.*, 2005) as such ability is one main factor affecting adaptive capacity of other actors in the water sector to climate (Adger *et al.*, 2007; Gupta *et al.*, 2010). This is because even if 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).

A good case of adaptation and eventual resilience is put across by Bolling's (2003) work on Pokot pastoral community in Kenya. Bolling explained that both populations have developed a number of strategies to cope with shortfalls in food production. These include: herd diversification to contain different impacts of drought on grass and bush land; intensified sharing of food; networks of livestock sharing through livestock loans and gifts during good times to create networks of obligations; institutionalized resource protection through indigenous knowledge approach; extended spatial mobility and rituals; as well as reliance on food aid. Adger (2003) postulated that adaptation to global environmental change is likely to be punctuated by examples of system collapse unless resilience is recognized as a central goal of sustainable development. Further, success in environmental policy should be redefined by how it promotes and facilitates resilience, and by how it promotes legitimate, a broad-based development that allows individuals and societies to cope with risk and adapt to changing circumstances over time (Adger, 2003). In the same argument, Majule *et al.,* (2007) noted that adaptation mechanisms have been developed by different socio-economic groups; the poor people sell labour in rich peoples' farms, engaging in non-farm income generating activities such as brick and charcoal making, reducing the number of meals from two to one per day; the middle adapt by engaging in non-farm income generating activities, food vending, and resorting to cheap marriages; and the rich tend to hide food to discourage the rest of the community from begging food. Researchers indicated that most works on the adaptive capacity of watershed institutions are either hypothetical assessments or not focusing on the inherent characteristics of the institution's capacity. Hence approaches are proposed to assess if institutions are enhancing the adaptive capacity of society to respond to climate change (Gupta *et al.,* 2010) and how the characteristics of governance approach shape the adaptive capacity of water systems to climate change (Engle and Lemos, 2011).

2.5.1: Institutional Role in Socio-ecological Resilience and Adaptive Capacity Enhancement

Crawford and Ostrom (1995), defined institutions as enduring regularities of human action in situations structured by rules, norms and shared strategies. Created by people, institutions organize and structure human behaviour towards collective ends (Ostrom, 2005; Bussey *et al.,* 2012). Institutions can promote or hinder individual actions to adapt to changing conditions (Koontz *et al.,* 2015).

Advancing from IPCC, (2007) definition of 'adaptation' and Ostrom's definition of 'institution' Engle and Lemos (2010) defined adaptive institutions as those institutions where actors are able to adjust to, encourage individuals to act in ways that maintain or improve to a desirable state. Further, such adjustment demonstrates flexibility and diversity, where the ‘‘ability of the institution to bend, but not break, and to learn through experience, speaks to its ability to manage a crisis effectively and efficiently".

River basin management is designed to address the effects of upstream and downstream interdependencies of water use in a catchment (Moss, 2004). The challenge is that a river basin is not just a simple spatial entity but a complex one. In terms of space, most river basins are said to 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).

Adaptive institutions are intended to cope with multiple objectives inherent in such 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). Studies identified numerous characteristics of adaptive institutions, including participatory, inclusive, integrative, risk tolerant, flexible, legitimate, accountable, diverse, creative, learning, iterative, autonomous, resourceful, self-assessing, collaborative, transparent, reflexive, and integrated them broader processes (Gupta *et al.,* 2010).

Researchers have also identified a variety of variables linked to adaptive institutions including; social capital, leadership, resources, external regimes, self-organization, rule compliance, and biophysical context. These characteristics are described as normatively desirable since they help promote the desired end of more successful problem solving (Koontz *et al.,* 2015). The institutional memory of past climate events and traditional knowledge have, to the present, dominated adaptation experiences among local communities in Kenya. Among farmers, for instance, the increasing unpredictability of rainfall season in East Africa has led to more people having to adapt simple modern technologies such as use oxen ploughs and tractors as opposed to traditional approaches. Ploughing land using oxen is much faster than hand and this speed allows maximum use of the shortened, often intermittent rainy period for crop production. However, the poorest households can rarely afford to plough using oxen and the wealthier owners prepare their own fields first (Nelson and Stathers, 2009).

An entitlement literature by Sen (1981), concerned with the problem of inequality, and the ways in which formal and informal rules create and reinforce unequal access to resources such as watersheds. According to Leach *et al.* (1999) in the framework for environmental entitlement, heterogeneity among communities and categories of institutions at macro, meso, and micro levels were considered. Therefore, the relationships among the institutions and between scale levels influences which social actors that gain access to and have control over local resources. This was found useful because it keeps an eye on the conflicting interest in organizing livelihoods since communities are not static and multiple identities and conflicting values and claims over the natural environment occur; it also showed how political arena of livelihoods should be analyzed through the working of institutions (de Haan and Zoomers, 2005). Therefore, the framework contributed to the analysis of livelihoods as it emphasized the economic attributes of livelihoods as mediated by social institutional processes (Scoones, 2009).

Elsewhere, according to Moss (2004), institutional interplay refers to boundaries problems related to political responsibilities and social sphere of influence, and that it is along these boundaries, where the jurisdictions and interests of actors' overlap, that conflicts between institutions arise (Komakech, 2013). Similarly, Warner *et al.* (2008) argued that water management approaches are not cast on stone but outcomes of political choices which are based on values and preferences. The choice of a river basin as the most appropriate scale of water management is just a political one; it can be made differently (Warner *et al.*, 2008). Nygren (2005) applied the Leach *et al.* (1999) framework in analyzing the institutional context of communal forest management in Honduras and found that sustainability of communal forest management depended on many macro-scale forces including land tenure legislation, loan conditions, and national and global forest markets.

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. Adaptive institutions 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). In summary, the concept of adaptive institutions is different from the general concept of institutional change. Institutional change they do not necessarily mean to take a direction that maintains or improves a desirable state. For instance, it is suggested that an institutional change could make an institution less adaptive or improve institutional characteristics other than adaptiveness (Koontz *et al.*, 2015).

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) such as the Lower Sio River Basin.

2.5.2: Governance role in Socio-ecological Resilience and Adaptive Capacity enhancement

Adaptive governance is an approach that is expected to generate the desired end goal of adaptive capacity (Cook *et al.*, 2011). Studies indicate that researchers confuse adaptive governance with adaptive institutions, Koontz *et al.* (2015), defined adaptive governance as changing rules and norms of institutions as defined by Ostorm (1990). Adaptiveness can be understood as the ability to recover or adjust to change through learning and flexibility, so as to maintain or improve to a desirable state (Engle and Lemos, 2010). Advancing from Lebel *et al.* (2006) definition of the concept of governance, researchers noted that governance also include “a range of institutions and relationships involved in the process of governing,” which “encompasses both formal institutions such as laws, policies, and organizational structures, and informal institutions (Huitema *et al.*, 2007). These institutions can provide more effective solutions to collective action problems than centrally mandated institutions because they foster local knowledge, the inclusion of participants, better-adapted rules, and lower enforcement costs (Ostrom, 1990). According to Koontz *et al.* (2015), adaptive governance steers policy interactions to guide management of resources in a manner that is able to recover or adjust to change so as to maintain or improve to a desirable state. The adaptive governance approach was found relevant for social-ecological systems, whose dynamic nature is not well served by a static approach. These systems occur at a variety of scales and include a wide range of resources, from local fishing economies to global climate change (Ostrom, 2009).

Klein (2004) clarified 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. 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. Adaptation to climate change can be reactive or proactive (anticipatory) (Paavola and Adger, 2005; Parry *et al.,* 2005). Literature on adaptation showed that reactive adaptation responds by reacting to the present impacts of climate change with, for example, the provision of food aid after a disaster, relocation or reconstruction of infrastructure after flood damage or migration to a new location. Proactive adaptation, on the other hand, seeks to avoid the risks and impacts of climate change before they happen for instance diversification of crops and change of agricultural patterns, designing and building higher floor levels or suspended timber floors and land zoning (Parry *et al.*, 2005).

Based on Lawrence *et al.* (2011) argument, an institutional work highlighted how and why actors work to interpret, translate, transpose, edit, and recombine institutions, and how those actions lead to unintended adaptations, mutations, and other institutional consequences. However, it is indicated that in Africa, policymakers have recognized the need to integrate climate change adaptation into all spheres of public policy-making (Madzwamuse, 2010). Adaptive governance of ecosystems generally involves polycentric institutional arrangements, which are nested on quasi-autonomous decision-making units operating at multiple scales (McGinnis, 2000). They involve local, as well as higher, organizational levels and aim at finding a balance between decentralized and centralized control (Imperial, 1999). The vertical links of such arrangements may boost adaptive governance, for instance when local and national institutions gain strength from being nested in regional and global institutions. According to Young (2002), such links can also stifle adaptive governance, as in cases where national land-use regulations contradict or undermine informal local systems of land tenure and limit practitioners' abilities to exploit an inter-organizational network's collaborative capacity (Imperial, 2001).

Koontz *et al.* (2015) argued that if adaptive governance of social-ecological systems is the desired approach, then researchers should seek to understand what factors promote it. Further, several studies in the past two decades have identified a variety of such factors operating in different contexts including; polycentric systems, vertical coordination, informal networks, learning, leadership, evolving rules, information, conflict resolution, rule compliance, infrastructure, institutional preparedness for change, nested institutions, institutional variety, dialog, social capital, memory, knowledge, cross-scale interaction, multi-level governance, and organizations. Such factors promote or influence adaptive governance through adaptive institutions (Koontz *et al.*, 2015).

Integrated planning and management of international river basins has seldom proved straightforward in Africa. Developing these basins requires agreements, institutions, information sharing and human resources (Wright *et al.,* 2003). Some authors acknowledge that degradation of water resources in Kenya is compounded by intense water exploitation. However, more literature has revealed that the water sector in Kenya has historically suffered from low levels of investment, resulting in low adaptive capacities, also many watersheds have been damaged by logging, encroachment of settlements, and changing borders, in addition to government policy changes which include de-gazettement of national forests in the early 1990s (Miller *et al.,* 2003). The Water Act (2002) now repealed Water Act (2016) did not recognize the existence of a pluralistic legal framework or customary rights (Mumma, 2005). On the other hand, although irrigation schemes such as the proposed Lower Sio Irrigation Scheme are considered by some as important for agricultural development and food security, for others these are "white elephants". According to Yanda and Mubaya, (2011), the success of these schemes is notably fought by conservation groups and other resource users. As a result of little capacity by the governments to feasibly implement climate change adaptation, the burden is left to local communities, households and/or individuals. It is valid to note that local communities need help to adapt to climate change and other environmental changes, as these coping strategies may lead them to become more vulnerable not only to changes in the natural resource base but to food and nutritional insecurity (Yanda and Mubaya, 2011).

2.6: Nexus between watersheds governance and food security

Studies by Wani *et al.* (2008b) and FAO, (2017) revealed that a watershed is not only a hydrological unit but also a socio-ecological entity that plays an important role in determining food, social and economic security as well as providing life support services to rural people. As a result, recent developments have occurred in response to global food and economic crises at a watershed level. The Water- Energy Food Nexus (Bazilian *et al.,* 2011) acknowledged the links between water, energy and food resources in management, planning and implementation (Bach *et al.*, 2012). Water, energy, climate and food security are self-evidently close related. The nexus is often presented as the integration of multiple sectorial elements such as energy, climate, and water and food production within an overarching governance approach (Benson *et al.,* 2015). Moreover, global policy makers emphasize that good governance is a precondition for water, energy and food security where political stability with the absence of violence, the rule of law, voice and accountability, government effectiveness, regulatory quality, control of corruption and environmental governance (World Bank, 2004). Instability of food prices linked to climate change events highlighted the general vulnerability of resource production systems and the overexploitation of water in particular. To avert such issues, the 2008 World Economic Forum (WEF) annual meeting agreed upon a Call to Action on Water aimed at re-examining the relationship between water and economic growth (Bach *et al.,* 2012).

A fundamental prerequisite for this integration is coordination between government agencies (Rouillard *et al.,* 2014) and hence government steering of different policy objectives. Two important objectives involve linking social and economic development with natural ecosystems protection, and the optimal allocation of water services (GWP, 2010). Recent indicators underpinning discussions on water resources, food security, climate, energy globally, focus on policy integration, governance, scale, participation, resource efficiency and sustainable development. There is need to conceptualize these terms together to ensure sustainability. In addition, the WEF nexus was one of the main approaches considered by the United Nations in setting its Sustainable Development Goals (SDGs). According to Benson *et al.* (2015) given this high-level support, it could be anticipated that the nexus discourse should be influencing national water governance strategies. Early studies indicated that water-food nexus issues are salient in Kenya (Patel *et al.,* 2012; Obando *et al.,* 2007). This is as a result of competing demands for water resources resulting to a challenge to decision-makers in the face of population growth and increasing negative impacts of climate change (FAO *et al.,* 2012; Villamayor, 2015). To sieve through the complexity in watershed management and food security, this study examined the state of adaptive watershed governance in enhancing food security in the Lower Sio River Basin, Busia County, Kenya.

2.6.1: Watershed governance changes impacts on food security

Watershed governance can be viewed as both a challenge and a solution to food security. Literature revealed that bad governance in any state or a nation is to blame for the negative outcomes on the nation's food security (Candel, 2014). Therefore, well-developed governance arrangements that are able to respond effectively to both crisis situations and structural concerns are inherent to eradicating hunger (Haddad, 2011; Candel, 2014).

Researchers in food security and watershed governance emphasized that poor governance that may lead to the destruction of watersheds rather than the natural conditions may constitute the main driver of food insecurity (Boyd and Wang (2011). Thus governance systems characterized by conflicts, lack of institutional capacity, poor policy design, and lagging implementation can inflict serious harm to the production and distribution of healthy food (Candel, 2014). It can be a significant contributing factor to food insecurity when it fails to effectively address natural, economic, or social drivers of conjectural or structural hunger (Sahley *et al.*, 2005; FAO, 2012; Pereira and Ruysenaar, 2012). Earlier studies have proved that governments often fail to respond to crises because of poor decision making, limited coordination, weak institutions, and scarce resources (Ruysenaar, 2012). The creation of a new social policy program and a ministry, which has been tasked with coordinating the work of other ministries toward a number of food security goals, has had a significant positive impact on food and nutrition security for example in Brazil's (Haddad, 2011; Candel, 2014).

Watershed governance can be a very complex in food security interventions. Food security is always affected by a wide array of domains such as agriculture, trade, fisheries, environment, development cooperation, and energy, as a result of which many actors and institutions are involved in food security governance (Mohamed, 2009). Therefore, it is recognized that food security is a highly complex and multi-dimensional issue that is impacted by a broad range of drivers and food system activities, stretches across various scales, and involves multiple sectors and policy domains (Pereira and Ruysenaar, 2012; Colonelli and Simon, 2013).

The literature emphasizes that food security governance is spread not only across domains and sectors but also across spatial scales. States of, as well as challenges to, food security can be considered on a global, regional, or national level, but have also been increasingly studied and addressed at local, community, household, or individual levels over the last decades (Candel, 2014). As a result, Paarlberg (2002) argued that the main drivers and solutions should primarily be sought at national level while McKeon (2011) emphasized that recent food crises have shown that ongoing globalization and the associated entanglement of world food systems have led to a situation whereby food insecurity drivers increasingly lie outside the scope of national governance.

The successes and failures of current institutional architectures to address complexities in watershed governance as a necessary condition for food security governance is also another concern. Critiques of the global governance and food security are that there is no truly authoritative and encompassing body or institution with a mandate to address food security concerns across sectors and levels (McKeon, 2011; Colonelli and Simon, 2013). However, this can be attributed to the lack of national and sub-national governance arrangements and associated studies, especially in developing countries (Thomson, 2001). Candel (2014), indicated that instead, responsibilities, jurisdictions, and foci are spread across a broad range of international organizations and forums, which all have their own core business, but none of which dealt with food insecurity in a holistic and inclusive manner (FAO, 2011; FAO, 2012).

In addition, complexity and the difficulties with the design of institutional structures stem from an increase in the number of actors involved in the watershed and food security approaches, or that have a direct or indirect impact on food security (McKeon, 2011;

Pereira and Ruysenaar 2012; Seed *et al.,* 2013). The increase in stakeholders in watershed management and food security can be reduced to three types in particular: international organizations, civil society organizations (CSOs), and private sector corporations (Candel, 2014). These actors are active on all governance levels and within international organizations or government agencies, whereby they often 'shop' between forums or venues, depending on where they perceive their interests to be best represented (McKeon, 2011; Duncan and Barling, 2012). Civil society organization participation in the watershed and food security activities provides a complementary role to more traditional government-centred approaches.

Civil society can provide 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 (Koc *et al.,* 2008). CSOs also form bridges and linkages between government agencies that did not previously cooperate, or between various governance levels (global – national, national – local, global-local), and thus contribute to a multi-sector and multi-scalar approach (McKeon, 2011; Edwards, 2012). CSOs frequently operate as co-workers of government agencies and can offer the capacity that government often lacks (Seed *et al.,* 2013; Candel, 2014). In some cases, some actors may benefit from the exclusion of others, because it enables them to satisfy their own agendas. Therefore, these forms of collaborative governance call for appropriate structures, capacity, and political will, which are not always at hand. In addition, involving civil society actors entails a shift in bureaucratic philosophies, and this requires time and continuous effort (Seed *et al.*, 2013; Koc *et al.*, 2008).

According to Candel (2014) the individual actions of organizations, countries, donors, corporations, and other private actors can address various drivers and aspects of watershed governance and food insecurity but would, together, have to result in a coherent and holistic approach, whereby trade-offs and duplicated efforts are minimized and one actor’s course of action does not impair that of others. Therefore, a high degree of coordination was proposed, both between the currently fragmented institutions and between governance levels, and integration of food security concerns into other policy domains or sectors (McKeon, 2011; Seed *et al.*, 2013). On the other hand, various discourses or paradigms may exist at the same time and compete for domination; this leads to conflicts between their proponents about the courses of action to follow and about who is to decide (Lang and Barling, 2012). Increasing awareness and understanding of the multitude of ideas and to agree on some basic principles and values will be necessary (McKeon, 2011).

Based on Brandes (2006) proposals, good watershed governance arrangements will require various types of resources that are essential to create and maintain responsiveness and effectiveness to food security issues. Further, it is indicated that governance arrangements have often failed to effectively address hunger because most energies were expended on shaping their architectural features without sufficiently thinking out the sustainable resource allocation that these institutional architectures need to be effective in the long term (Candel, 2014). For example, a sufficient budget (FAO, 2009), political will, leadership, prioritization, knowledge and values such as accountability, transparency, legitimacy, inclusiveness, and responsiveness are inherent to enhance food security (FAO, 2011; Haddad, 2011; FAO, 2012). These values are applicable not only during policy formulation but throughout all governance processes, including implementation and evaluation (FAO, 2011).

2.6.2: Watershed governance and food security initiatives in Kenya

From the year 1999, the Government of Kenya (GoK) has been in the process of water sector reforms that culminated with the enactment of the "Water Act 2002" (GoK, 2002) and currently Water Act of 2016. Since then, all previous policies and programmes related to the conservation of water sources and water bodies (including; lakes, streams and rivers) have been subjected to this new Act. The review of the Act revealed that institutional reforms in the Water Act (2016) were guided by several principles among them; decentralization of the decision making and operations from the national level to the catchment level to increase efficiency and effectiveness, devolution of responsibilities for water resources management to the Water Resources Authority, Catchment Boards, communities and other actors, and the inclusion of stakeholders and users in advisory and decision-making capacities wherever possible (GoK, 2005). It, therefore, provided mechanisms for complaints, public notification and consultation (Section 107). Section 15 of the Act empowered the Water Resources Authority (WRA) to formulate Catchment Management Strategies (CMS) for the management, utilization, development, conservation, protection and control of water resources. This was to be done in consultation with local stakeholders gathered around an entity known as the "Water Resources Users' Association (WRUA) (Luwesi *et al.*, 2014).

On the other hand, the National Water Resources Management Strategy (NWRMS) outlined major issues and challenges faced as well as key objectives and strategies that would address these issues (GoK, 2007). According to Ngigi and Macharia (2007), it emphasized the application of Integrated Watershed Management (IWM) principles to support Kenya's social and economic development and required substantial investments in the water sector. Therefore, the implementation of these reforms was directly supported by development partners such as German International Cooperation and academic institution such as Kenyatta University alongside Integrated Watershed Management (IWM) practitioners and local stakeholders. These forums focused on capacity building for the implementation of IWM plans. Hence, they provided a ground for the development of implementable strategies that address major challenges facing watersheds in the country (Luwesi *et al.*, 2014). According to Obando and Shisanya, (2006), in Kenya, the Bwathonaro and Ngaciuma Kinyaritha watersheds of the Tana River Basin were retained as pilot areas for implementations of the new water rules (Luwesi *et al.*, 2014). Therefore, governance issues in watersheds in Kenya have been conceptualized as part of IWM which has been viewed as an appropriate analytical and management unit for sustainable utilization of resources.

Studies indicate that Kenya suffers from chronic food shortages with less than 20 per cent of its land suitable for agricultural use (Langinger, 2011); the majority of the population in Kenya is still living in rural areas, hence depending on agriculture as their source of livelihoods. To make it worse, agricultural production heavily depends on rainfall, thus current trends of climate change heavily impacts Kenya's agricultural sector (GoK, 2011). For instance, according to Patel *et al.* (2012), droughts are more frequent and last longer, rainfall patterns in recent years have become unpredictable and heavier thus destroying crop yields while rain fed agriculture is the major contributor to domestic food supply in Kenya.

Water has been recognized to be the most limiting factor for food production in the country. Food and water are inextricably linked; without water security, there will be no food security (Patel *et al.,* 2012). Therefore, for food security to be achieved in Kenya, an integrated approach in managing water resources is necessary; at the community level (upstream-downstream relationships), Sub-basin (within countries), Basin, Nationals (shared water, basins) and Regional (for example, Nile Basin Initiative). Some authors suggested that failure to achieve food security is due to ignorance of agricultural sector in developing country's agenda (Rajaonarison, 2014); the Kenyan government has continued to implement agricultural policies and programs related to environmental protection and food security to foster sustainable food production. The country receives foreign aid in form of various development programs related to natural resource management and food aid. In addition, watershed resources management has remained a focus in Kenya’s food security policies (GoK, 2011).

2.7: Effective adaptive co- management in a social ecological watershed system

According to Armtage *et al.* (2009), social-ecological complexity and the ever-changing human-environment conditions require building trust through collaboration, institutional development, and social learning efforts to foster ecosystem management and resolve multi-scale society–environment dilemmas. Therefore, adaptive co-management is emerging as an approach towards addressing these dilemmas. According to Olsson *et al.*, (2006) governance in adaptive co-management is fundamentally founded on the concept of cross-scale linkages, but the cases that are used to illustrate how this might work are almost invariably drawn from experiences in developed countries. According to Armtage *et al.,* (2009), attention to the learning (experiential and experimental) and collaboration (vertical and horizontal) functions necessary to improve the understanding of, and ability to respond to, complex social-ecological systems is need. On the other hand, Koontz *et al.* (2015) noted that collaborative governance is also another closely related concept to polycentrism. This is a situation whereby governments or non-governmental actors configure and reconfigure networks and organizations related to a particular issue or functional area (Ansell and Gash, 2008). Moreover, Koontz *et al.* (2015) postulated that collaborative governance shares many features with polycentricism. For example, collaborative governance for environmental issues such as watershed management is marked by overlapping boundaries (watersheds that cross political jurisdictions), a focus on a particular issue, and power sharing across multiple jurisdictions (Schlager and Blomquist, 2008). This is a characteristic of the Lower Sio River Basin whereby it is a trans-boundary river between Kenya and Uganda as well as the upper Sio originates from Bungoma and Kakamega counties in Kenya.

The literature indicates that most developing countries, characterized by low levels of capacity at multiple scales, cross-scale institutional linkages constitute the fundamental challenge when attempting to initialize transitions toward adaptive co-management (Cundill and Fabricius, 2009). There are concerns among scientists and researchers that adaptive co-management of complex systems has not progressed beyond mere philosophy and that the concepts and processes involved are poorly understood. This is because: First, although the need to evaluate the processes and outcomes of adaptive co-management is recognized (Plummer and Armitage, 2007), approaches to achieving this have not been tested on the ground (Cundill and Fabricius, 2009). Second, although a descriptive analysis of transformations in local governance has been provided (Olsson *et al.,* 2006) based on case study comparisons, the mechanisms that drive transformations in social-ecological systems are not well understood (Walker *et al.,* 2006). Third, although the need to understand the ways in which such transformations might be initiated and monitored is considered critical (van der Brugge and van Raak, 2007), appropriate methods to measure and monitor change in complex systems have not been systematically developed or tested (Western, 2004), and the tools for evaluating co-management, in general, have been described as surprisingly blunt (Carlsson and Berkes, 2005). Such interventions have not been tested under the current system of governance in Kenya. Creating a supportive environment for developing the self-organizing capabilities of role players in adaptive co-management is therefore critical. Further, it is identified that factors requiring greater attention in efforts to initiate adaptive co-management in the future include community perceptions of support from outside agencies, access to long-term funding for adaptive management, and access to reliable information (Cundill and Fabricius, 2009). In Kenya, the agencies and actors in watershed management and agriculture sector exist but a mechanism of engagement within the new governance system is not yet documented at a multiple-level for example county and national levels.

Armitage *et al.* (2009) provided ten conditions necessary for adaptive co-management. These include; well-defined resource system, small-scale resource use contexts, clear and identifiable set of social entities with shared interests, reasonably clear property rights to resources of concern, access to adaptable portfolio of management measures, commitment to support a long-term institution-building process, provision of training, capacity building and resources for local-regional-national level stakeholders, key leaders or individuals prepared to champion the process, openness of participants to share and draw upon a plurality of knowledge systems and sources, and national and regional policy environment explicitly supportive of collaborative management efforts. Co-management emphasizes the sharing of rights, responsibilities, and power between different levels and sectors of government and civil society (Huitema *et al.*, 2009).

However, polycentricism contributes to adaptive governance, through the promotion of self-organized institutions, because individuals in a polycentric system are empowered to develop collective solutions to local problems as they arise (Koontz *et al.,* 2015). Polycentric systems can also give rise to spillover effects with potentially undesirable consequences for racial segregation, income sorting, urban sprawl and environmental degradation (Ross *et al.,* 2013).

2.8: Linking Devolved Governance in Kenya to Socio-ecological Adaptive Capacity and Co-management

In recent years, Kenya has undergone through socio-economic, environmental and political transformations that have been instigated by development challenges such as poor governance, threats of climate change, environment resource degradation, rapid population growth and increasing levels of socio-economic inequalities among others. This resulted in institutional and organizational reforms as an adaptive policy response to the challenges. Like other world governments, the focus today is on introducing decentralized decision-making bodies such as River Basin Authorities, with prescriptions for public and private sectors involvement in decision making (Komakech, 2013). Central to the approaches are some key design principles contending that management institutions can be crafted by the resource users and policymakers (Ostrom, 1990; Ostrom, 1993).

Actors involved are likely to rework the new arrangements in combination with the pre-existing local institutions, or reject them all together (Cleaver, 2002). Thus the governance process can be undertaken by the government, resource users as well as by organizations of all types and at all scales (Blomquist, 2009). The challenge, however, is that no perfect governance arrangements, to be applied in water-stressed river basins, exist (Komakech, 2013). According to the World Bank, (2012), decentralization has been increasingly seen and adopted worldwide as a guarantee against the discretionary use of power by central elites, as well as a way to enhance the efficiency of social service provision, by allowing for a closer match between public policies and the desires and needs of local constituencies. Earlier lessons on African Socialism at Kenya's independence; Harambee; District Focus on Rural Development (DFRD); Local Authority Transfer Fund (LATF); and Constituency Development Fund (CDF) development strategies (Namenya, 2012) just to list a few were faced with challenges of efficiency in delivery of public services in addition to highly centralized government bureaucracies as earlier indicated by Mwabu *et al.* (2001). At its heart, the Constitution of Kenya (2010) came with the change through the concept of devolution of political and economic power to forty-seven newly created counties as a key vehicle for addressing spatial inequalities and institutional inefficiencies.

In Western Kenya, regional authorities such as Water Management Authority, Lake Victoria Water Service Boards created under the Water Act of 2002 now Water Act

2016, National Environment Management Authority created under Environment Management and Coordination Act (EMCA) of 1999 revised 2015; alongside Lake Basin Authority and among others were institutions created to promote water resources and environment sectors. Similarly, the Constitution of Kenya (2010) marked a critical juncture in the nation's history, as a Constitutional law, it is concerned with the role and powers of state institutions and with the relationship between citizens and the state (Giussani, 2008) this includes in watershed resource governance. In Chapter 2, Article 6(2) of the Constitution of Kenya (2010), the two levels of government (national and county governments) were created each with distinct, interdependent and to conduct business on the basis of consultation and cooperation. This gave the Kenyan system of governance a more polycentric and multi-level governance outlook. The forty-seven county governments in Kenya are responsible for; county legislation, executive functions, and functions transferred from the national government functions agreed upon with other counties and establishment and staffing of a public service (GoK, 2010).

Polycentricism is a system of governance featuring multiple, overlapping jurisdictions at different scales, each with some independent authority over particular issues or functional areas (Koontz *et al.,* 2015). On the other hand, Ostrom *et al.,* (1999) defined Polycentricism as a pattern of an organization where many independent elements are capable of mutual agreement for ordering their relationships with one another within a general system of rules. To sum it up, polycentricism describes a governance system of qualified independence among interdependent centres of authority (Oakerson and Parks, 2011). A key feature of polycentricism is adaptable boundaries where new jurisdictions being created as needs arise. These new boundaries can be made to match the scale of the issue at hand, for example, a watershed, and not necessarily contained within just one higher level jurisdiction, such as a nation. Polycentric systems typically exist within federal systems (Koontz *et al.*, 2015).

Polycentric systems are described as self-organized, arising in a bottom-up fashion, as stakeholders interested in particular goods and services institute arrangements to do so (Pahl-Wostl, 2009). The presence of a variety of special purpose jurisdictions encourages people to create new, self-organized arrangements to tackle common problems. Although polycentric institutions are often associated with federal systems, they can be created outside of federal systems, a case when the French national government (a more unitary system) created regional watershed jurisdictions that overlapped existing local government boundaries (Buller, 1996). Another closely related concept to polycentrism according to Koontz *et al.* (2015), is the concept of Type 2 governance (Hooghe and Marks, 2003) whereby jurisdictions spanning vertically across political organizations and horizontally across mutually exclusive but rather overlapping geographically and lack established representation.

According to the World Bank (2001), when governments devolve functions, they transfer authority for decision making, finance, and management to quasi-autonomous units of local governments with corporate status. Further, devolution usually transfers responsibilities for services to municipalities (equivalent to county governments in Kenya) that elect their own mayor and councils (equivalent to the county executives and county assemblies in Kenya), raise their own revenues, and have independent authority to make investment decisions. In a devolved system, local governments have clear and legally recognized geographical boundaries over which they exercise authority and within which they perform public functions (World Bank, 2001). The county governments present an opportunity to address the diversity of local needs, choices and constraints in Kenya. Needs are very different between geographical regions in Kenya. The County Government Act of 2012 provides for county governments' powers, functions and responsibilities to deliver services and for connected purposes. Counties are better placed than the national government to deliver social services because different regions have specific challenges and the local knowledge to address them. With a constitutional guarantee of unconditional transfers from the centre, Kenya's counties have the means and the autonomy to begin to address local needs, and their citizen are abler to be held accountable for their performance including institutional strengthening and development, watershed, natural resources, environmental management and agriculture and food security.

Further, based on the World Bank (2012) sentiments, enabling counties to deliver implies a massive re-organization of state functions around these new units. It is inevitable that things will not always go according to plan, and that implementation will reveal problems which were not anticipated. The breadth of the transformation makes it imperative to consider clearly what these changes will involve, and how best to prepare for them. At this point, it is necessary to start thinking how to make institutions being created more adaptive given threats like climate change, degradation of environmental resources, food insecurity and increasing population among others; especially in watershed management and food security as a paradigm shift from the past where little or no attention was given to such sector institutions or adopting watershed management approaches in development agendas in Kenya (Namenya, 2012). This study explored how the current system of governance in Kenya enhances adaptive watershed governance by assessing the possibilities of adaptive governance, adaptive institutions and adaptive co-management at the village, ward, sub-county, county and national levels in micro-watersheds that have initially lacked well-defined management plans and governance framework such as Lower Sio River Basin. As such, it presents the building blocks that need to be in place for devolution to be successful in achieving its goal especially in the watershed and environmental management and sustainable food security.

The World Bank (2012) described the Kenyan devolution as one of the most ambitious even by international standards implemented globally because, besides the creation of the forty-seven counties, the process has also involved the creation of new systems of administration that have absorbed some or all of three prior systems of administration. Implementing devolution involves simultaneous changes to both political and administrative arrangements, in a context where other key government institutions are being reformed, poses enormous challenges. An entirely new layer of elected and the executive government has been created, that assume major service delivery functions at the local county level. With so much change occurring concurrently, complexity is inevitable.

Under this dispensation, as argued by many researchers, effective water institutions may be achieved by upscaling nested arrangements in which local communities have been managing their water resources from homestead, plot, village, and sub-catchment levels (Van der Zaag 2007). This is based on the premise that local communities do recognize their interdependencies and in return adopts and discard rules including management strategies as and when they require, by integrating history, and cultural meanings into the management of water and conflict (Komakech, 2013). It is important to understand how the watershed institutions form relational effects that can be successful in certain contexts such as enhancing food security and fail in others.

2.9: Theoretical Applications

2.9.1: Common Pool of Resources

The Lower Sio River Basin is considered what Ostrom (1990) termed as a Common Pool of Resources (CPR) where efforts to promote IWRM approach failed to integrate institutional and political dimensions in the governance of the resource. The watershed exhibits two main characteristics: excludability whereby the supply of water and other resources may exclude or limit the potential resource beneficiaries from utilizing; and substractability whereby when one person utilizes the resource in an unsustainable manner reduces the availability of the resource to another user (Ostrom, 1990). The challenges to the governance of Lower Sio River basin is how to coordinate and implement the sustainable use of the resources by an individual as the population grows, increased resource degradation, accelerated by the negative impacts of climate change and changing social governance occasioned by devolution in Kenya. This is in order to prevent overexploitation and degradation (Williams, 1998).

2.9.2: The Tragedy of the Commons

Moreover, to focus on what could happen to the watershed resource in the face of the mentioned changes, the study revisited Hardin model of “The Tragedy of the Commons”. The description based on what could happen when a hypothetical open access to pasture (in this thesis watershed resources; land, water, riparian and wetlands in River Sio) is open for all people. Hardin argued that people are motivated by selfish and individual nature and pasture will be overexploited due to the maximization of benefits by individual users over several users (Hardin, 1968). Since users are likely to ignore the effects (in this case watershed resources degradation) of their actions on the pool of resources when pursuing their self-interest, it must be concluded that most of the watershed resources in common river basins as Lower Sio River bear the risk of a tragedy of the commons.

Proponents have proposed efforts towards promoting private ownership of natural resources such as watershed resources (farmland, forests, hilltops, wetlands pastures, riversides) to ensure that users have incentives to manage their resources well (Raymond, 2003) while other proponents advocate for state ownership whereby governments are appropriate custodians of the natural resources (Hardin, 1968). However, there are other researchers who emphasized that there is no universal solution to the tragedy of commons problems of resource management as private owners, governments and communal resource management (Acheson, 2006). Through self-organization and self-governance, collective action can be a means by which communities can overcome common property resources overexploitation and use the resources in a more sustainable manner. Collective action is action taken by a group, either directly or on its behalf through an organization, in pursuit of members perceived shared interest (Marshall, 1998). Therefore, sustainable communal resource management is attained by seeking people's participation and devising resource management approaches according to the local socio-cultural settings (Lise, 2007).

At the centre of all the proposed solutions to the problem of the tragedy of commons as either governments or collective approach through social groups and communal resource management, the institutional arrangements play a key role in the organization and sustainability of the solutions. Formal and informal institutions play a critical role in linking people and the environment, whether at an individual or at different collectivities.

2.9.3: Institutional Theory

According to North (1990), institutions are viewed as "rules of the game in society" or "the humanly devised constraints that shape human interaction". Institutions stabilize the human behaviour and interaction of agents, create predictability, and hence resolve conflicts by regularizing rules of engagement (March and Olsen, 1989). Institutions affect how social groups, governments, and authorities are constituted, exercised, controlled, and redistributed by providing a source of constraint, reward, or punishment such as monetary sanctions (Olsen, 2007). As a result of this perspective, institutions influence the outcomes of collective efforts towards managing communal resources such as watershed resources (Moe, 2005). Particular institutional forms and capacities will vary according to national circumstance (Meadowcroft, 2009). By examining and assessing watershed governance structures and their applications, watershed management expertise and resources created as an incentive in watershed management, the effectiveness of co-management and households' satisfaction towards the watershed governance, these variables determined the structure of governance of the nature-related transaction (Hagedorn, 2008) in the study area. Hence study aimed at assessing the status of watershed governance as a means of preventing the tragedy of commons that result in perpetuating food insecurity in the Lower Sio River Basin.

Building a resilient watershed governance system for food security in the Lower Sio River involve institutional networking that will lead to the formation of polycentric management networks, and cut across scales, which include local communities at village, wards, sub-county, county and central government managing ecosystem services across scales, from the level of a village to a catchment (Xu *et al.*, 2005). The importance and advantage to institutional diversity are that it promotes alignment of rules and policies at different scales whereby it becomes more difficult for "free riders" to break diverse sets of rules; stakeholders at various scales might use information and resources at their disposal from cross-scale interactions to undermine trust and reinforce their own authority (Dietz *et al.,* 2003). Further, Adger *et al.,* (2005) posited that “understanding adaptation required consideration not only of different scales of human action but also of the social construction of appropriate scales by institutions to further their own aims”.

Further, Ostrom *et al.* (1994) developed the Institutional Analysis and Development (IAD) framework which focused on individuals that make decisions over the course of action. The framework introduced the context in which local actors interact to create the institutional arrangements that shape their collective decisions and individual actions (Andersson, 2006). The framework identified four variables that could affect policy processes and outcomes that are applicable to Lower Sio River Basin: attributes of the physical world; attributes of the community within which actors are embedded, a rule that creates incentives and constraints for certain actions; and interactions with other individuals.

2.10: Conceptual Framework

The existence of national and county governments, communities and individual households, and other non-state actors under the devolved system of governance makes it difficult to understand the scale at which watershed governance should be implemented given the socio-ecological dynamics at a river basin. Bohensky and Lynam (2005) noted that across scales, well-defined formal institutions and policies that are easy to understand and adapted could effectively facilitate local adaptive capacity and enable communities to participate in and influence policy processes.

Therefore, the study adopted the framework below: It was organized in three levels in the sense that the primary level independent variables determined watershed governance in the Lower Sio River watershed. These included variables that determined watershed governance; adaptive capacity, effective co-management, and perception variables at different scales. This study modified variables considered by different researchers including Gupta *et al.* (2010) to define intervening variables that formed the basis for this study at multilevel institutions such as national and county, sub-county, ward, village and household levels that could viably contribute to adaptive watershed governance.

The intervening variables included: Knowledge, attitude, satisfaction, policies, laws, plans, institutional memory, watershed conditions, visionary leadership, watershed expertise, financial resources, participation, accountability, and collaboration. Governance is also a pre-requisite for sustainable food security, by assessing these variables; the study also aimed at assessing the contribution of watershed governance to food security. Therefore, the outcome variable was food security. Finally, tertiary variables on food security including the availability of food, access to food, utilization of food, and stability of food supply were assessed in the Lower Sio River Basin (Figure 2.1).

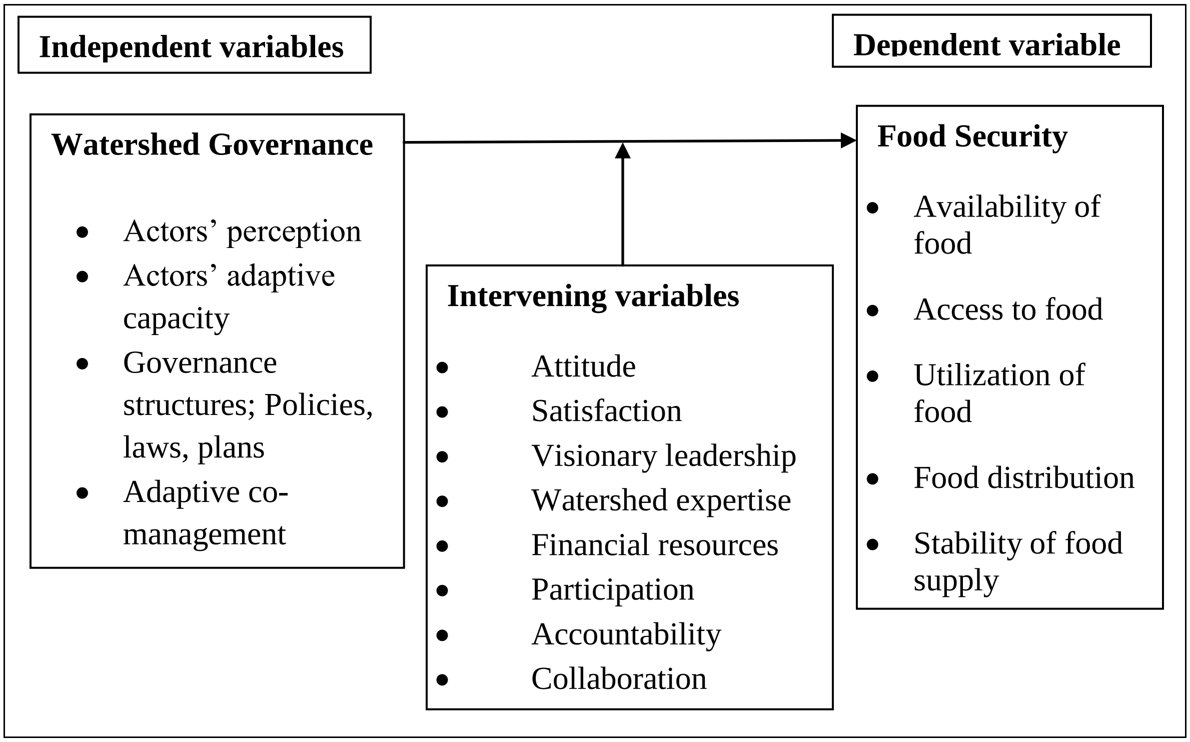


Figure 2.1: Conceptual Framework Model of Watershed Governance and Food security
Source: Author (2018)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1: Introduction

This chapter presents a description of the study area based on location, geographical features, climatic conditions, livelihoods, socio-economic characteristic and land use. It describes the research designs, methodology, sampling strategy, data collection, data analysis and presentation.

3.2: Study area

The Lower Sio River Basin is trans-boundary, (Figure 3.1), It originates in Kaujai and Luucho Hills in Bungoma County, Kenya at an altitude of 1800m and flows into Berkeley Bay in Lake Victoria Basin in Uganda. The upper 65% of this sub-watershed is in Kenya, while the remaining portion 35% lies in Uganda (Obando *et al.,* 2007). The watershed lies between latitudes 0^0N and 10^0N and longitudes 30^0E and 36^0E (Wanjogu, 2004). The drainage pattern of Sio River basin is dendritic and the drainage density is high. The mainstream of Sio River stretches approximately 78 km from the source in Kenya to the mouth in Uganda (Albinus *et al.,* 2008). The lower parts of Funyula also have numerous degraded Samia hilltops which are sources of numerous streams, springs and wetlands most of them draining into River Sio which drains into Lake Victoria thus forming a common hydrological unit 'a watershed'or a basin. There are diverse, unevenly distributed natural resources which connect communities that use the resources differently depending on their positions. Consequently, both the watershed resources and the user communities are interdependent (Shiferaw *et al.,* 2012; FAO, 2017).

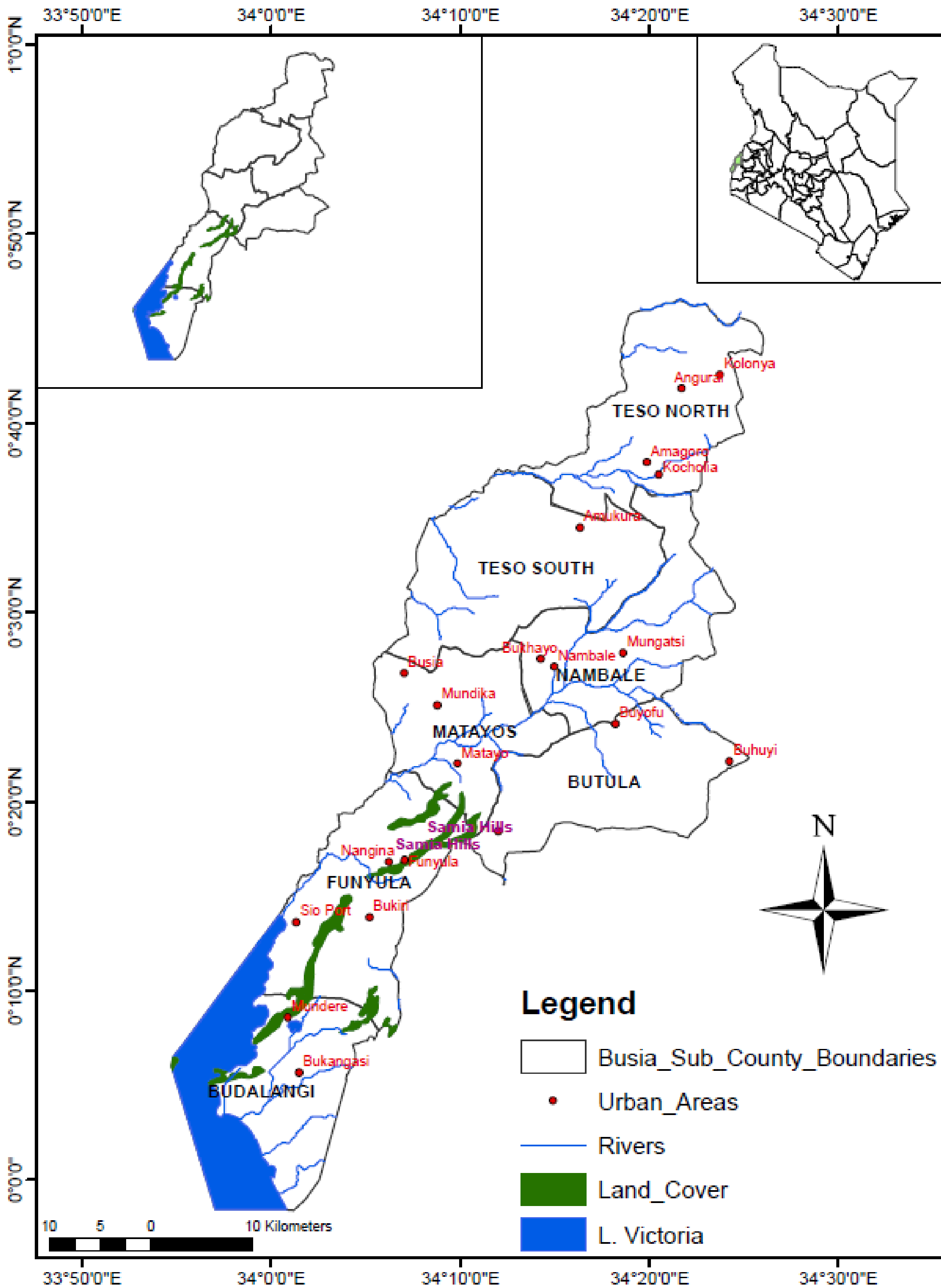


Figure 3.1: Map of the Lower Sio River Basin
Source: Author, 2018

The selected sites in Busia County, Kenya are down-stream of Sio River entering Lake Victoria, situated at the mouth and in villages' representative as the midstream section of the basin thus targeted the three; Funyula, Matayos and Nambale Sub-counties out of the seven sub-counties in Busia County, Kenya (Figure 3.1). These study sites were selected on the basis of the observed environmental and land use changes; through onsite observations such as setting up of two sugar factories, National Irrigation Board Lower Sio Irrigation scheme, deforestation and degradation of Busia hilltops among other changes in the watershed that resulted from the increased unsustainable population and county government activities, and preliminary interviews with key informants. In addition, the area has high poverty levels of 65.9% (GoK, 2007) with 93.5% of the households in Funyula Sub-county depending on rain-fed on-farm and off-farm activities for their livelihoods (Namenya, 2012). In addition, the rationale for the selection of the Lower Sio River Basin in Kenya was guided by field visits, interpretation of existing topographic maps and literature.

3.2.1: Physiographic and natural conditions

The physiographic and the natural conditions of Lower Sio River Basin are largely reflective of the relief features that are in Busia County and its surroundings. They are the physical land features and ecological and climatic conditions.

3.2.2: Physical and topographic features

Most parts of Lower Sio River Basin fall within the Lake Victoria Basin. The land is undulating and rises from about 1,130 metres above sea level at the shores of Lake

Victoria to a maximum of about 1,500 metres in the Samia and North Teso Hills (GoK, 2013a).

The central part of the watershed, especially Matayos and Nambale Sub-counties, are occupied by a peneplain marked by low flat divides of approximately uniform height, often capped by lateritic and a shallowly incised swampy drainage system (GoK, 2013a). The Samia Hills, occupying most parts of Funyula Sub-county, represent the basement complex and consist of acid and sub-acid lavas, tuffs, and agglomerates, banded quartzite and ironstones. The Kavirondo series rocks are developed around Matayos and Nambale sub-counties. The northern part of the central region bordering Nambale sub-county features granitic outcrops, which is essentially part of the peneplain and is characterized by the presence of large granitic hills (GoK, 2013a).

The southern part of the basin is covered by a range of hills comprising the Samia and Funyula Hills which run from the North East to the South West culminating at Port Victoria; forming a very conspicuous topographic feature. The River Sio stream traverses Nambale, Matayos and Funyula Sub-counties and drains into Lake Victoria at Sio Port in Funyula Sub-county. The area forms a colony of papyrus growth forming a wide wetland and is broken by irregular water channels and occasional small dams with grassy islands. This area is covered with lacustrine and alluvial deposits of recent and Pleistocene times (GoK, 2013a).

3.2.3: Ecological conditions

The Lower Sio River Basin lies in a Lower Middle Ecological Zone, divided into four Agro-ecological zones (Jaetzold *et al.,* 2010). Whereas most parts of the Lower Sio River basin have sandy and loam soils, dark clay soils cover the central parts of Nambale and Matayos sub-counties the Lower Midland Sugar Cane Zone, at an altitude of 1200-1440 meters above sea level and receives an annual rainfall of about 1800-2000 mm. Also, patches of other soil types found in most parts of several streams in the watershed are sandy clays and clays.

Funyula North sub-county is classified under Marginal Sugar Cane Zone, at an altitude of 1,200-1,350 meters above mean sea level and receive an annual rainfall of about 1,550-1,800 mm (GoK, 2016b). The land formation and structure makes it suitable for both food and cash crops like tobacco in the Northern parts of Nambale. The lower part covering parts of Nambale, Funyula sub-counties are suitable for maize, Robusta coffee, sorghum, millet, cotton and sugarcane cultivation (GoK, 2013a). Therefore, most parts of the watershed have a high potential for agriculture and promises of faster growth to sustain food security.

3.2.4: Climatic and hydrological conditions

Due to its proximity to the equator and the lake, the area experiences high humidity as a result of evaporation. The annual mean maximum temperature ranges from 26^0 C to 30^0 C, while the annual mean minimum temperature varies between 14 ^{0}C to 18 ^{0}C. Evaporation in this region varies between 1800 mm to 2000 mm per year (GoK, 2007). River Sio is the main river flowing across the sub-county a few kilometres to Lake Victoria. The rainfall pattern in the region varies between 1020 mm and 1270 mm mean annually. The long rains may start as early as mid-February and last until mid-May with a peak in April. The short rains may last from mid-November to mid-January. The dry season with scattered rains falls from December to February. Precipitation in the watershed is unreliable and drought is an ever expected phenomenon.

3.2.5: Sources of livelihoods and socio-economic practices

The Lower Sio River Basin forms a significant base for the livelihood of small-scale farmers engaged in mixed farming, depending on agriculture and livestock keeping as well as a large population depending on fishing which also forms a larger percentage of sources of food. Rain fed farming is the main socio-economic activity whereby food crops which include; cassava, sweet potatoes, arrowroots, finger millet, sorghum, bananas, groundnuts, cowpeas, green-grams and monkey nuts whereas poultry include quill, chicken and ducks, other sources of livelihoods are fish, termites and animals such as sheep, goats and cattle. Crop production is majorly for subsistence purpose and the nature of farming is characterised by the use of low input level, and local seed varieties are used by about 80% of the farmers (GoK, 2007). In 2013, 87% of the households did not have enough food (GoK, 2016b). Malnutrition of children below 5 years was very high where approximately 27%, 14% and 10% of the children were stunted, underweight and wasted respectively, a factor that was attributed to high consumption of cereals and low consumption of animal and vegetable proteins (Nungo *et al.,* 2012).

The basin has a high population density exceeding 300 persons per square kilometre (GoK, 2010a) and cattle density of 38 per square kilometre, and continue to increase pressing heavy demand on the watershed resources – water, soil, vegetation (Obando *et al.*, 2007). Majority of the population (83% of the male- and 87% of the female-headed households) use firewood as the main source of energy for cooking (GoK, 2013b). Access to health facilities is also poor as 71% of the population has to walk for 5 or more kilometres to a health facility (GoK, 2016b). Lower Sio River wetlands, river banks and road reserves have degraded as a result of farmers exploiting these ecologically fragile ecosystems without initiating appropriate conservation measures (GoK, 2007). To make it worse uncontrolled charcoal burning, hilltop burning, stone and sand harvesting (Namenya, 2012) are key businesses that put both public and private land, forests, hill-tops and River Sio stream flow at risk.

The watershed continues to be deforested as demand for human settlements, agriculture and grazing land increases leading to land degradation that is characterised by fertility losses, erosion by water and increases in sediment load as it drains into Lake Victoria. The livelihood of the population has been adversely affected by environmental and climatic changes and has, in turn, led to unsustainable natural resources utilization as existing development initiatives such as the CDF projects do not adopt watershed management approaches (Namenya, 2012).

The irony is that all these activities happen in the wake of new institutional reforms in Kenya whereby decision making, local legislation, financial resources on key livelihood sectors such as agriculture, environment and natural resources management are decentralized while devolved funds have been on increase to tackle poverty at grass root levels with the aim of reducing poverty-environment impacts. The county governments have been mandated by the Constitution of Kenya (2010), County Government Act, (2012) to share with the national government the function of environmental management, lead in agricultural, crop and animal production and formulate county plans, legal frameworks and to facilitate execution of such functions. This calls for sound ecological management governance that can be achieved through adaptive watershed governance in the Lower Sio River Basin.

3.3: Study population

Lower Sio River basin, Busia County was expected to be having a human population of 383,232 by 2017 as shown in Table 3.1. The basin has a higher population growth rate of 3.1% compared to 2.9% at national level rate due to high fertility rate placed at 6% compared to the national rate of 4.2%. The population is largely rural considering that only 10% of the population resides in the urban areas (GoK, 2013). Approximately 64% of the population lives below the poverty line, making Busia one of the counties with the highest poverty incidences in the country. Majority of these people are found in the rural compared to the urban areas (64% and 42% respectively) (GoK, 2016b).

Table 3.1: Population distribution by sub-county in the Lower Sio River basin

Sub County	Density (km^2)	2009 (census)	2012 (projection)	2015 (projections)	2017 (projections)
Matayos	568	111,345	122,197	134,106	**142,684**
Nambale	398	94,637	103,861	113,983	**121,274**
Funyula	353	93,500	102,613	112,613	**119,817**
Total	**437**	**299,482**	**328,671**	**360,702**	**383,232**

Source: Kenya National Bureau of Statistics, (Gok, 2010a)

The targeted population in this study were (19,002) households in Nambale, (68,781) in Matayos and (19,395) in Funyula sub-counties, Busia County Kenya as shown in Appendix I (GoK 2010a) and the state and non-state actors who were service providers at the villages, wards, sub-county and county level in leading organizations that directly or indirectly dealt with watershed activities, agricultural services and governance at local level. In addition to local community-based organizations and local based international non-governmental organizations in the sub-counties of Busia County.

3.4: Research design

According to the Oxford Dictionary (2010), a research design is defined as a scheme, culture or plan that is used to generate answers to research problems. Research designs are constructed to answer research questions which vary considerably. It utilized both qualitative and quantitative methods, probabilistic and non-probabilistic sampling techniques. As a socio-ecological study, it employed a mixed methods approach (Stringer, 2009). The study focused on polycentric and multi-level watershed governance, therefore, the need to ensure both external and social validity which called for evaluation design to address the third and fourth of study objectives on watershed governance and food security. More so, the cross sectional survey design was employed in the pre-test study. The use of a mixed method approach in this study provided an opportunity to triangulate and cross-check the results thus ensuring validity and credibility in the research process (Stringer, 2009).

The cross-sectional survey design was employed in determining the characteristics of a household's perceptions, attitudes, satisfaction and knowledge in the first and second study objectives. According to Walingo and Ngaira, (2008), cross sectional design is applied in determining the frequency with which something occurred, or with which it was associated with something else. The major purpose of adoption of a cross-sectional survey design in this study was the description of the state of affairs as it existed at the moment. The design was also suitable because it was used to ascertain attitudes and opinions as well as factual information. According to Serem *et al.* (2013), survey studies are used to obtain information about existing phenomenon by asking individuals their perceptions, attitudes, behaviours or values.

Evaluation research design is concerned with assessing the effects and impacts of social and development interventions in the real world; it uses scientific methods to measure the implementation and outcomes of programs. According to Punch (2003), outcome or impact evaluation is the aspect of assessment that focuses on the effects that have been achieved by the intervention. It aims at establishing causal effects. It has a strong experimental tradition with a quantitative approach. But some researchers (Maxwell and Caldwell, 2008) have also introduced qualitative approach. Table 3.2 below summarizes the research design for each study objective and the variables for measurement.

Table 3.2: Summary of research design of each study objective and respective variables

	Objective	**Measurable Variables**	**Research Design**
i.	To determine the perceptions of households on changes in rural watershed governance in the Lower Sio River Watershed.	Knowledge Attitude Perceptions Satisfaction	Cross-sectional survey
ii.	To examine the adaptive capacity of state and non-state institutions to watershed governance for sustainable food security in the Lower Sio River Watershed.	learning, institutional memory, access to information, visionary leadership, authority, watershed expertise and financial resources	Cross-sectional survey
iii	To evaluate the impacts of watershed governance structures on rural food security in the Lower Sio River Watershed under devolved governments in Kenya	Food availability, food access, food utilization, food stability, food distribution	Evaluation
iv.	To determine the effectiveness of adaptive co-management of watersheds for sustainable food security in the Lower Sio River Watershed.	Multi-level actor, collaboration, policies and plans, legislation, equity, responsiveness, accountability	Evaluation

Source: Author, (2018)

3.5: Qualitative methods

3.5.1: Narrative method

The research intended to unfold facts and perceptions from actors in a multi scale institutions approach. Storytelling unveils how humans explain, make sense of social reality and share knowledge. Traditionally, a narrative has a clear beginning, a chronological progress, a plot and an ending (McDougall, 2008). In social sciences, researchers construct knowledge through their interaction with relevant respondents for the purpose of revealing social reality through their own stories and or according to the ideas that present them through the stories. In order to understand institutions' or organizations' characteristics and processes of management, it has become increasingly important to discover knowledge from a narrative approach (Rhodes, 2005). A social researcher can always further develop the story with additional interviews or theoretical perspectives, and subsequently, end up with a completely new story. Therefore, using a narrative approach implies that the researcher understands reality as a social construction, where the varied understanding of the same story and those stories exist is continually transforming (McDougall, 2008).

Story-telling has long been recognized as a means by which individuals find meaning in institutional and organizational life (Rhodes, 2005). In this study, knowledge construction was premised on the stories of relevant institutional actors involved in promoting watershed governance activities as a path towards sustainable food security. It is envisaged that through narrating their own experiences in relation to what and how institutions engaged in watershed governance, came to understand the approach to sustainable food security from the experiences from actors in the field.

Focusing on the relations between the characteristics of institutions attempting to foster adaptive capacity in communities as a pillar in watershed governance, its core values and practices on ensuring food security, in a changing environment. Through stories, institutional actors and participants from the field shared their experiences, institutional and otherwise. Narratives are thus regarded as the means through which experience is reflexively reconstituted, made meaningful and made communicably (Rhodes and Brown, 2005). The stories generated in this study were recently revealing the change process and the institutional reactions that have developed in watershed governance and food security.

3.5.2: Case method

Case studies lend themselves to the exploration of present day phenomena within its real life context and are especially appropriate when the boundaries between phenomenon and context are not clear (Yin, 2003). A case study provides the researcher with an uncontrolled and unpredictable environment to observe a range of social phenomena including the description of routine events that may otherwise be overlooked (McDougall, 2008). According to Yin (2003), cases that are singular in nature are used for various reasons when the case is unique or severs to a revealing phenomenon previously not observed. In this study, a case study was presented in the form of the table of cases of actors.

3.5.3: Documents review method

This study utilized secondary data from existing documents to review a variety of existing sources with the intention of collecting independently verifiable data and information. The documents were internal to programs or institutions and organization. Documents were hard copies and electronic and included; reports, performance ratings, funding proposals, policy documents, project evaluation reports among others. This method was relevant to collect background information, determined if the implementation of the programs reflected program plans, as well as collected information that helped develop other data collection tools for the assessment. Both qualitative and quantitative data were collected during the documents review process. Document analysis was guided by data collection on legislations, policies, and power analysis during the study.

3.5.4: Qualitative methods

In this study, purposive, convenient and snowballing sampling were used to determine the sample for key informants who participated in the interviews and other necessary community participatory workshops, while quota sampling was used to select a sample for the focus group discussions. Key informants' interviews were conducted with senior and operational staff in relevant governmental directorates, civil societies and non-governmental organizations. Qualitative data were collected in a participatory manner. The sample size was determined by the nature of actors including the elderly due to their long term experience in the study site, county government officials; and grassroots community-based organizations and non-governmental organizations working in the sub-counties. The staff were systematically selected and interviewed from their work stations by use of a key informant interview guide.

A list of registered associations, governmental and non-governmental organizations that offer climate change, environment, watershed management, and agriculture and food security related activities in the sub-counties were obtained from the relevant Busia County government departments of Social services, Environment, Water and Natural Resources, and Agriculture and Animal Resources. Members who participated in Focus Group Discussion (FGDs) and narrative sessions were registered members of the organizations identified earlier and were selected from established lists of registered members of specific organizations. Members were selected from sites with the organizations as well as non-organization intervention. These groups were selected and classified according to age, gender and status. One FGD session was done at start and end of data collection in each location. These groups of individuals comprised of actors in climate change adaptation, watershed management, environmental management and agriculture known to share common interests and therefore the researcher expected free and fair discussions.

3.6: Quantitative sampling methods

The study used both probability and non-probability sampling techniques to determine the sample size for quantitative data. 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 flow thus forming a common hydrological basin. A two-level multi-stage sampling was conducted; the First level, simple random sampling techniques were used to select at least 10% (Mugenda and Mugenda, 1999) of the two locations from each of the Sub-county; and second level, two sub-locations from each selected location were selected using the simple random technique.

The appropriate sample size (Table 3.3) for this study was calculated from a (sample frame) list with the number of all households in each sub-location in the three sub-counties obtained from the Kenya National Bureau of Statistics (KNBS) 2009 National Census Report (GoK, 2010a) at Busia County offices and updated with household lists obtained from respective chiefs' offices in May, 2017.

Proportionate sampling was used to distribute the samples in the sub-locations based on their population variations in the sample frame. 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. Yamane (1967) simplified the formula for small population sample size calculation was adopted for the study. The formula equation (3.1) states:

$$n = \frac{N}{1 + N(e)^2} \quad \text{…...…………….……………………………Equation (3.1)}$$

Where:

n = the desired sample size

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

e = Margin of error 5 %

From the formula: n = 387

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

Simple random sampling was used to identify samples for households' respondents. The proportionate samples sizes for each sub-location were calculated from the formula in Equation (3.2):

$$Ps = \frac{Nhh}{TNhh}(n) \text{ ………………...……………………Equation (3.2)}$$

Where:

Ps = Proportionate sample for each sub location

Nhh = Number of households in each sub-location recorded at Chief office as at May, 2017

TNhh = Total number of households in all sampled sub-locations at Chief Offices as at May, 2017 which was (11,988)

n = Calculated sample size which was (387)

Table 3.3: Calculated study proportionate sample size distribution

Sub-County	Location	Sub-Location	HH per KNBS	HH at Chief as at May, 2017	Proportionate Sample size
Nambale	Township	Kisoko	1833	1912	62
		Syekunya	1597	1670	54
	Walatsi	Musokoto	892	965	31
		Khwirale	1247	1370	44
Matayos	Nangoma	Muyafwa	792	901	29
		Nangoma	948	992	32
	Lwanya	Busende	638	681	22
		Igero	665	701	22
Funyula	Nambuku	Lugala	413	521	17
		Mango	406	492	16
	Namboboto	Luanda	889	982	32
		Buloma	721	801	26
Total	**6**	**12**	**11,041**	**11,988**	**387**

Note: Locations and sub-locations as at 2009 Kenya National Census were used instead of wards and villages because all these administrative units existed and population information on created wards and villages were not available.

Source: Author (2018)

The study further benefited from the purposively sampled key informants, representatives of the national and county governments, and non-governmental organizations including: Assistant county commissioners, environment, water, social services, cooperative and agriculture sub-county officers, ward administrators, chiefs and assistant chiefs, County Kenya Forest Service officer, County Kenya Meteorological Department Officer, County department of irrigation and fisheries, Water Resources Management Authority, Busia Water and Sewerage Company, Coordinator of Western Kenya Community-Driven Development and Flood Mitigation, Programme for Agriculture and Livelihoods in Western Communities, Simpact Kenya, One Acre Fund, Anglican Development Services and County NEMA officer. In addition, community groups including; Farmers Common Interest Groups, Community Forest Associations and Water Resources User Associations were targeted. The information from the key informants was instrumental particularly in triangulating information provided by the interviewed households. Table 3.4 summarizes sampling methods and sample sizes for the study population.

Table 3.4: Summary of sampling methods and sample size for the study population

Study Population Units	Sampling method	Sample size
Household Heads	Multi-stage random, Simple random and proportionate	387
State Actors or government officers	Purposive, convenient and snowballing	12
Non-State Actors or non-governmental representatives	Purposive, convenient and snowballing	15
Focus group discussion	Quota	8-12
Observation units	Purposive	Three sub-counties

Source: Author, (2018)

3.7: Data collection instruments

Data collection techniques for this study varied according to respective activities to address each study objective.

3.7.1: Household Questionnaires

The procedure for data collection essentially necessitated semi structured questions, open and closed ended questions, and attitudinal questions based on a Likert scale. The questionnaire gathered data on the four study objectives through the variables that included; diversity of solutions, learning capacity, institutional memory, access to information, visionary leadership, authority, human resources, financial resources, multi-level actors, collaboration, policies and plans, legislations, equality, responsiveness, accountability, knowledge, attitude, and perceptions. Socio-demographic variables were used to determine the association between dependent and independent variables. Research assistants were identified and recruited and trained to conduct face to face interview exercises.

Respondents who were not available for the first round of interviews were mapped and targeted for follow-up for an interview, to ensure consistency in data for the sampled population. The English version of the questionnaire was used. Serial numbers were inserted on the questionnaire to avoid individual identification. This, therefore, meant that no identifiable details of participants were disclosed on the format any given time. The researcher ensured data obtained was kept confidential and protected from access by unauthorized persons. The researcher also kept and protected the list that contained contacts of participants. The researcher was allowed access to the data, serialized forms as well as the list that contained contacts of participants.

3.7.2: Key Informants Interview guides

Key informant interviews were individually conducted on twenty-seven key informants who included senior staff and operational staff of government departments and non-governmental organizations. National and county government service provider including the; members of county assembly, ward administrators, ward managers, chiefs, assistant chiefs, sub county water, agriculture and environment officers, NGOs and CBOs representatives were also interviewed. The interviews were carried out at their work stations and guided by interview guide with unstructured questions. The study also determined adaptive capacity, roles and characteristics of governmental and non-governmental organizations in watershed governance the characteristics that fostered adaptive capacity and how they impacted on food security in communities as well as climate change adaptation as a key determinant to food security.

The data gathered from governmental and non-governmental staff covered areas on: diversity of solutions, learning capacity, institutional memory, access to information, visionary leadership, authority, human resources, financial resources, multi-level actors, collaboration, policies and plans, legislations, equality, responsiveness, accountability, knowledge, attitude, and perceptions. The researcher together with the research assistants ensured data obtained was kept and protected from access by anybody not permitted.

3.7.3: Focus Group Discussion guide

Focus Group Discussion (FGD) sessions were participatory, performed on formal and informal groups or associations that engaged in environment and watershed management activities, agricultural production, food security, and climate change adaptation in their usual meeting site. Participants for FGDs sessions were selected from established and registered groups and associations of people. Jointly ward managers, chiefs and assistant chiefs helped study teams in mobilizing respondents to attend sessions as designed. Discussion sessions were carried out at their usual meeting place.

The researcher with two selected research assistants (moderator and note taker) guided FGD sessions and also ensured participants understood the purpose of the stated discussion before the participants' consent. They controlled any tension likely to erupt; encourage the use of acceptable language, and also created an environment that was encouraging throughout the process. Audio-taping and video recording during the focus group discussion sessions were done by research assistants and the researcher with the permission of the respondents. The data collected were under the custody of the researcher.

Discussion sessions were guided by a FGD guide. The instruments that were used during the FGD sessions included; checklist, the flip chart for writing any information that was necessary, audio recorder and video camera after obtaining consent from respondents. One session groups were held in each sub-location, one cluster comprised of six youths both males and females and another group comprised of six adults both males and females.

Overall four FGD sessions were carried out one from each location. Individuals were selected and grouped categorically according to their status, education, sex and age. A moderator, timekeeper to monitor the time taken by each group together with an audio recorder was identified from the research assistant team members and mandated to take tasks as assigned. Video recording was done as the note taker did not capture all information conversed. Each FGD session was virtually one hour and 30 minutes with time guided by FGD moderator. Participants discussed and expressed views on watershed governance aspects in their respective locale in addition to, how the food security situation was affected by such aspects. They further discussed and provided details about experiences as well as institutional intervention in watershed governance as well as food security.

3.7.4: Observation and photography checklist

Observation method was used to solicit on-site information on watershed governance activities in ensuring food security in the three sub-counties in the Lower Sio River Basin. In addition, information and images on the biophysical environment in the sub-county were gathered and photographs were taken and documented based on different study themes. Table 3.5 summarizes the targeted population, sampling method, sample size, and data instruments for primary data collection.

Table 3.5: Summary of instruments for primary data collection

Study Population Units	Sampling method	Sample size	Data collection instruments	Appendix number
Household Heads	Multi-stage random, Simple random and proportionate	387	Household Questionnaire	V
State Actors or government officers	Purposive, convenient and snowballing	12	Key informant guide	VI
Non-State or non-government actors	Purposive, convenient and snowballing	15	Key informant guide	VI
FGD	Quota	8-12	FGD guide	VII
Observation checklist	Purposive	Three sub-counties	Photography and visual Observation checklist	IV

Source: Author, (2018)

3.8: Pre-test, validity and reliability of data instruments

Validity is the ability of the instrument to measure what it is supposed to measure (Walingo and Ngaira, 2008). It considers whether data obtained in the study represents the variables of the study. This is important in research because conclusions drawn from such data are more accurate, relevant and meaningful. Therefore, 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).

A pre-test study is important in testing the validity of the instruments and clarity of language (Mugenda and Mugenda, 1999). The pre-test was performed on both the quantitative and qualitative data collection instruments to assure validity, reliability and sensitivity in Esikulu Sub-location, Matayos Sub-county. This sub-location was not among the sampled sub-locations although it had similar biophysical environmental and socio-economic characteristics with the sampled sub-locations in the three sub-counties. The aim of the pre-test study was to assess the clarity of the wordings in the questionnaires, interview schedule, focus group discussion guide and observation check lists. Issues on the interpretation of concepts, length and time to be spent at each respondent emanated. The items which failed to meet the anticipated data were discarded after pretest.

The instruments were then reviewed to capture changes that emanated from the pre-test. In addition, issues such as the length of the tool, time to be spent on each tool and interpretation of the tools to the local language where applicable were addressed. Interpretations of concepts were then revised among the research assistants re-training to ensure concepts were interpreted in a similar manner to all households. The researcher used content validity to measure the degree to which data collected using a particular instrument was represented. Attempts were made to ensure the validity of research results by taking into consideration by controlling extraneous variables on watershed governance and food security across the sampled households. The same variables were considered when interpreting results.

On the other hand, reliability refers to the consistency that an instrument demonstrates when applied to similar situations (Mugenda and Mugenda, 1999). To test the reliability of instruments the researcher used the test- retest method. The consistency of data collection instrument in this study was checked during the pre-testing. The interview schedule was administered to the respondents and then repeated after two weeks, a comparison of answers was made and analyzed.

The Cronbach's alpha reliability coefficient (Cronbach, 1990) using the IBM Statistical Package for Social Sciences (SPSS) version 20 was used to measure the internal consistency of multiple attitudinal questions in the study. Table 3.6 presents the Cronbach's Alfa for the tested variables of the study.

Table 3.6: Reliability Statistics using Cronbach's Alfa

Variables	Number of Tested variables	Cronbach's Alfa
Satisfaction with watershed governance	7	0.964
Attitudes and perceptions of watershed governance	9	0.865
Food security	17	0.894

Source: Author, (2018)

Table 3.6 shows that overall, the Cronbach's alpha internal consistency was above 0.7 therefore of $\alpha \geq 0.7$ and (above) was acceptable for this study. Throughout the process, the researcher coordinated, supervised, facilitated logistics monitored the process and ensured instruments were filled correctly. Similarly, ensured all instruments and data were well protected with no access to any unauthorized persons. A total of 12 research assistants were identified and recruited to undertake training for competency in data collection. The training ensured they were able to understand, interpret, and translate designed instruments to local language for easier use. Research assistants were recruited from the local community, familiar with the local language and also possessing respect locally based on certain criteria; they comprised females and males of above 18 years of age who have attained at least an undergraduate degree and above in environmental studies, natural resource management and social sciences related field.

3.9: Data analysis

Institutional analysis of communally managed watershed systems is very complex. Usually, these kinds of resources are frequently characterized by multiple users and actors. In addition, there is a need for an arrangement for individual and collective negotiation and mechanisms for resource use and management among different stakeholders. Therefore, institutional rules for sharing the resources comprise individual actions, which are useful in resolving misuse and creating incentives for investment and resource development (Acheson, 2006). At the same time, there is need to have institutions for collective action, either in the form of formal organizations or informal forms, state or no-state for cooperation, to ensure sustainable utilization while adhering to the property rights as well as act collectively for the betterment of the community and sustainable livelihoods. These characteristic of watershed governance institutions that enhance food security are a bit difficult to analyze quantitatively.

However, qualitative approaches are increasingly used in conjunction with quantitative approaches and such combinations can enhance the validity and reliability of analysis and evaluation (Bamberger, 2000). Therefore, triangulation formed the basis for analysis for complementing data to ensure validity. In this study, a mixture of both quantitative and qualitative approaches was appropriate to provide the quantifiable results of factors which determine adaptive capacity, adaptive co-management of state and non-state institutions that promoted the adaptive capacity of society in addition to changes in rural watershed governance structures under Kenyan devolution. It provided an explanation on adaptive co-management of the watershed at different levels for food security in the Lower Sio River Basin.

3.9.1: Descriptive data analysis approach

This analysis approach mainly focused on analyzing the descriptive statistics of the whole data spectrum. The data mainly contained information regarding the adaptive capacity of state and non-state institutions that promoted the adaptive capacity of communities in addition to, institutional and rural watershed governance structures changes under Kenyan devolution system in the Lower Sio River Basin. Quantitative data from the households' questionnaires on the four study objectives with variables assessing; diversity of solutions, learning capacity, institutional memory, access to information, visionary leadership, authority, human resources, financial resources, multi-level actors, collaboration, policies and plans, legislations, equality, responsiveness, accountability, knowledge, attitude, and perceptions were subjected to descriptive statistics. The study used IBM Statistical Package for Social Sciences (SPSS) version 20 and Microsoft Office excel software to analyze quantitative data collected. The data was summarized and presented in percentages, tables, charts, graphs and figures.

3.9.2: Qualitative data analysis approach

This approach was used to analyze the households and other actors' characteristics, arrangements and processes in watershed governance and mechanisms as pathways to enhancing households' food security. Specifically, the data contained variables that indicate the adaptive capacity of state and non-state actors, adaptive co-management, actors' perceptions and the impact of selected watershed governance variables on households' food security. These included variables that assessed; diversity of solutions, learning capacity, institutional memory, access to information, visionary leadership, authority, human resources, financial resources, multi-level actors, collaboration, policies and plans, legislations, equality, responsiveness, accountability, knowledge, attitude, and perceptions.

The qualitative information was gathered using an open-ended and Likert scale questions that were included in the questionnaire. Qualitative data was analyzed and presented on pre-determined themes through the thematic approach, specific institutional case analysis, content analysis, categorization, contextualization, verbatim and plates and determination of similarities and trends of watershed governance and food security.

3.9.3: Inferential data analysis

Cross tabulation was used to compare relationship among variables, to give inference and thereafter ensure generalization. Quantitative data were analyzed using; bi-variate analysis to ascertain the association and level of significance between the dependent and independent variables. Quantitative data were analyzed using IBM Statistical Package for Social Science (SPSS) version 20 software. Frequency distribution was used to organize categorical variables for quantitative data and further calculated measures of mean alongside measures of variation. Chi-square (χ^2) was used to examine the statistical significance of relationships between categorical variables. Regression analysis determined whether the potential for food security is a function of background socio-demographic factors such as age, sex, and religion and land tenure system on different scales. More so, regression analysis was also used in determining the relationship between index score of food security and watershed governance structure, watershed expertise, households' satisfaction towards watershed governance and co-management of the watershed. Results were presented in form of tables, charts, and graphs. Table 3.7 summarizes data analyses methods with reference to specific study objectives.

Table 3.7: Summary of data analysis methods with reference to specific objectives and research designs

Specific Objective	Measurable Variables	Research Design	Methods of data Analysis
i) To determine the perceptions of households on changes in rural watershed governance in the Lower Sio River Watershed.	Knowledge Attitude Perceptions Satisfaction	Cross Sectional Survey	Descriptive statistics, bi-variate analysis, Likert scale, Chi-square, T-test and context and qualitative analysis
ii) To examine the adaptive capacity of state and non-state institutions to watershed governance for sustainable food security in the Lower Sio River Watershed.	learning, institutional memory, access to information, visionary leadership, authority, watershed expertise and financial resources	Cross-sectional survey	Descriptive statistical analysis, bi-variate analysis, Chi-square and T-test , context and qualitative analysis
iii) To evaluate the impacts of watershed governance structures on rural food security in the Lower Sio River Watershed under devolved governments in Kenya.	Food availability, food access, food utilization, food stability, food distribution	Evaluation	Descriptive statistics bi-variate Chi-square, T-test and regression analysis, context and qualitative analysis
iv) To evaluate the effectiveness of adaptive co-management of watersheds for sustainable food security in the Lower Sio River Watershed.	Multi-level actor, collaboration, policies and plans, legislation, equity, responsiveness, accountability	Evaluation	Descriptive statistics, bi-variate analysis, Chi-square T-test and, context and qualitative analysis

Source: Author (2018)

3.10: Data management and Quality Standards

Qualitative data from the field was cleaned to yield accurate information that can easily be used for analysis and report writing. Each team led by team leader went through four transcripts and compared them with the audio versions to check whether accuracy and consistency of data reported had been maintained. There was high-level quality control of quantitative data. Quantitative data for the study were collected from the field using a web based - online system (Open Data Kit (ODK) by a well-trained team of data collectors using their smart phones. The principal researcher who was the administrator of the online system www.ona.io.com invited the research team, trained and hosted the server for the results relay. An XLSFORM was developed with no room for sending the incomplete form to the server by the research assistants. Also, the GPS location of each filled questionnaire was shown, time and the data collector were indicated in the server thus, improving the quality of the data.

During the data collection process, the principal researcher supervised the research team and had access to the server at all times for data quality assurance. The principal researcher also had access to the research assistants' phones each evening for verification purposes before the questionnaires were sent to the server. Upon completion of the data collection exercise, the principal researcher downloaded and exported the raw data to IBM Statistical Package for Social Sciences (SPSS) version 20 for analysis. Thus, there was an improvement in the quality of the data and reduction of data that contains errors. Consequently, validity and reliability of the data were adhered to throughout the data collection exercise.

3.11: Measurements, data analysis and interpretation

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. However, quantitative data were analyzed using the IBM Statistical Package for Social Sciences (SPSS) version 20 and excel spreadsheet. Frequencies were run using all the variables to check for missing cases if any as well as for explanations. The dependent variables (food security), watershed governance structures, actors' adaptive capacity (expertise), watershed governance conditions, watershed co-management knowledge, watershed level of satisfaction and watershed level of attitudes and perceptions were recorded to ensure that a higher score means a correct or more positive answer (0-1 for binary; (yes, no) and 0-4 for Likert scale). Each dependent variable that was used to measure food security was summed up to compute an index score of food security. (Therefore, an index food security score, Modified Bloom's cut-off point was created for the purpose of performing inferential statistics).

Further, independent variables concepts values were summed up and computed to form different independent index scores for the specific concept. Due to the high quality of data collected from the field, all the 17 variables for the food security dependent variable were included in the calculation of index score of food security since the reliability tests showed tight coherence with a Cronbach's alpha above 0.7 or higher being 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 scored 0-49%' (food insecurity households) and 1 ‘indicated households scored 50-100%' (food security households).

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 watershed governance structures, actors’ adaptive capacity (expertise), watershed governance conditions, watershed co-management knowledge, watershed level of satisfaction and watershed level of attitudes and perceptions. In running Chi square tests by the groups for background information (watershed governance structures, actors’ adaptive capacity (expertise), watershed governance conditions, watershed co-management knowledge, watershed level of satisfaction and watershed level of attitudes and perceptions variables) p values were used to show the level of significance/differences between the groups of households with or without food security.

Pearson Chi-square results that showed p-values: $p<0.1$ at 90 % confidence level; $p<0.05$ at 95 % confidence level; and $p<0.01$ at 99 % confidence level (meant that there was statistically significant evidence or difference or variations between the tested variable and control variable (households with food security and households with food insecurity) in terms of watershed governance structures, adaptive capacity, expertise, knowledge, conditions, co-management, level of satisfaction and, perceptions.

The t-test was run to provide the overall index score of independent variables towards food security and food insecurity group of households; with mean, standard deviation and p values being recorded and interpreted. The difference was highlighted and presented in various tables: where the food insecurity group of households scored higher than the food security group of households; in watershed governance structures, actors' adaptive capacity (expertise), co-management knowledge, level of satisfaction and watershed level of attitudes and perceptions towards watershed governance and; where the food security group of households scored higher than food insecurity group of households.

To control the results of background characteristics and independent variables both linear and logistic regression analysis were run using index score for food security and dummy binary food security, respectively as the dependent variable against age, sex, land size, religion, household land tenure system, watershed governance structures, actors' adaptive capacity, knowledge of governance structures, and level of satisfaction as independent variables that had showed statistical relationship with groups of food security and food insecurity households. Although age and sex showed no relationship they were considered as more important background factors in both regression analyses.

Sex, religion and land tenure system variables were considered categorical when running logistic regression and dummy variables when running the linear regression to distinguish scores of 0,1 and 2 where necessary for example in sexes (0=Female and 1=Male); religion (1=Christians and 0=Others). Age (on continuous scale, 18-87 years), land tenure system (0=Freehold, 1=lease and 2=Communal with lease as reference category), watershed governance structures (continuous scale), actors' adaptive capacity (continuous scale), co-management knowledge (continuous scale), level of satisfaction (continuous scale) and watershed level of attitudes and perceptions (continuous scale) towards watershed governance were control or background variables explaining variations on the scores of levels or status of food security outcome on both continuous and binary (food secured and food insecure) scale among the households. The index score of food security levels and dummy binary level of food security among different households were outcomes being measured.

3.12: Limitations to the study

The following limitations were encountered in the field while collecting data;

i. Some targeted county and national government officers feared to disclose information on watershed governance and food security projects for fear of being investigated or victimization. The researcher obtained research authority from the County Secretary and County Commissioner who were direct supervisors of the officers. The authority simplified the release of information. The researcher also clearly explained how the data collected could be used in addition to assuring the actors of total confidentiality of the information released.

ii. Limited data on watershed governance and food security projects in the watershed because most households did not participate in public governance forums and did not keep records. The researcher depended on estimates and approximations as narrated by the household heads and this was compared with secondary and key informants' data during triangulation.

iii. Some household respondents did not conceptualize the study at the beginning of the interviews. The researcher had to explain to the households' key concepts in Kiswahili and local language where possible. Further, the researcher clearly explained the objective of the study and the importance of the respondents' participation beforehand in addition to triangulation during data collection and analysis process.

3.13: Assumptions to the study

The following assumptions were made in regard to the study:

i. All respondents and key informants would cooperate in releasing required information.

ii. All respondents understood the objectives and key terms operationalized for effective participation in the study.

iii. The political environment was conducive for the successful completion of the study.

iv. Information gathered from the study was generalized for other watersheds in the country.

3.14: Participation, ethical consideration and informed consent

Participation was voluntary with participants allowed to withdraw at any time they wished to. Individuals who chose to take part in the interview were asked to read and ensure they had understood the idea before consenting. The protocol of the study was put through the scientific processes set by the University Directorate of Postgraduate Studies research requirements. Ethical clearance for the study was sought from the National Commission of Science and Technology (NACOSTI). The approval was then presented to the County Director of Education, County Commissioner and County Secretary before presented to the sub-county officers. Each participant was asked to give consent before participating in the study. Participants undertook face to face interviews. During the process of study, there was no known harm or risks associated with the procedures done that affected participants, although some participants felt uncomfortable answering some questions on leadership and financial resources due to victimization as a fear for corruption "whistleblowing".

Participants for quantitative interview were randomly selected from existing locations and sub-locations. The interviews took place at homesteads in a discrete manner to breach confidentiality. Selected participants who were not available for interview were visited at home by research assistants for the second time. Key informant interviews were conducted with respective staff officers including senior managers and operational officers. Interviews with the key informants took place at respective workstations.

FGD was conducted on established groups' common meeting places. The researcher was liable for ensuring that recorded audio and video instruments were kept. Only research assistants involved in moderating FGD accessed data kept in the cabinet. To ensure the issue of confidentiality, unauthorized persons were not allowed to join any of the discussion sessions. The researcher together with the research team ensured that the data obtained was well kept and protected from access by any unauthorized person. No identifiable details of any participant were disclosed during and after study, and dissemination of findings.

CHAPTER FOUR

HOUSEHOLDS PERCEPTIONS TO CHANGES IN RURAL WATERSHED GOVERNANCE

4.1: Introduction

This chapter presents and discusses the quantitative together with qualitative findings based on the interviewed household heads (HH) and community focus groups discussions; knowledge, attitudes and satisfaction on various variables that determine watershed governance and food security. This is in order to corroborate the information gathered using the household questionnaires on the status of adaptive capacity of the state actors and non-state institutions, adaptive co-management and the impact of watershed governance on food security in the Lower Sio River Basin. Therefore, the chapter covers the first objective of the study. The chapter starts by presenting data on households' socio-demographic determinants of watershed governance and food security.

4.2: Households Socio-demographic Characteristics and Food Security

The household questionnaires were administered to a total of 387 respondents from 12 sub-locations found in the Lower Sio River Basin in Busia County, Kenya. The study sought to establish the background information of the household heads; their gender, ages, religion, the composition of the households, levels of formal education attained acreage of land, legal status and tenure system of the land held. These variables play an important role in determining households' perception, adaptive capacity and co-management in various interventions in watershed management and food security. Majule *et al.* (2007) observed that adaptive capacity to climate change varied within communities due to various factors including variations in wealth among social groups, age, gender and sex. The variables were further analyzed in relation to the variations in household food security status among the households with food secure and food insecure status and hence formed part of the independent variables during data analysis. Table 4.1 provides a summary of the socio-demographic characteristics of the respondents in the study.

Table 4.1: Summary of Households Socio- demographic Characteristics

Characteristics	Categories	Frequency(N=387)	Percent
Sex of the respondent	Male	184	47.5
	Female	203	52.5
Are you head of household	Yes	273	70.5
	No	114	29.5
Educational level	None	43	11.1
	Primary	179	46.3
	Secondary	131	33.9
	Tertiary	34	8.8
Main Occupation	Farmer	266	68.7
	Civil servant	16	4.1
	Employee in private sector	09	2.3
	Business person	49	12.7
	On farm laborer	16	4.1
	Off farm laborer	21	5.4
	Other specify	10	2.6
Religion	Christians	348	89.9
	Muslims	09	2.3
	Traditional African	01	0.3
	Other specify	29	7.5

Note: Other occupations include: housewife, retired officers; Religion others include; Non-believers/Pagans.

Source: Field data, (2018)

4.2.1: Households' Gender Distribution and Food Security

Although the study targeted household heads, during household visiting time only 70.5% (273) of the household heads were available and interviewed in their homes while 29.5% (114) were not available, therefore adults aged 18 years and above were interviewed as representatives of household heads. The respondents' gender in the study was assessed based on the biological sex either male or female (Table 4.1). Therefore, in terms of gender, 52.5% (203) of the respondents were female while male respondents were 47.5% (184). Adhikari and Lovett, (2006) indicated that increased female representation in decision making always leads to improved performance of collective action institutions, an example given is in the domestic water supply, while women exclusion in watershed decision making negatively affected collective watershed management action (Agrawal, 2001).

The gender composition in this study was well balanced, like in any other African rural community; males own the land resource while females are the workers in agricultural food crop production. It was, therefore, assumed that the findings from the study presented a balanced gender view of the actual scenario in watershed governance and food security. However, similar to Bekele and Drake (2003) findings that gender had no significant factor in influencing farmers' decision to adopt climate change adaptation measures, the Chi-square test performed on households' responses shown in Table 4.3 found that there was no statistically significant difference between gender and households' food security status in the Lower Sio River Basin.

4.2.2: Households' Levels of Education and Food Security

The study assessed the education level of respondents since education is considered as an important factor in determining individual opportunities, income and access to resources and information, knowledge, and perceptions on watershed governance and food security in the watershed. From Table 4.1, the study found that majority (46.3%) (179) of the respondents 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. However, it was also important to note that a large portion of the respondents, 11.1% (43) did not have formal education. On the contrary, earlier Albinus *et al.* (2008) found that the number of respondents with primary education in the Sio River basin Kenya was at 58% while those with secondary education was 19% and those without formal education was 21% suggesting an increase in the percentage of the respondents with secondary education and a decrease in the percentage of the respondents without formal education in the Lower Sio River Basin.

The variations in the statistics of primary, secondary and those without formal education were attributed to the Government of Kenya education policies that were initiated in the year 2002 such as Free and Compulsory Primary Education policy, increased education bursaries through devolved funds such as CDF, Ministry of Education bursaries, and efforts to regulate secondary school fees to make education affordable as efforts to increase enrollment rates at primary level as well as increasing transition rate from primary to secondary education. This was also one of the efforts aimed at attaining the Millennium Development Goal (MDG) now Sustainable Development Goals (SDGs) on education in Kenya.

A study by Terry and Israel (2004) found that the higher the farmers' education level the greater their likelihood of satisfaction in any form of extension service offered to them. Moreover, Elias *et al.* (2015) noted that education not only increased the farmer's resources and the capacity to achieve goals but also it expanded farmer's awareness of alternatives and the rewards expected from farmer's activities. Further, Maddison (2007) emphasized that educated and experienced farmers were expected to have more knowledge and information about climate change and adaptation measures to use in response to climate challenges. However, a Chi-square test carried out on the households' responses and presented in Table 4.3 did not establish any statistically significant difference between education and households' food security status. On the contrary, the early study in the neighbouring Bungoma County found that there was a statistically significant association between educational levels and food security (food supply) in the county (Wabwoba *et al.,* 2015). Therefore, the level of education of the household decision maker determines households' ability to obtain and process information and to implement knowledge intensive conservation practices and agricultural technologies (Kagombe *et al.,* 2018).

4.2.3: Households' Main Occupation and Food Security

The study assessed at the main occupation of the respondents and other household members. Findings presented in Table 4.1 indicate that majority (68.7%) (266) of the households in the Lower Sio River Basin 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 on businesses, 4.1% (16) were civil servants and 2.3% (09) were employees in the private sector respectively. About 2.6% (10) of the households' heads reported engaging in other activities which included; housewives, carpentry, the local brewery and retired officers. Studies revealed that farmers are the key determinants in the success of watershed governance as they are expected to make major decisions on the willingness to accept incentives in conservation (Kagombe *et al.,* 2018).

Further, the main household occupation is the main determinant of household disposable income which is vital in efforts to invest in watershed management activities and access to food. Anley *et al.* (2007) urged that improving education and employment was necessary to stimulate local participation in various adaptation measures and natural resource management initiatives. However, Wabwoba *et al.* (2015) found a highly significant variation in the source of income and households' food security status. In Table 4.3 the Chi-square test performed on households' responses unexpectedly found out that there was no statistically significant variation between occupation and households' food security and food insecurity status in the Lower Sio River Basin.

4.2.4: Households' Religion and Food Security

Religious ethics and morals are inherent in determining human behaviour related to watershed resources management and utilization in attaining food security. Therefore, during the study, the religious affiliation of the respondents was assessed. The study found in Table 4.1 that the majority (89.9%) (348) of the households in the watershed practiced Christianity while 2.3% (09) practiced Islam and 0.3% (01) practiced Traditional African religion. However, 7.5% (29) practices others forms of religion which included activities that were classified either as Christianity, traditional African religion and paganism. In Christianity, environmentalism is enshrined in the story of creation in the Holy Bible, the book of Genesis; God gave the man the mandate to take care of other creatures and manage all other resources, this call for good environmental stewardship among the Christians. In Table 4.3 the study showed that there was a highly statistically significant difference with p-value =0.000 at 99% confidence level in religion types and status of households' food security. This implied that religious activities were important in promoting determining households' food security Lower Sio River Basin.

Table 4.2: Socio-demographic Characteristics on interval scale

Characteristic	Mean	Median	Std. Deviation	Variance	Range	Min	Max
Age (in completed years)	42.73	42	13.24	175.40	69	18	87
Land size (acres)	2.73	2	2.52	6.35	25	0	25
How many male are in the household?	3.11	3	1.70	2.90	10	0	10
How many female are in the household?	3.26	3	1.81	3.28	11	0	11
How many members are aged below 18 years in this HH?	2.83	3	1.80	3.25	10	0	10
How many members are aged 18-64 years in this HH?	3.41	3	2.31	5.34	15	0	15
How many members are aged 65 years and above in this HH?	0.21	0	0.49	0.24	2	0	2

Source: Field data, (2018)

4.2.5: Households' Members Average Age and Food Security

The age of the respondents was considered to be an important variable in determining the status of understanding watershed governance issues and the status of households' food security. The average age of 43 years of the respondents was documented and other descriptive statistic measures drawn as presented in Table 4.2. Age of the beneficiaries of any project is important in determining the participation, satisfaction and knowledge about a given phenomenon. According to Lavis and Blackburn (1990) and Terry and Israel (2004) in the study of farmers' satisfaction on extension services in Ethiopia, it was concluded that older farmers were more satisfied with the services provided by extension officers compared to younger farmers the factor that was attributed to differences in farm experience.

However, in the same study, older farmers were viewed as less flexible in addition to less willing to engage in the new or innovative activity as a result of fear of risk while younger farmers were found to be more risk averse to implement new farming technologies on their farm (Elias *et al.*, 2013). However, the Chi-square test results presented in Table 4.3 showed that there was no statistically significant difference between age and households' food security status in the Lower Sio River Basin. This is similar to Bekele and Dekele (2003) findings where age had no influence on farmer's decision to participate in climate change adaptation activities which is a key determinant of households' food security. On the contrary, Bayard *et al.* (2007) found that age was positively related to some climate change adaptation measures in Haiti.

4.2.6: Household Size and Composition, and Food Security

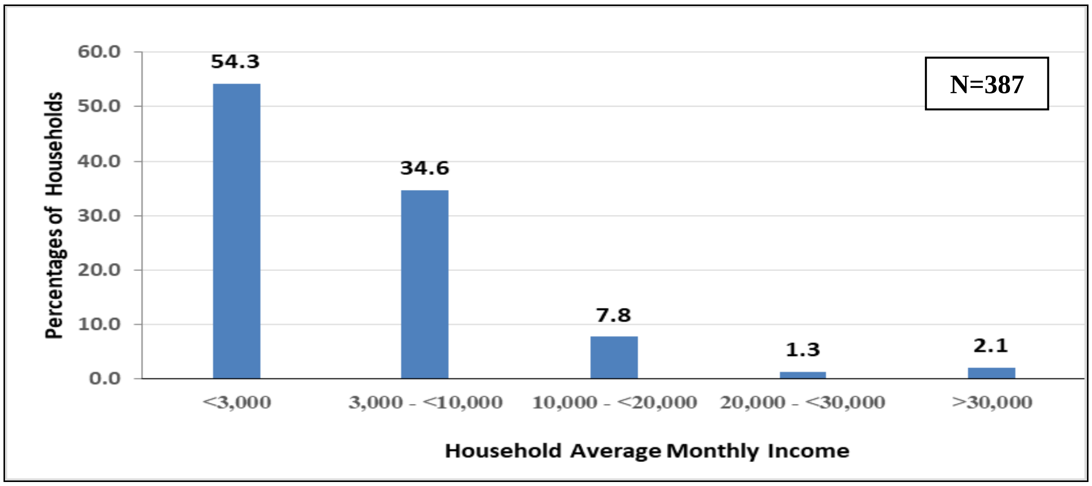
The size of the households based on the number and composition of members was considered an important determinant of household engagement in watershed activities and food security and thus an influencing factor in the household adaptive capacity and co-management. The households' sizes were classified based on gender and age of members. Table 4.2 shows that on average the households had three male members and three female members. An average of three members was aged below 18 years while three members in the household were aged between 18 years and 64 years. Further, on average one member of the household was aged above 65 years. Elsewhere, studies indicate that the composition of the household in a watershed is important since it helps mitigate farm labour issues (Elias *et al.*, 2015) hence how watershed resources are utilized as well as how the resources are managed.

An earlier study by Albinus *et al.* (2008) in the Sio River basin Kenya noted that family labour was the main soil tillage practice with 21.8% of the households using family labour. However, during the interviews in group discussions, oldest aged and females who were heads of the households argued that it was difficult for them to engage in simple soil management activities such as digging of terraces because they did not have the energy to do so even though they were willing. For those who had school going male youth, engaged them in digging terraces and digging tree planting holes especially on the slopes of hills where land had formed hardpans. In the Kenya Rural Household Budget Survey of 1981-1982, it was found that women in Kenya spent 65% of their time in agricultural crop production as compared to men who spent 35% of their time on similar activities (African Women's Studies Centre, 2014). A similar finding was reported by Kumar (1994) study in Zambia who found that women were responsible for 49% of the agricultural crop production family labour compared to men (39%) and children at 12%.

Elsewhere, studies on asset ownership in Ethiopia showed that wealth status of rural household farmers motivated them to implement extension advice effectively thus adaptation activities. Further, the family size of farmers, livestock ownership, and the size of land helped farmers to mitigate labour shortage, incomplete credit and insurance markets (Ayalew and Deininger, 2012).

4.2.7: Average Households income and Food Security

On average, (54.3%) (210) of the total households reported to earned less than KES.3000= (USD 30) monthly income while 34.6% (134) on average earned income ranging from KES. (3000 = (USD 30) to KES. 10,000= USD 100) monthly. Those who indicated to earn between (KES. 10,000=USD 100 to KES. 20,000= USD 200) were 7.8% (30) while 1.3% (05) indicated to earn between (KES. 20,000=USD 200 to KES. 30,000=USD 300). Only 2.1% (08) of the households in the Lower Sio River watershed reported earning above KES. 30,000 = USD 300 per month as presented in Figure 4.1. A study by Namenya (2012) in Funyula Sub-county one of the study sites found that majority (60.2%) of the households reported earning an income below KES. 15,000=USD 150. Results show that the Chi-square test carried out and presented in Table 4.3 show that the study did not establish any statistical significant variation between various levels household income and households' food security or food insecurity. This is contrary to earlier study findings in the neighbouring, Siaya County where it was reported highly significant variations in the level of income and households' food security among fish farmers (Shitote, 2013).



NOTE: Exchange rate at 1USD =KES. 100

Figure 1.1: Average monthly income of households in different categories

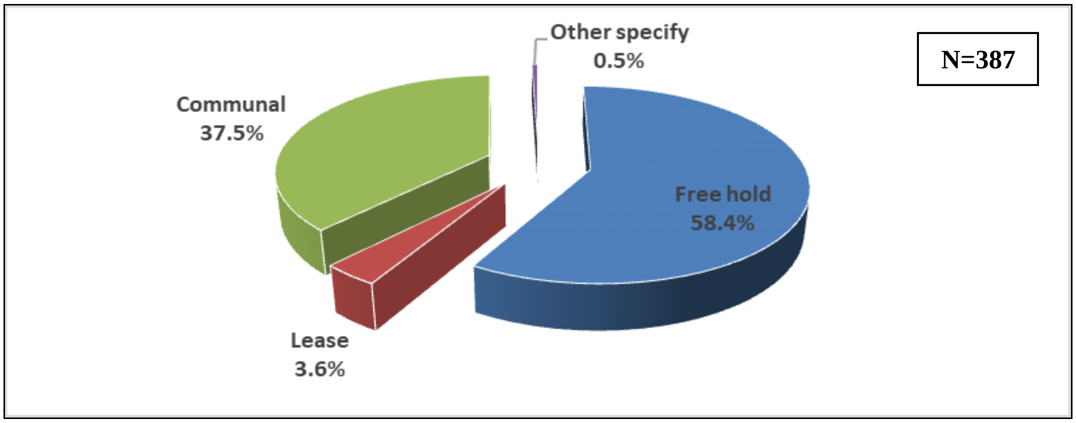
Source: Field data, (2018)

In a similar study in Ethiopia (Oromia, Amhara and Tigray) where the actors concentrated on watershed management activities as an approach to increase household income and thus food security, the findings indicated that watershed management improved farmers' incomes and food security by an average of 50% and 50%, respectively. This affirmed that investment in watershed management activities as a long-term development agenda in a watershed has a positive impact on natural resource conservation, crop and livestock production and productivity, socioeconomic conditions and livelihood (Gebregziabher, 2016).

4.2.8: Households' Land Tenure System and Food Security

Based on the findings presented in Figure 4.2, the majority (58.4%) (226) of the respondents reported that the household land tenure system practiced was freehold. In addition, communal land tenure system was practiced by 37.5% (145) while lease land tenure system was practiced by 3.6% (14) of the households. In addition, 0.5% (02) reported other land tenure system such as donations and gift in the watershed. The focus group discussions also indicated that the land tenure system was in favour of the male members in the household; the land cultural practices including inheritance rights only considered the males in the families in households with freehold, lease and communal tenure systems. This reduced the adaptive capacity of women in the watershed since women were left with limited options for holding productive land other than depending on males for them to access land and decision making.

However, some respondents acknowledged the land ownership rights in the Constitution of Kenya (2010) were the key milestone and a game changer in female land ownership in the watershed although reported that they were yet to be affected. In addition, in Table 4.3, a Chi-square test established that there was a positive statistical significant difference p-value =0.085 at 90% level of confidence in households with freehold and lease land tenure systems and households with food security. On the other hand, communal land tenure system had a marginal significant variation in households' food insecurity status in the Lower Sio River Basin. Elsewhere, in the study by Wabwoba *et al.* (2015) a significant variation on household heads decision making on land allocation and food security was reported in Bungoma County.

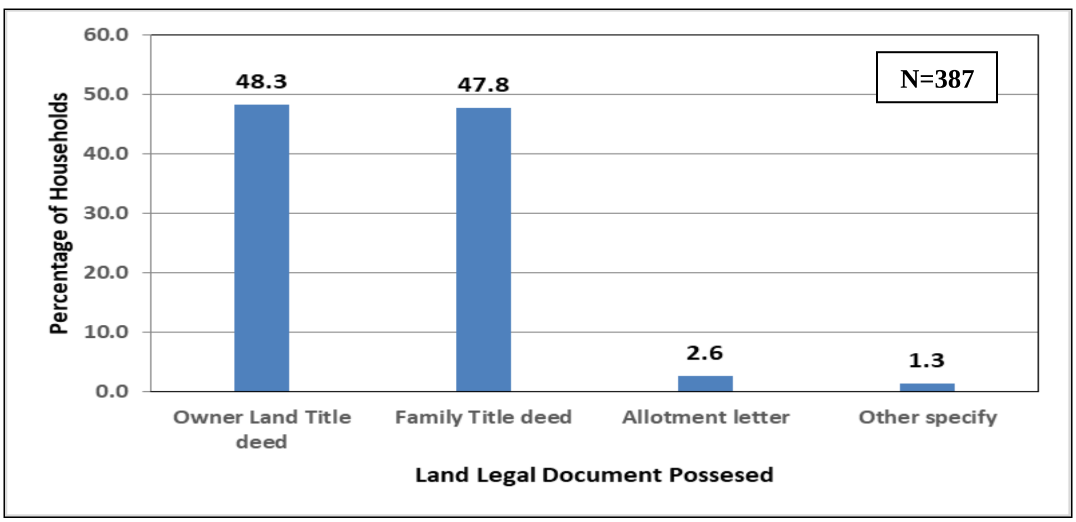


Note: Other; donations and gifts. Communal meant collectively owned by extended family members
Figure 2.2: Household Land Tenure System in the Lower Sio River watershed
Source: Field data, (2018)

Land tenure was found to have an influence on natural resources management with many environmental problems such as soil degradation and forest depletion characterized as a result of incomplete, inconsistent and non-enforceable property right (Bromley & Cernea, 1989; Watchter, 1992; Kagombe *et al.*, 2018). The study findings were similar to an explanatory study by the World Bank (2012b) where it was found that women's access to land in Kenyan agricultural communities through the local power dynamics in both formal and informal justice systems underpin control and ultimately undermined the access to land by women. Further, it is indicated that past formal titling initiatives led to men holding almost all land titles in Kenya through patrilineal landholding practices where inheritance systems through kinship structure were also based (African Women's Studies Centre, 2014).

4.2.9: Households' Land Legal document possessed and Food Security

Based on the findings, Figure 4.3 shows that 48.3% (187) of the households in the Lower Sio River Basin held own land title deeds while 47.8% (185) held family title deeds. Land allotment letters were land legal documents held by 2.6% (10) of the households while other 1.3% (05) of the households indicated that had no physical document hence families' agreements were considered during allocation of land. During focus group discussions it was noted that collective family title deeds prohibited most households from practicing watershed management activities including tree planting and soil conservation terraces and gabions. This was attributed to ownership conflicts that emerged during the informal sub-division of family land. Therefore, individuals reported abandoning soil and water management activities for fear that other family members with economically stable claimed trees upon maturity and fertile lands for which they never contributed to planting or conservation initiatives.



Note: Other include; No land legal document

Figure 3.3: Household Land Legal document possessed

Source: Field data, (2018)

In the interview with the County Land Registrar, it was observed that most of those who held land title deeds either had purchased land or acquired through succession. Land ownership disputes were on the rise since most of those title deeds held were issued in the 1970s; since then families with numerous adult male children have increased resulting to family land sub-divisions without following the legal procedure of acquiring land title deeds. In addition, the Land and Environment Court in Busia had also recorded an increased number of land succession cases as well as land disputes that result from deaths of grandparents whose land parcels were registered in the 1970s. The court process was reported to take long, a minimum of five years which was also another challenge to ownership and effective use of land as watershed resource. According to FAO (2011), gender inequalities in control of livelihood assets limited women's participation in food production. A study in Ghana found that insecure access to land led women, farmers, to practice shorter fallow periods than their colleague men who securely owned land, hence reduced women agricultural production yield, income and the availability of food for the households headed by women (African Women’s Studies Centre, 2014).

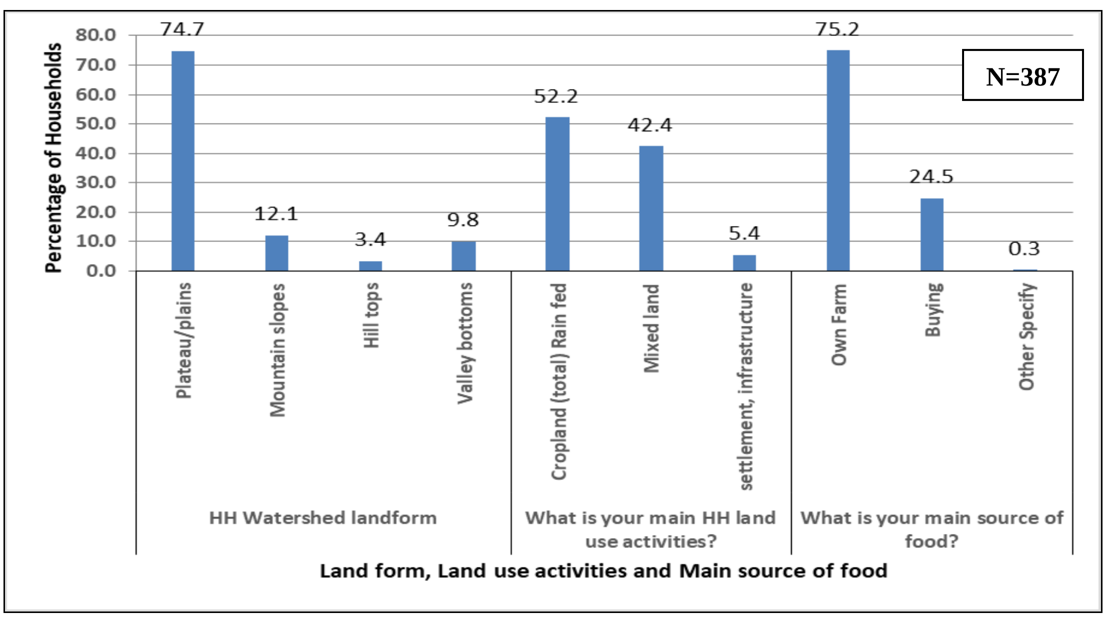
4.2.10: Households’ watershed land area occupied, main land use and main source of food

The results show that majority, 74.7% (289) of the households in Lower Sio River basin are inhabitants of plain land area, 12.1% (47) mountain slopes, 9.8% (38) valley bottoms and 3.4% (13) hilltops as illustrated in Figure 4.4. The landforms occupied by households determined access to water resources thus the quality of agricultural production. During transect walk, it was observed that numerous streams formed the tributaries of River Sio. Water pans, wetlands along the streams and the main river channel, shallow wells in the settlement areas, boreholes, protected and unprotected springs and roof water from rainfall were the possible sources of water for domestic and agricultural production. Through consensus, the groups acknowledged that the amount of water in all sources had reduced in recent years due to frequent prolonged droughts. Among tributaries of River Sio is the Walatsi which joins the Sio River at Nambale Market.

Other smaller tributaries of the Sio River listed by groups include the Mererak, Musokoto, Muyala, Mumbao, Ludacho, Mudoma, Wakhungu and Munana which also join the Sio River near Nangina. All the streams and the main Sio River are covered by extensive wetland which is a colony of papyrus reeds. Gebregziabher *et al.,* (2016) showed that upstream and downstream areas of a watershed are linked through hydrology. However, during discussions with communities' groups, it was reported that there were no mechanisms in place to regulate the activities of the upstream land user for the sustainability of the downstream water users' activities in the Lower Sio River Basin.

According to Gebregziabher *et al.* (2016), natural resource management interventions at the watershed level in Ethiopian Highlands were used to reduce the rate of soil erosion, sedimentation in the downstream reservoirs and river systems for improved soil moisture and increased crop yield. On the contrary, in the Lower Sio River, the ineffective natural resources management in the upstream was blamed by Busia County NEMA officer during the interview as the ultimate cause of flooding and destruction of means of livelihoods in the downstream of both rivers. Further, a comparative study showed that a successful watershed management intervention increased groundwater recharges and raised the sub-surface water levels which in turn led to increased irrigated and increased crop yields across the watershed in Ethiopia (Gebregziabher *et al.,* 2016).

The main challenges identified in the Lower Sio River identified during the key informant interviews include: lack of clear ownership by the communities for some of the water sources and facilities, ineffective water management practices and lack of clear laws and regulations at the grassroots to protect water sources that threatened the sources with pollution and environmental degradation. Consequently, increased human activities were also blamed for water scarcity in the watershed including; unsustainable farming practices that resulted to a negative impact on the water cycle reducing underground water recharge and high evaporation occasioning huge shortages during the dry spells from September to March every year. Further, it was noted that most affected areas with water scarcity in the watershed were small urban markets including Busia town, Mundika, Nambale, Matayos, Namboboto and Funyula which had experienced immigrants who come from rural areas in search for economic opportunities as a result of the devolved system of governance.



Note: Other source of food include; Donations from neighbours, government

Figure 4.4: Household watershed landform occupied, main land use and main source of food

Source: Field data (2018)

Further, the study in Figure 4.4 shows that 52.2% (202) of the households indicated that rain-fed cropland was the main land use activity, 42.4% (164) of the households indicated mixed farming was practiced on the land while 5.4% (21) of the household indicated that the land held was only for settlement and infrastructure. During transect walk, it was observed that the agricultural land use activities in the Lower Sio River Basin were rain-fed subsistence farming. However, other studies in East Africa showed that diversification of options at the household level were critical for incomes and food security. Further, it was found that the households that were engaged in more cropping and non-agricultural activities tended to be better off than those who engaged in fewer activities (Thornton *et al.*, 2007, 2011; Patt *et al.*, 2012). However, during the focus group discussions, a male respondent said: -

> "Farming practices in this watershed have not been sustainable whereby the expanded cultivated land had exacerbated soil erosion. In addition, large areas of forest cover especially on the hill slopes in Matayos and Funyula Sub-counties and riparian zones along River Sio and its tributaries have been lost to agriculture due to increased demand for food as the population increase. Further, watershed degradation is on the rise as soil erosion and sedimentation increase as a result of increased county government activities such as grading and murram roads, ploughing using tractors and increased use of subsidized inorganic fertilizer in farms".

Plate 4.1 presents some of watershed destruction activities due to county roads infrustructure that results from poor watershed management activities.

Plate 4.1: Watershed destruction activities due to County roads infrustruture in the Lower Sio River Basin

Source: Field data, (2018)

On the lowlands along main streams and River Sio channel, small-scale farming was observed to be practiced by the households. In most cases, due to the undulating terrain, as a result of hills in Matayos and Funyula sub-counties, the County Irrigation Officer revealed that farmlands suitable for irrigation were located at higher elevations than the river level, together with lack of sufficient fund among the households to procure water pumping systems restricted irrigation to small-scale plots for food production.

The study findings in Figure 4.4 further showed that 75.2% (291) of the households' main source of food was from own farmlands while 24.5% (95) of the households depend on bought food. Government, civil society organization and neighbours donations were other sources of food to 0.3% (01) of the households in the Lower Sio River Basin.

Results in Table 4.3 show a bivariate analysis, Chi-square tests and T-tests were run to show the statistical significance between the background factors and different levels of food security at households. Based on earlier discussions in various sections of this chapter, the analyses show that age and sex of the head of the household, geographical area (sub-county), education level, main occupation, and average income had no statistically significant difference with levels of food security at the households. However, with reference from previous studies, age was expected to have a positive impact on food security (Geda *et al.,* 2001; Deaton, 1997 and Lemba, 2009).

This finding is similar to Nyariki *et al.* (2002) who found that age had insignificant influence on energy availability levels of households in the former Makueni District (Lemba, 2009). On the other hand, level of education was expected to have a positive effect on food security due to its link with better production and access to non-farm income (Geda *et al.,* 2001; Nyariki *et al.,* 2002). Similar findings were reported by Lemba (2009) in the study on food security in the former Makueni District Kenya. Results showed that land size in acreages showed no statistically significant difference with food security status, implying that households with less land size were more food secure while those with more acreage of land were food insecure (p-value=0.000 at 99% confidence level). Out of 10 background variables whose associations were tested with food security levels, only two showed the positive relationship with households that were food secure at the time of the study.

For instance, there was significant difference (d=8.8; p-value =0.000) at 99% confidence level in religion types and status of food security where 94.8% (164) households with food security reported as Christians and 86% (184) of households with food insecurity, implying that households with Christians as heads were more food secure than those households with heads of different religions (Table 4.3). Similarly, household land tenure system had positive marginal statistical differences with food security status at the household level (p=0.085) at 90% confidence level. Households with freehold (d=4.2) and lease (2.9) land tenure systems reported being more food secure than those with communal (d=-8.2) and others (d=1.2) land tenure systems.

Table 4.3: Food security and insecurity households' measurement comparison association amongst the Socio-demographic background factors of respondents at their household levels

Variable		**Food Insecurity (n=214)**	**Food Security (n=173)**	**Difference**	**$\chi2$**	**p-value**	**Significant ?**
Age group	18-35 years	35	37	2	1.182	0.554	No
	36 - 64 years	57	57.8	0.8			
	65 - 87 years	7.9	5.2	-2.7			
Sex	Male	49.1	45.7	-3.4	0.444	0.505	No
	Female	50.9	54.3	3.4			
Sub County	Funyula	15+	19.1	4.1	1.484	0.476	No
	Matayos	33.2	34.1	0.9			
	Nambale	51.9	46.8	-5.1			
Education level	None	11.7	10.4	-1.3	0.173	0.982	No
	Primary	45.8	46.8	1			
	Secondary	33.6	34.1	0.5			
	Tertiary	8.9	8.7	-0.2			
Religion	Christians	86	94.8	8.8	20.589	0.000***	Yes
	Muslims	1.4	3.5	2.1			
	Traditional African	0	0.6	0.6			
	Other specify	12.6	1.2	-11.4			
Main Occupation	Farmer	65.4	72.8	7.4	6.506	0.369	No
	Civil servant	4.2	4	-0.2			
	Employee in private sector	1.9	2.9	1			
	Business person	16.4	8.1	-8.3			
	On farm labourers	4.2	4	-0.2			

Cont'	Off farm labourers	5.6	5.2	-0.4			
	Other specify	2.3	2.9	0.6			
land size (acres) Categorical	less than 2 acres	27.1	46.2	19.1	15.476	0.000***	Yes
	2 - 4 acres	53.7	41	-12.7			
	More than 4 acres	19.2	12.7	-6.5			
Average monthly income	<3,000	52.8	56.1	3.3	2.785	0.594	No
	3,000 - <10,000	37.4	31.2	-6.2			
	10,000 - <20,000	7.5	8.1	0.6			
	20,000 - <30,000	0.9	1.7	0.8			
	>30,000	1.4	2.9	1.5			
HH land tenure system	Free hold	56.5	60.7	4.2	6.634	0.085*	Yes
	Lease	2.3	5.2	2.9			
	Communal	41.1	32.9	-8.2			
	Other specify	0	1.2	1.2			
Age	Mean	43.15	42.20	-1.0	t-test (F=0.43)	0.835	No
	Standard Deviation	13.22	13.29	0.1			
Land size (acres)	Mean	2.90	2.52	-0.4	t-test (F=1.241)	0.266	No
	Standard Deviation	2.19	2.87	0.7			

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

Source: Field data (2018)

During transect walk, it was observed that the Lower Sio River Basin, especially in Nambale and Matayos sub-counties, were dominated by farmlands which comprised of areas under cultivation for either commercial or subsistence agriculture purposes. Therefore, farmlands formed the main livelihood opportunities, especially for the rural population. In commercial sugar cane farming, agricultural production was reported to be done by farm machinery in large plantations, using agro-chemicals and inorganic fertilizers. The farms had access roads for machinery, animals and humans; therefore, in most cases, the roads acted as a runoff concentration area and result in gullies. In addition, the compacted road areas promoted surface runoff generation. On the other hand, machinery movement also caused compaction of the subsoil in the farms hence reducing infiltration and recharge into the groundwater. Consequently, the surface runoff generated builds the potential for soil erosion and flooding.

As a result of subsistence agricultural practices, simple tools were used for cultivation in advanced households, where animal power was employed. The Sio River Basin was characterized by small-sized farmlands most of which were demarcated downslope as a result of high population growth and the cultural requirement of formation of the new household for married adults which contributed to land fragmentation. This encouraged waterways between the small land sub-divisions which in most cases ran down slopes. As a result, runoff concentrated along the farm boundaries since the neighbouring farms discharged runoff into the waterways, therefore, increased runoff volumes accelerated gully erosion in most farmlands adjacent to graded roads in the watershed. Studies show that soil erosion has been associated with the persistent reduction in crop yields and river sedimentation and flooding in the downstream areas (National Environment Management Authority Uganda, 2002; Fiona *et al.,* 2013). Studies in Sasumua showed that contour farming combined with grass strips had highest effects of reducing sediment load, followed by terracing, contour farming and grasses waterway (Namirembe *et al.,* 2013; Kagombe *et al.,* 2018). Table 4.4 and Plate 4.2 present a summary of observed land use activities and its implications in various sections of the basin.

Table 4.4: Summary of Observed Land Use activities and their Environmental Impacts in the Lower Sio River Basin

Ecological Zone	Land use activity and its impacts
Valley bottoms areas	The valleys between the hilltops in Matayos and Funyula sub-counties had increased clearing of the land for farms, gullies were observed, no proper runoff structure had been put in place. Footpaths were all-over; there were several types of spring for water used in homes. **Impact:** Loss of fertile top soils to soil erosion that negatively reduced crop yield.
Mountain slope areas	There was cultivation on hill slopes in Matayos and Funyula Sub-counties, farms had been eroded, crop looked unhealthy. Homesteads could be observed especially in Nangoma location. There were also increased graded roads by the county government. The land had very few trees on farms boundaries. **Impacts:** Uncontrolled run off with high velocity leading to soil and water resources degradation, siltation and sedimentation in the streams and main river.
Hill tops areas	There was observed burning of the hilltops especially in Matayos and Funyula sub-counties also hilltops were experiencing gullies. Indigenous trees were cut down, and rocks could be observed occupying most hilltops due to massive erosion. **Impacts:** Uncontrolled run off with high velocity leading to the forest, soil and water resources degradation, siltation, sedimentation and eutrophication.
Plateau/ Plain land	In Nambale, Matayos and Funyula sub-counties increased open farms were observed, increased gullies along the roads, sediment deposited in bridges. Increased settlement as new homes were witnessed; there were newly opened access roads by the counties. Very few trees were observed in the plot boundaries and homestead fences. Most farms in December and January fire was used to clear farms. There was increased clearing of trees to give way for electricity line and roads in most parts. Shallow wells were witnessed in most homesteads. **Impacts:** Uncontrolled run off with high velocity leading to the forest, soil and water resources degradation, soil erosion, reduce water levels in wells.
Streams	In Nambale, Matayos and Funyula sub-counties increased open farms were observed, increased gullies along the roads, sediment deposited in bridges. Increased settlement as new homes were witnessed; there were newly opened access roads by the counties. Very few trees were observed in the plot boundaries and homestead fences. Most farms in December and January fire was used to clear farms. There was increased clearing of trees to give way for electricity line and roads in most parts. Shallow wells were witnessed in most homesteads. **Impacts:** Uncontrolled run off with high velocity leading to the forest, soil and water resources degradation, soil erosion, reduce water levels in wells.

Source: Field data, (2018)

Plate 4.2: Land use practices in the Lower Sio River Basin
Source: Field data, (2018)

An earlier study indicated that 42% of the respondents in the Sio River Basin in Kenya revealed that land productivity was lower than 30 years back (Makalle *et al.*, 2008). The reasons advanced for the declining land productivity were over cultivation because owned and cultivated land was decreasing as a result of overgrazing and increase in human settlements that reduced acreage under cultivation. Consequently, poor cultivation techniques, use of fire to clear land, inadequate use of fertilizers, mono-cropping and persistent drought periods contributed to the decline in agricultural productivity and were cited as the main causes of declining land productivity in the Lower Sio River Basin (Makalle *et al.*, 2008). The study findings show that since the time the study by Makalle and others was carried out in (2008), little interventions have been implemented to increase land productivity through watershed management as a result of ineffective watershed governance in the study area.

As evidenced in studies from Ethiopia, watershed governance interventions are needed in the study area to reverse land productivity. A study by Gebrehaweria *et al.,* (2016) revealed that reclamation of gullies along hill slopes and roadsides, reforestation activities through a watershed management program resulted in improved soil depth in Bechyti, Goho-Cheri, Bedesa Kela and Kereba watersheds. This was implemented together with simple land management technologies at the household farm level such as soil and stone bunds, hillside terraces, deep trenches, check dams, diversion ditches and sedimentation storage dams. Further, on the hillside landscapes, efforts to stabilize the conservation structures through tree planting were of economic importance. On the other hand, cultivated areas needed grasses, legume plants to stabilize and reinforce soil and water structures in addition to soil fertility improvement measures such as the use of compost and nutrient-fixing plants (Gebrehaweria *et al.*, 2016).

The decrease in farm sizes in the Sio River Basin was attributed to the increased subdivision of land parcels as a result of population increase, extensive soil erosion which was associated with river siltation and sedimentation on the river bank resulting to papyrus reeds growth (Makalle *et al.,* 2008). Despite the fact that respondents acknowledged the decrease in land productivity and diversion to alternative sources of livelihoods such as sand harvesting and charcoal burning, fishing farming were not widely practiced along the hilltops, streams of River Sio. In group discussions, various reasons were given these included; threats from dangerous wildlife such as crocodiles, snakes, monitor lizards along the River Sio at its tributaries, lack of adequate finances at the household level to invest in fishing ponds and other fishing farming infrastructure, limited skills and extension services to promote fish farming. Evidence shows that fish farming is a key contributor to households' food security and management of water resources in Siaya County (Shitote, 2013). The Plate 4.3, shows pieces of evidence pieces of forms of soil conservation efforts taken during the transect work.

Plate 4.3: Forms of soil conservation efforts in the Lower Sio River Basin
Source: Field data, (2018)

4.3: Households’ Perceptions to Changes in Rural Watershed Governance and Food Security

Households' perceptions play an important role in determining watershed governance and food security in the Lower Sio River Basin. This section focuses on the assessment of households' perceptions, knowledge, satisfaction and attitude on various variables of watershed governance and food security. The section presents households’ perception of the need for changes in rural watershed governance and household satisfaction with the domains of watershed governance; factors that are needed for a more collaborative watershed governance. The section also explains why there is the need for changes in the watershed governance in the study area. The relationship between variables that test perceptions and two types of households (food secure and food insecure) and satisfaction with the background socio-demographic data were discussed.

4.3.1: Households Perception on Rural Watershed Governance and Food Security

The study sought to establish households' perception of changes in rural watershed governance. Results in Table 4.5 revealed that 81.9% (317) of the households agreed that watershed governance determined the status of household food security while 64.6% (250) were in agreement that the current devolved system of governance in Kenya had impacted on watershed governance. Subsequently, 88.1% (341) of the households in the Lower Sio River basin agreed with the fact that the county government system had a potential to promote watershed governance and thus impact on households’ adaptive behaviour, this factor was agreed by 85.0% (329) of the households. Consequently, 93.0% (360) of the households supported that watershed management should be prioritised during county planning.

Table 4.5: Households Perception on Changes in Rural Watershed Governance

Changes in rural watershed governance	Disagreed	Undecided	Agreed
	Percentages (N=387)		
Watershed governance determine food security	11.9 (46)	6.2(24)	81.9(317)
Current devolution system in Kenya has impacted on watershed governance	22.7(88)	12.7(49)	64.6(250)
The county system has potential to promote watershed governance	7.2(28)	4.7(18)	88.1(341)
Current devolution system has potential to promote adaptive behaviour through watershed governance	7.5(29)	7.5(29)	85.0(329)
Watershed management should be prioritized during county planning	3.4(13)	3.6(14)	93.0(360)
Accepted watershed governance will promote sustainable livelihoods.	3.1(12)	2.8(11)	94.1(364)
County government focus on watershed governance will increase budgetary allocations and human resources for sustainable food security.	14.0(54)	12.1(47)	73.9(286)

Source: Field data, (2018)

A chi-square test carried out on the households' perceptions of changes in rural watershed governance in Table 4.6 indicated that there was a highly significant variation in the household's perceptions among the households with food security and households with food insecurity with the variables that were used to measure the expected changes in the rural watershed governance. Results showed that watershed governance determined food security at p-value=0.000 at 99% level of confidence implying that the households expected improvement in watershed governance to positively improve the status of households' food security.

On the other hand, current devolution system in Kenya had impacted on watershed governance at p-value=0.003 at 99% level of confidence implying that the households observed that the county governance had an impact on watershed governance thus food security. Further, results showed that at p-value =0.000 at 99% level of confidence, the household perceived that the county devolved system had a potential to promote adaptive behaviour through watershed governance.

Table 4.6: Food security and insecurity households' measurement comparison association amongst the households perception of changes in rural watershed governance

	Food insecurity (n= 214)	Food Security (n=173)	Difference	χ^2	p-value	Significant?
Watershed governance determine food security						
Disagreed	9.6	2.05	-7.95	35.33	0.000***	Yes
Undecided	8.9	2.9	-6.0			
Agreed	36.0	47.1	11.1			
Current devolution system in Kenya has impacted watershed governance						
Disagreed	12.2	10.4	-1.75	16.15	0.003***	Yes
Undecided	9.8	16.2	6.4			
Agreed	33.0	31.5	-1.5			
The county system has potential to promote watershed governance						
Disagreed	2.8	4.7	1.9	5.31	0.257	No
Undecided	4.2	5.2	1.0			
Agreed	45.1	42.8	-2.3			
Current devolution system has potential to promote adaptive behavior through watershed governance						
Disagreed	5.9	1.2	-4.7	20.45	0.000***	Yes
Undecided	6.1	9.2	3.1			
Agreed	41.2	44.2	3.0			
Watershed management should be prioritized during county planning						
Disagreed	0.7	2.9	2.2	32.78	0.000***	Yes
Undecided	2.3	5.2	2.9			
Agreed	48.2	44.5	-3.7			
Accepted watershed governance will promote sustainable livelihoods						
Disagreed	0.9	2.3	1.4	5.31	0.257	No
Undecided	1.9	4	2.1			
Agreed	48.2	45.7	-2.5			
County government focus on watershed governance will increase budgetary allocations and human resources for sustainable food security						
Disagreed	4.7	9.8	5.1	32.78	0.000***	Yes
Undecided	13.1	11	-2.1			
Agreed	38.8	34.7	-4.1			

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

Source: Field data (2018)

From focus group discussions it emerged that households expected the county government through its departments to lead all actors including the households in watershed management activities with the aim of promoting sustainable agricultural production in the Lower Sio River Basin. Studies on households' perceptions and status of food security concluded that food insecure households felt that the government should provide social security and that the households themselves were not responsible at all for their food insecurity situation. This suggested that policymakers needed to consider households' perceptions on poverty and other factors that contribute to poverty such as inefficient watershed management policies as part of developing a policy framework towards addressing poverty in low-income neighbourhoods (Grobler, 2016).

4.3.2: Households Satisfaction with Aims of Watershed Governance and Food Security

The study assessed the households' level of satisfaction with the domains of watershed governance in enhancing involvement in food production and distribution. As indicated in Table 4.7 the majority of the households were not satisfied with various domains of watershed governance. Whereby, 45.7% (177) of the interviewed households indicated that were not satisfied while 24.5% (95) were satisfied with the creation of local social resilience to adapt to climate change. On the other hand, only 19.9% (77) of the households were satisfied with the goal of enhancing water-use efficiency and conservation and improving management in the study area.

Table 4.7: Households Level of Satisfaction with Aims of Watershed Governance

Domains of watershed governance in enhancing household involvement in food production and distribution in this watershed	Not Satisfied	Moderate satisfied	Satisfied
	Percentages (N=387)		
Clear roles and responsibilities of various actors	43.9(170)	30.5(118)	25.6(99)
Creation of local social resilience to adapt to climate change	45.7 (177)	29.7(115)	24.5(95)
Watershed management for food production decision-making process	46.5(180)	30.0(116)	23.5(91)
Protection of ecological health and functions including food production	49.1(190)	29.7(115)	21.2(82)
Enhancing water-use efficiency and conservation and improving management	48.8(189)	31.3(121)	19.9(77)
Reducing or avoiding watershed related conflicts	45.5(176)	34.6(134)	19.9(77)
Involving local expertise and resources	44.7(173)	35.9(139)	19.4(75)

Source: Field data (2018)

According to the WHO (2000), assessing beneficiaries' satisfaction can address the reliability and responsiveness of services or the willingness of the service providers to meet beneficiaries' needs. This finding shows the need to consider households' satisfaction in policies on watershed governance in the study area.

Table 4.8: Households' food security and insecurity measurement comparison association amongst level of satisfaction with aims watershed governance

Satisfaction with aims of watershed governance	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value	Significant?
Creation of local social resilience to adapt to climate change						
Satisfied	19.9	26.6	6.7	44.11	0.000***	Yes
Moderate satisfied	11.2	24.3	13.1			
Not satisfied	24.5	11.3	-13.2			
Enhancing water-use efficiency and conservation and improving management						
Satisfied	22.5	26.9	4.4	39.68	0.000***	Yes
Moderate satisfied	10.7	21.4	10.7			
Not satisfied	22.2	12.4	-9.8			
Involving local expertise and resources						
Satisfied	20.3	24.9	8.6	54.33	0.000***	Yes
Moderate satisfied	12.6	26.0	13.4			
Not satisfied	23.4	12.15	6.3			
Clear roles and responsibilities of various actors						
Satisfied	22.9	20.8	-2.1	42.21	0.000***	Yes
Moderate satisfied	9.8	20.8	11.0			
Not satisfied	22.2	18.8	-3.4			
Protection of ecological health and functions including food production						
Satisfied	23.6	25.8	2.2	32.25	0.000***	Yes
Moderate satisfied	7.0	19.7	12.7			
Not satisfied	22.9	14.5	-8.4			
Reducing or avoiding watershed related conflicts						
Satisfied	21.5	24.3	2.8	49.01	0.000***	Yes
Moderate satisfied	14.0	19.7	5.7			
Not satisfied	21.5	15.9	-5.6			
Watershed management for food production decision-making process						
Satisfied	22.0	24.9	2.9	49.36	0.000***	Yes
Moderate satisfied	7.9	20.2	12.3			
Not satisfied	24.1	15.1	-9.0			
The overall score for the satisfaction of watershed governance						
Mean(SD)	44.26 (34.95)	55.92 (23.66)	11.7 (-11.3)	83.939	0.000***	Yes

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

Source: Field data (2018)

A Chi-square test carried out on the households' responses indicated in Table 4.8 that there was a highly significant variation in the responses among the households with food security and households with food insecurity and the levels of households' satisfaction with the aims of watershed governance in all the seven variables tested at p-value=0.000. This finding revealed that household level of satisfaction with aims of watershed governance was inherent in determining the household status of food security. Early studies on perceptions of food secure and food insecure households on causes of poverty found that statistically, a significant difference existed between food secure and food insecure households and poverty (Grobler, 2016).

Drawing conclusions from early studies on the evaluation of farmer satisfaction with agricultural extension services in Ethiopia (Elias *et al.*, 2015) the primary beneficiaries' satisfaction is vital in a number of ways. Apart from the beneficiaries having the right to judge the performance of the level of watershed governance, as the end users and implementers of the activities, the households have personal experiences with watershed management and food insecurity challenges which are not shared by non-users of watershed resources. Lastly, the sustainability of watershed governance and thus food security initiatives ultimately are dependent on the willingness of the beneficiaries to continue with their involvement. Therefore, assessing beneficiaries' levels of satisfaction has been at the centre of policy research (Ridaura *et al.*, 2002) as an important indicator of sustainability (Flores and Sarandon, 2004).

4.3.3: Watershed Governance Contextual Factors that need to be addressed

When the households were asked to rank watershed governance contextual factors that must be addressed by all actors in the watershed, the results in Table 4.9 indicate that according to 83.5% (323) of the households' geographical diversity was important. As a basin, Lower Sio River is a geographical area drained by a common hydrological unit. Moreover, 73.9% (286) ranked cultural diversity as important, while land tenure system was ranked important by 78.8% (305) of the total number of households who were interviewed. Other factors that were ranked as important included: legal rights to water and water resources was ranked by 84.0% (325), existing strategic land use plans and other watershed resources was ranked by 78.8% (305), and lack of local government jurisdiction over upstream activities was ranked by 74.4% (288) of the households. The other factors were ranked as shown in Table 4.9.

Table 4.9: Watershed Governance Contextual Factors that need to be Addressed

Watershed governance contextual factors that need to be addressed by actors for sustained food production and distribution	**Not important**	**Important**	**Rank**
	Percentages (N=387)		
Legal rights to water and water resources	16.0(62)	84.0(325)	1
Geographical diversity	16.5 (64)	83.5(323)	2
Land tenure system	21.2(82)	78.8(305)	3
Existing strategic land use plans and other watershed resources	21.2(82)	78.8(305)	3
Limited or non-existence requirement to monitor and report actual water use	23.3(90)	76.7(297)	5
Emerging integrated single decision making for resource development in the county governments	23.8(92)	76.2(295)	6
The current lack of tools to assess cumulative watershed impacts	24.0(93)	76.0(294)	7
Lack of local government jurisdiction over upstream activities	25.6(99)	74.4(288)	8
Cultural diversity	26.1(101)	73.9(286)	9
Nature of potential changes to regulate groundwater extraction, monitoring, and assessment	27.4(106)	72.6(281)	10

Source: Field data (2018)

Management of its watershed resources is a human action that is aimed at ensuring sustainable use (FAO, 2007; 2017). This calls for an integrated ecosystem approach based on the understanding of interactions between biotic and abiotic factors, upstream and downstream users' interests. It also calls for understanding of inequalities among communities in terms of their socio-economic status and their access to water and other resources and services as a result of their geographical location addressed at watershed level (FAO, 2017).

4.3.4: Households Perception on Driver for Collaborative Watershed-focused approach and Food Security

The study further revealed (Table 4.10) that the majority (82.2%) (318) of the households agreed that the demand for local domestic use water protection called for a more collaborative watershed approach. However, 46.0% (178) of the households were undecided whether threat of increasing water use along River Sio formed one of the main drivers for a more collaborative approach to watershed governance. More so, 44.4% (172) and 58.9% (228) of the households indicated that fiscal constraints on all levels of government and institutional barriers that result from fragmented decision-making respectively were main drivers for a need for a more collaborative watershed-focused model in the Lower Sio River Basin. This finding is vital since the influence of attitudes, subjective norms, and perceived behavioural control on the intentions of individuals to undertake particular actions, is premised in understanding the social determinants of human behaviour related to water resources, and for informing policies on watershed management (Ajzen, 1991). It is worth to note that consideration of the perception of households on their needs for collaborations in watershed management activities would result in more ownership and participation in other actors' activities at a watershed level.

Table 4.10: Households perception on the need for a more collaborative watershed-focused approach

Driver for a collaborative watershed-focused approach	Disagree	Undecided	Agree	Rank
		Percentages (N=387)		
The demand for local domestic use water protection	6.7 (26)	11.1(43)	82.2(318)	1
Concerns of fish and other water habitant protection	2.1(08)	20.2(78)	77.8(301)	2
Growing demand for citizens to have a viable voice in watershed decision making	6.7(26)	18.9(73)	74.4(288)	3
Recognition of increasing water scarcity	3.6(14)	30.5(118)	65.9(255)	4
Institutional barriers that results from fragmented decision-making	4.4(17)	36.7(142)	58.9(228)	5
Increasing uncertainty and conflicts among water users	5.9(23)	40.1(155)	54.0(209)	6
Threat of increasing water use along River Sio	4.1(16)	46.0(178)	49.9(193)	7
Fiscal constraints on all levels of government	7.5(29)	48.1(186)	44.4(172)	8

Source: Field data (2018)

Table 4.11 shows the significant differences using p-values generated from chi-square test carried out on the drivers for more collaborative watershed-focused approach variables and levels of households' food security. The findings indicate that out of the nine drivers' items that were tested, only four showed the positive significant difference between the households that were food secure and food insecure. These include; the demand for local domestic use water protection (p-value=0.000), water pollution control (p-value=0.087), recognition of increasing water scarcity (p-value=0.073), and growing demand for citizens to have a viable voice in watershed decision making (p-value=0.000).

The results showed that the demand for local domestic use water protection, concerns of fish and other water habitat protection, and the growing demand for citizens to have a viable voice in watershed decision making had positive significant differences between two types of households with food secure and food insecure (d=0.2; d=-0.1 and d=0.0 respectively p-value=0.000) at 99% level of confidence. In addition, fiscal constraints at all levels of government were found to be significant d=-0.1; p-value=0.001. Further, water pollution control and recognition of increasing water scarcity were found to be significant with households' food security (d=0.1; p-value=0.087 and d=0.2; p-value=0.073) respectively at 90% level of confidence, meaning that these drivers were mentioned most by food secure households.

Table 4.11: Food security and insecurity households' measurement comparison association amongst the drivers for a collaborative watershed-focused model variables

Variable	Food Insecurity (n=214)	Food Security (173)	Difference	χ^2	p-value	Significant?
The demand for local domestic use water protection	3.0	3.1	0.2	20.125	0.000***	Yes
Water pollution control	3.0	3.2	0.1	8.122	0.087*	Yes
Threat of increasing water use along River Sio	2.5	2.6	0.0	2.383	0.666	
Concerns of fish and other water habitant protection	3.0	3.0	-0.1	25.513	0.000***	Yes
Recognition of increasing water scarcity	2.8	3.0	0.2	8.573	0.073*	Yes
Increasing uncertainty and conflicts among water users	2.6	2.6	0.0	4.112	0.391	
Growing demand for citizens to have a viable voice in watershed decision making	2.9	2.9	0.0	23.503	0.000***	Yes
Fiscal constraints on all levels of government	2.5	2.4	-0.1	17.954	0.001***	Yes
Institutional barriers that results from fragmented decision-making	2.6	2.7	0.0	3.272	0.513	
The overall score for attitudes towards watershed governance						
Mean(SD)	69.43 (16.14)	70.57 (13.20)	1.1(-2.9)	F=0.738	0.391	No

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

Source: Field data (2018)

Furthermore, Table 4.11 shows that institutional barriers that result from fragmented decision-making and increasing uncertainty under a multi-level decision-making structure that has been occasioned by the current devolution in Kenya and conflicts among water users that are currently being observed in the watershed were found to be insignificant to the households' food security status. This is despite the fact that there exist numerous regulations at the county and national level some conflicting as well as conflicts in the use of water resources from the river as indicated in Chapter seven. Overall the mean score for drivers for a collaborative watershed-focused model (d=1.1) had insignificant difference thus conclusion that drivers in the collaborative watershed-focused model were found to be insignificant in ensuring household food security in the Lower Sio River Basin. Watershed management will not be successful because people talk about issues, but because people use their power and influence to change others' beliefs, opinions, and behaviour (Morton, 2011; Kristin *et al.,* 2015). For effective watershed policy making it is prudent to consider the mentioned drivers by either government agencies or non-governmental agencies.

4.3.5: Households Perception on the need for Changes in Watershed Governance Systems

When respondents were asked about necessary changes in watershed governance systems, it was revealed that majority 86.3% (334) of the households as shown in Figure 4.5 needed changes in watershed governance to ensure water resources management was treated as a public trust while 79.3% (307) felt that the changes were necessary to ensure that new forms of governance were put in place that involved sharing of power or re-scaling of decision making processes to the local level. In addition, 78.3% (303) of the households were of the opinion that the changes were necessary to ensure a commitment to a more holistic watershed management approaches in the Lower Sio River Basin.

Moreover, 65.9% (255) of the households also felt that change was needed for the institutions that attempt to address the problem of fit between physical boundaries.

Overall 62.8% (243) of the households needed changes in watershed governance system in the in the study area. This finding is in support for households call for adopting systems in the governance of watershed resources. Evidence shows that systems with high adaptive capacity are able to re-configure themselves when subject to change without significant declines in crucial functions of the socio-ecological system (Koontz *et al.*, 2015).

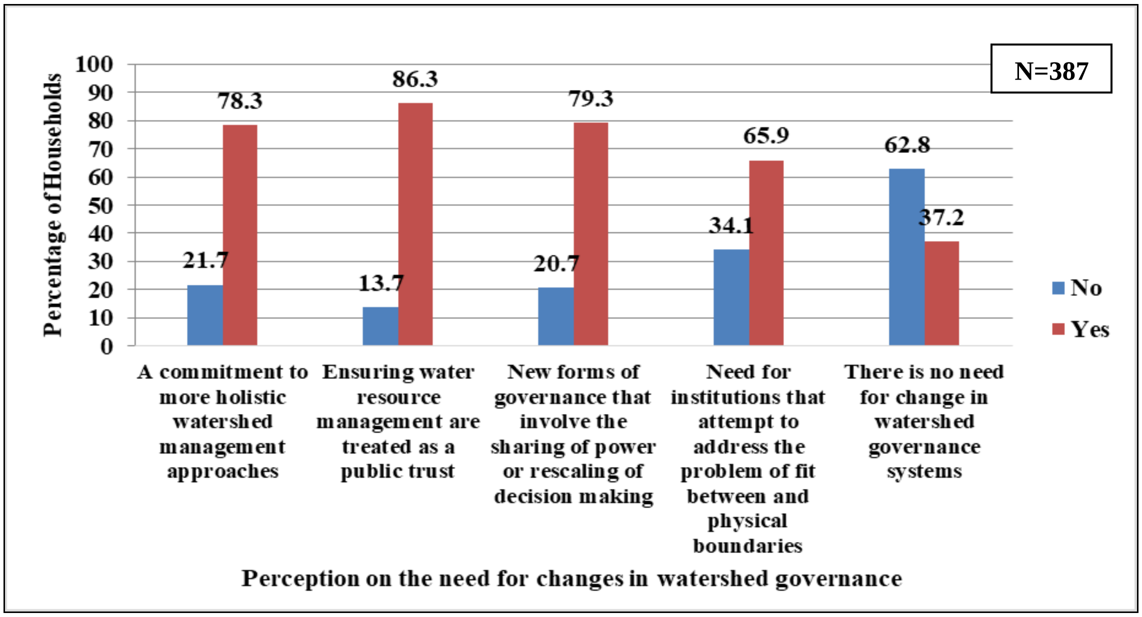


Figure 4.5: Households Perception on the need for Changes in Watershed Governance Systems
Source: Field data (2018)

In this study household, food insecurity was used as an indicator of unresponsive watershed governance policies. Therefore, understanding of households' perception may help to develop policies to promote watershed governance especially at river watersheds in Kenya. Policy-makers both at the county and national government levels need to understand the opinions of the public and any other involved stakeholders in order to make well-informed decisions with a positive outcome. This is especially important in the context of watershed management, where the watershed and a range of diverse stakeholders may be affected (Borecki *et al.*, 2016).

CHAPTER FIVE

ADAPTIVE CAPACITY OF STATE AND NON-STATE ACTORS IN WATERSHED GOVERNANCE FOR SUSTAINABLE FOOD SECURITY

5.1: Introduction

The study examined and described the status of adaptive capacity of state and non-state actors based on Gupta *et al.* (2010) suggested variables. Therefore, the ability of institutions to encourage the involvement of a variety of perspectives, actors and solutions were examined. In addition, the ability of the institutions to enable social actors to continuously learn and improve their institutions was also examined during the study. Examination of other variables was based on the ability of the institutions to allow and motivate social actors to adjust their behaviour alongside the ability to mobilize quality leadership and resources for implementing adaptive measures at a watershed level. Finally, the study examined the support principles of fair governance in watershed and food activities in the Lower Sio River Basin.

5.2: Watershed Governance Goals

The results in Table 5.1 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 in the Lower Sio River Basin. 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 family land remained productive for food production. However, adaptive governance at a watershed level is expected to generate the desired end goal of adaptive capacity (Cook *et al.*, 2011). This finding clearly illustrates lack of adaptive governance in the study area.

Table 5.1: 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**

Source: Field data (2018)

The respondents attributed lack of collective and shared watershed governance goal to inefficient leadership 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 security. Another reason given was that the respondents were never involved in state watershed management activities nor did not 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 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). Evidence showed that adaptation activities are more local (that is sub-county, regional or national) issues rather than international (Paavola *et al.*, 2005; Parry *et al.*, 2005). Therefore, ensuring that national and county department's watershed management goals are owned at the household level will translate to adaptive behaviour. 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.

5.3: 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 watershed. Moreover, 25.1% (97) of the household reported that the aim of watershed governance was to create social resilience to adapt to a changing climate as illustrated in Figure 5.1. 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 watershed resulted in fragmented interventions that could not result in cumulative positive impact.

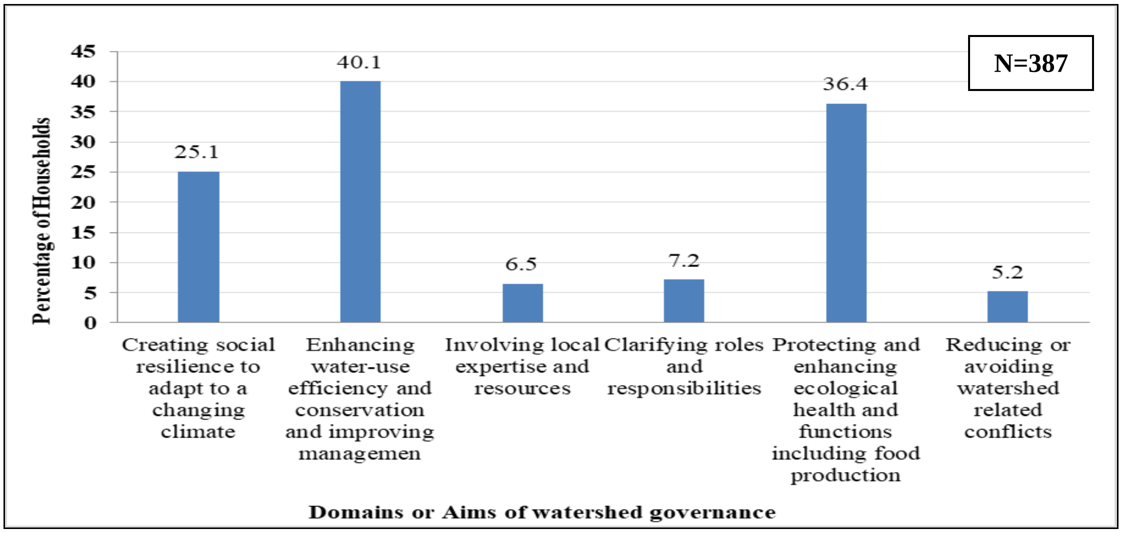


Figure 5.1: Aims for watershed governance in the Lower Sio River Basin
Source: Field data (2018)

A Chi-square test carried out on the responses as shown in Table 5.2 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 predictor of the status of food security in the watershed. 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 contrary, the aims of watershed governance including; involving local expertise and resources, protecting, enhancing ecological health and functions including food production, and reducing or avoiding watershed related conflicts 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 5.2: 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	Significant?
Creating social resilience to adapt to a changing climate	15	37.6	22.6	26.058	0.000***	Yes
Enhancing water-use efficiency and conservation and improving management	45.8	32.9	-12.9	6.575	0.010***	Yes
Involving local expertise and resources	7.5	5.2	-2.3	0.819	0.366	No
Clarifying roles and responsibilities	11.7	1.7	-10.0	14.106	0.000***	Yes
Protecting and enhancing ecological health and functions including food production	39.3	32.9	-6.4	1.642	0.200	No
Reducing or avoiding watershed related conflicts	5.1	5.2	0.1	0.001	0.978	No

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

Source: Field data (2018)

5.4: Observed Socio-economic and environmental changes in the Lower Sio Basin since 2010

Based on the findings from the study, 68.5% (265) of the households in the Lower Sio River Basin 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 watershed as illustrated in Figure 5.2. Elsewhere evidence showed that beyond any human self-interest, there are environmental changes, social and economic factors that outline the need for effective management strategies and sustainable water-land systems (Parkes *et al.*, 2010; Borecki *et al.*, 2016).

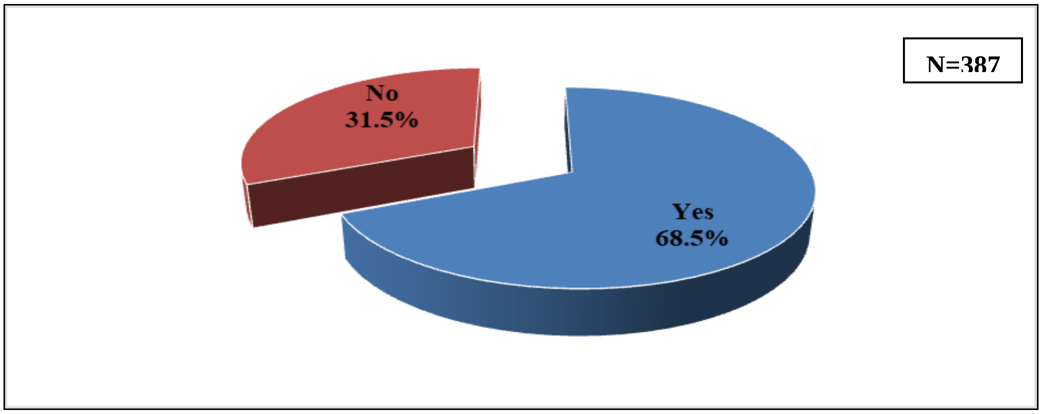
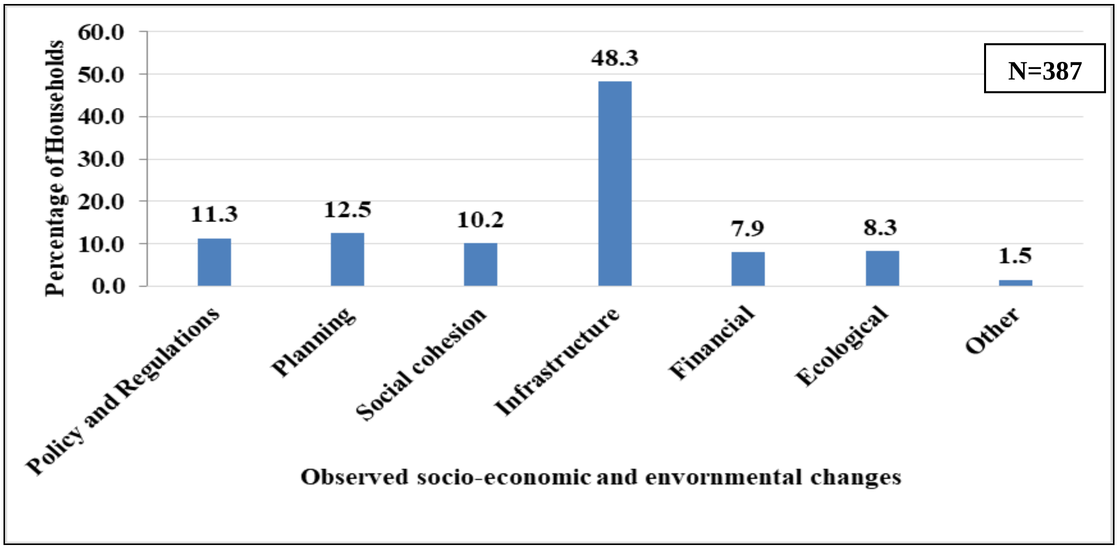


Figure 5.2: Socio-economic and environmental changes observed since 2010
Source: Field data (2018)

According to Cooper *et al.,* (2011), in East Africa farmers 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.

Socio-ecological changes in a watershed are realized at the household and community level; however, they are likely to differ across watersheds based on the differences in outcomes that depend on the specific socio-economic, institutional and biophysical factors. Figure 5.3 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 5.3: Observed Socio-economic and environmental changes since 2010
Source: Field data (2018)

Moreover, the study noted that 10.2% (27) had reported changes in social cohesion; the majority (48.3%) (128) per cent 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 (Figure 5.3). 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 PALWECO, WKCDD/FMP, One Acre Fund and Hand in Hand East Africa. These organizations were reported to offer inputs to farmers' groups on credit.

According to Gebregziabher *et al.,* (2016), successful watershed management in Abraha-Atshaba, Kereba and Goho-Cheri watersheds in Ethiopia revealed that changes such as enhanced biophysical conditions that led to increased water availability, reduced downstream flooding and siltation, reduced water pollution and increased irrigation were more visible at the community level. In addition, socioeconomic benefits such as diversified income sources, increased recreational opportunities, strengthening of community institutions, better conflict mitigation capacity and improved food security status emerged due to successful watershed management interventions. 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.

5.5: Watershed Governance Conditions

During the study, respondents were asked to identify watershed governance conditions that were present or absent that contributed to household's adaptation to social, economic and environmental changes observed. The results show in Table 5.3 that 30% (116) of the respondent acknowledged that collective grassroots by-laws were absent. Out of the interviewed respondents, only 21.2% (82) recognized the presence of collective grassroots by-laws while 17.8% acknowledged the presence of traditional and cultural values systems that were vital in the households' adaptation to social, economic and environmental conditions experienced in the Lower Sio River Basin.

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 long-term funding for adaptive watershed management activities. 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 enrich 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 inflict serious harm to the production and distribution of healthy food.

Table 5.3: 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

Source: Field data (2018)

5.6: Knowledge on Watershed Governance Structures and Households Food Security

In order to regulate people's behaviour and activities in the watershed, the study assessed households' knowledge of the structures that existed that could govern peoples' watershed management actions to adapt to socio-ecological changes. The findings in Table 5.4 show that a small portion 25.3% (98) of the households understood that there were water resources management plans while 12.9% (50) understand that there were water resource laws and regulations that guided the households' activities in the watershed. However, only 1.6% (06) of the total households in the watershed understood that there were water resources monitoring frameworks in the watershed. On contrary, 17.3% (67) acknowledged that cultural value 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 rule and religious values existed to guide utilization of watershed resources such as land.

Table 5.4: Watershed Governance Structures

Watershed governance structures	Frequency (n=430)	Percent of HH
Other specify	108	27.9
Water resources management plans	98	25.3
Cultural values systems	67	17.3
Water resources laws and regulations	50	12.9
Water resources policies	46	11.9
Water resource institutions	34	8.8
Water resources financial budgets	12	3.1
Transparency and accountability means	9	2.3
Water resources monitoring frameworks	6	1.6
Total	**430**	

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

Source: Field data (2018)

The low number of households who answered this question was also attributed to the households understanding of what constituted watershed governance structure. Therefore, the majority of respondents did not identify any governance structure due to low levels of knowledge and participation in watershed governance structures. Studies in governance revealed that a range of institutions and relationships involved in the process of governing encompasses both formal institutions such as laws, policies, organizational structures, and informal institutions (Huitema *et al.,* 2007) such as traditional and religious values, norms and beliefs.

Contrary to the intended purpose of watershed policies, the households who identified the existence of water resources regulations also indicated that laws such as Wildlife Conservation and Management Act (2013) and riparian buffer zone regulations hindered household food production initiatives. An example given was that the Wildlife Conservation and Management Act (2013) prohibited the killing of monkeys which were a problem of food destruction in their farms. On the other hand, the riparian 30 meters' buffer regulation was said to be a hindrance to households' food production because most of the farmlands had been eroded and fertile lands were reported to exist along the buffer zones. This showed that the households did not understand the importance of the laws in watershed governance. Therefore, social information is needed to understand and segment target households to develop effective messages and policy tools to support behaviour change (Kristin *et al.,* 2015).

Table 5.5 shows the significant differences using p-values generated from Chi-square tests between watershed governance structure variables and levels of food security. The findings indicated that, out of the nine watersheds governance structures, items that were tested, only four showed positive statistically significant difference between the households with food secure and insecure. 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). 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 (Kropff *et al.*, 2013). This calls for the involvement of all stakeholders at the watershed level in formulation and implementation of watershed governance structures.

Table 5.5: 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	Significant?
Water resources management plans	7.9	46.8	38.9	76.459	0.000***	Yes
Water resources laws and regulations	13.6	12.1	-1.5	0.170	0.680	No
Water resources monitoring frameworks	0.9	2.3	1.4	1.189	0.275	No
Water resources financial budgets	3.3	2.9	-0.4	0.046	0.830	No
Water resource institutions	4.7	13.9	9.2	10.104	0.001***	Yes
Water resources policies	18.2	4.0	-14.2	18.361	0.000***	Yes
Transparency and accountability means	2.3	2.3	0.0	0.000	0.987	No
Cultural values systems	17.3	17.3	0.0	0.000	0.989	No
Other specify	40.2	12.7	-27.5	35.881	0.000***	Yes
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***	Yes

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

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

Source: Field data (2018)

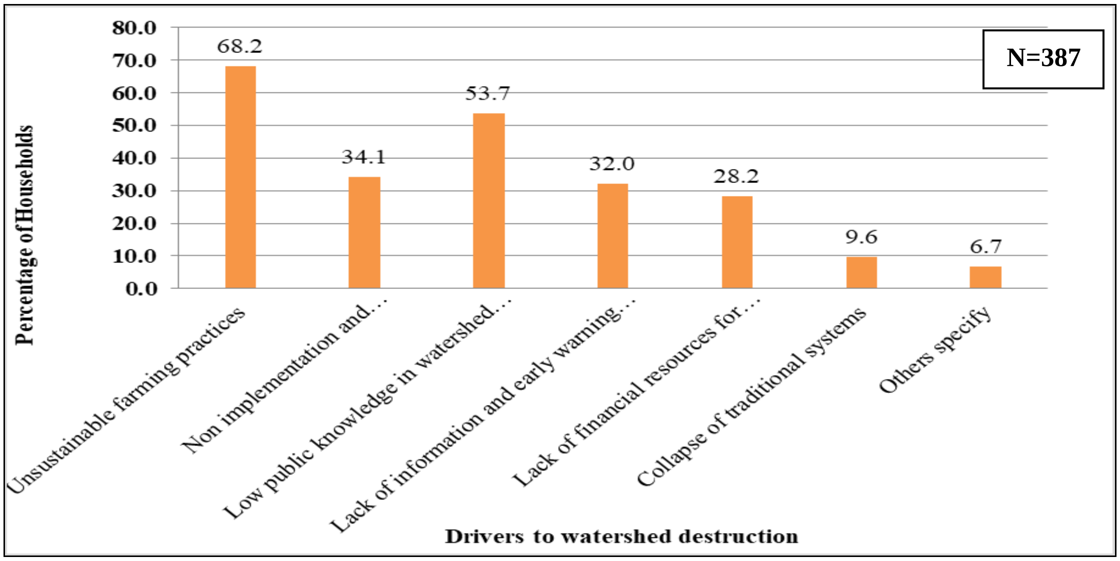
Results showed that watershed governance structures including water resources laws and regulations, monitoring frameworks, financial budgets, and means of ensuring transparency and accountability and cultural value systems were found to be insignificant in determining the households' food security status. 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. However, positive results showed that water resource management plans showed significant differences between two types of households i.e. with food secure and food insecure (d=38.9; p-value=0.000), while water resource institutions had positive significant differences with food security (d=9.2; p-value=0.001). On the other hand, water resources policies were found to have a negative significance difference with food security (d=-14.2; p-value=0.000), implying that more households with food insecurity reported that water resources policies were present than those with food secure.

In addition, other watershed structures which included group bylaws which were found to have a positive significance with food security (d=-27.5; p-value=0.000), meaning that other watershed structures were mentioned most by food insecure households. Overall the mean score for watershed governance structure (d=0.7) had significantly different at p-value=0.003. Consequently, the mean score difference among food security households and food insecurity 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. These institutions at the watershed level could provide more effective solutions to collective action problems than centrally mandated institutions because they foster local knowledge, the inclusion of participants, better-adapted rules, and lower enforcement costs (Ostrom, 1990). This implied the need for institutional strengthening to improve watershed governance based on the analysis of policy and institutional challenges, and support system for strategic planning and institutional coordination processes alongside creating incentives for multi-stakeholder dialogue and action platforms (FAO, 2017).

5.7: Drivers to Watershed Destruction and Households Food Security

The study results showed that there were several drivers of watershed destruction in the Lower Sio River Basin which were well known to the households. 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; it was revealed that an unsustainable farming practice for purposes of increasing food production was the main contributing factor to households' destruction of soil and water resources in the watershed. 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.

Other reasons included lack of information and early warning system which was identified by 32.0% (124) of the respondent 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 neighbours conflicts and lack of ownership of watershed resources management among community members in the watershed as presented in Figure 5.4. 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.



Note: Other includes; lack of means of ensuring social accountability, negligence from the public
Figure 5.4: Drivers to Watershed Destruction in the Lower Sio River Basin
Source: Field data (2018)

Earlier studies by Aloo (1993) and Namenya (2012) in Funyula Constituency found that it was difficult for landowners in the hilly areas to plant trees or rehabilitate eroded hilly areas due to lack of financial, labour and other resources. Further in the study, 80% of the households in non-hilly areas revealed that they practiced own initiatives in watershed management whose activities included; terraces, drainage ditches, live fencing of homesteads. These activities were reported to be based on community's indigenous knowledge (Namenya, 2012).

Further, a Chi-square test carried out on households' responses shown in Table 5.6 indicated a highly 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 others at p-value=0.007. In addition, real variation was noted on lack of financial resources for investment in watershed management at p-value=0.027. These implied that the four drivers of watershed destruction were important in determining the status of households' food security in the watershed. 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 determining households' food security status in the study area.

Table 5.6: 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	Significant?
Unsustainable farming practices	60.3	78	17.7	13.91	0.000***	Yes
Non-implementation and reinforcement of existing laws	35.5	32.4	-3.1	0.421	0.517	No
Low public knowledge in watershed management	60.3	45.7	-14.6	8.220	0.004***	Yes
Lack of information and early warning systems	29.9	34.7	4.8	1.002	0.317	No
Lack of financial resources for investment in watershed management	32.7	22.5	-10.2	4.887	0.027**	Yes
The collapse of traditional systems	32.7	22.5	-10.2	1.515	0.218	No
Others specify	9.8	2.9	-6.9	7.316	0.007***	Yes

**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
Source: Field data (2018)

Watershed destruction hinders the adaptive capacity of ecosystems and rural poor communities whose livelihoods are largely dependent on ecosystem services for agricultural production. Available evidence indicated that reduced water flow, watersheds and catchment forest degradation were mainly due to failures in watershed governance (Yong *et al.*, 2003; Franks *et al.*, 2011; Brandes, 2005; Makarius *et al.*, 2015). Plate 5.1

shows evidence of watershed resources degradation due to ineffective watershed governance in the Lower Sio River Basin.

Plate 5.1: Watershed resources degradation due to ineffective watershed governance in the Lower Sio River Basin

Source: Field data (2018)

Consequently, 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).

5.8: Factors that Contribute to Public Involvement in Watershed Management

The study assessed factors that contributed to the public involvement in watershed management activities. This was done by respondents ranking the factors in order of importance to their participation. 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 as 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 as shown in Table 5.7.

Table 5.7: 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)

Source: Field data (2018)

Other watershed management factors ranked as important by the households included; good 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). The absence of the listed factors would mean that households in the watershed 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.

According to the study by Namenya (2012) on watershed management approaches and CDF in Funyula sub-county, it was found that 40.7% of the households in Funyula Sub-county were members of watershed user groups and felt that the existing social groups and institutions in the watershed were the focal point for watershed management activities. Thus, Young (1999) noted that, though a number of physical, social and cultural factors influenced the watershed management, institutions understood as a patterned behaviour of the social group over a period of time constituted a cross-cutting factor and a particular driving force in watershed decision making (Young, 1999; Namenya, 2012).

5.9: Public Participation in Watershed Management Plans, Policies and Programmes and Households Food Security

The results in Figure 5.5 illustrate stages of participation of the households in watershed management policies, plans, and programmes at the grassroots level. The findings indicate that majority 87.3% (338) of the households did not participate in any way in the watershed and food security policies, plans and programmes organized by either state or other non-state actors in the Lower Sio River Basin. 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 noted 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.

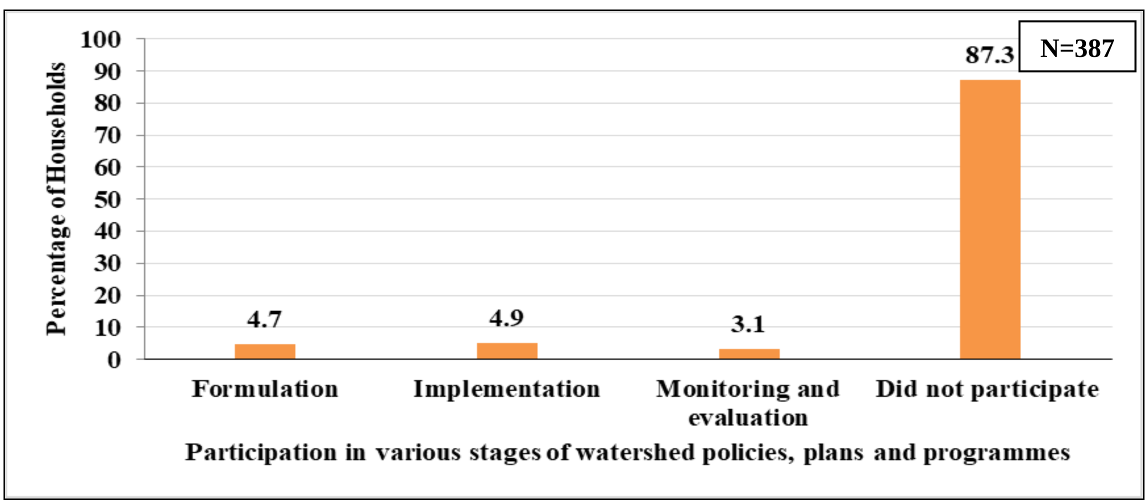


Figure 5.5: Stages of participation in watershed management plans, policies and Programmes
Source: Field data (2018)

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) of the households indicated that they were involved in monitoring and evaluation of the policies, plans and programmes related to watershed management and food security. 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 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 involved most people in the processes of policy making and planning.

A Chi-square test carried out on households' responses shown in Table 5.8 revealed that there was a significantly real variation at p-value=0.047 among the households with food security and households with food insecurity and households' involvement in the monitoring of watershed policies and plans.

Table 5.8: 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	Significant?
Formulation	45.5	72.2	26.7	2.078	0.149	No
Implementation	72.7	61.1	-11.6	0.408	0.523	No
Monitoring	18.2	55.6	37.4	3.932	0.047**	Yes

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

Source: Field data (2018)

This implied that households' involvement in the monitoring of the watershed policies and plan contributed significantly to the status of households' food security in the watershed. However, the study did not establish any significant variations among the households with food secure and food insecure and their involvement in formulation and implementation of watershed management and food security policies, plan and programmes.

A study by Kristin *et al.,* (2015) observed that it is vital for watershed management projects to determine at the outset the degree of power they are able to extend to stakeholders at each stage of planning and implementation. Failure to which perceptions of trust, legitimacy and fairness could be quite negative if stakeholders expect greater power in implementation of decision making that could reasonably be afforded by watershed managers. On the other hand, embracing constitutional ideals, such as devolution and participation as well as the promotion of discourse of good governance, provides a further impetus for changes in natural resource management policy in Kenya. Exclusionary natural resources policies both at county and national levels are viewed as undemocratic and incompatible with the goals of participatory democracy in devolution, accountability, transparency and efficiency that are promoted by the discourse of good governance. According to Foerster (2011), 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.

Interviews with the county government officers indicated that most households in the watershed did not participate in meeting forums 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. As noted by Brennan (2005), people are more likely to accept solutions that are consistent with their local situation and culture. Therefore, it is important that beneficiaries in the different watershed and food security activities engage in planning to evaluation of the policies, plans and programmes. Watershed governance also features stakeholders input and knowledge generation, objectives setting management planning, monitoring implementation and incremental plan adjustment in the face of uncertainty (Engle *et al.*, 2011).

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).

5.10: Governance Values observed and Household Food Security

Based on the results, majority 50.6% (196) of the households did not know any governance values in the watershed. Only 8.8% (34) of the household were aware that there were governance values to be observed in the watershed. On the other hand, 40.6% (157) indicated that there was lack of governance values in the watershed as illustrated in Figure 5.6.

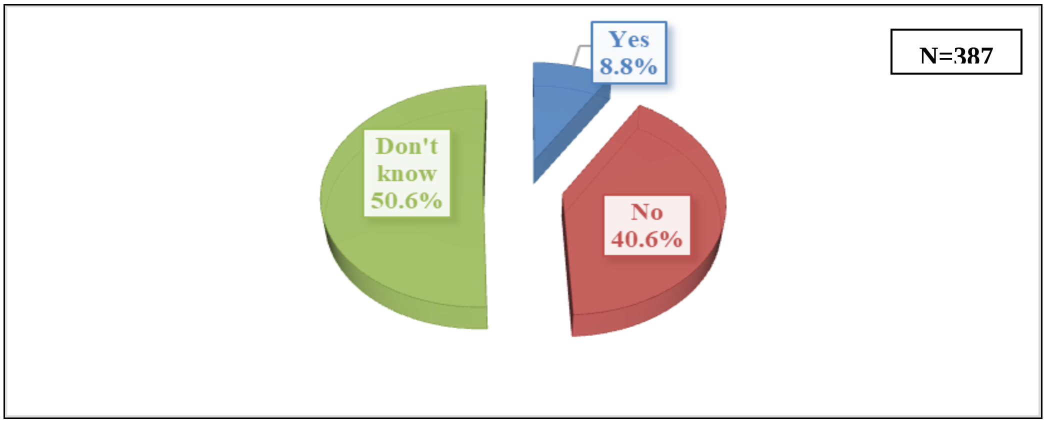


Figure 5.6: Awareness of Existence of Watershed Governance Values
Source: Field data (2018)

Evidence from 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). Further, from the study, those who reported the presence of watershed governance values in the watershed indicated observation of accountability, transparency, legitimacy, inclusiveness and responsiveness at different phases of policy including; policy formulation, implementation, monitoring and evaluation as presented in Figure 5.7.

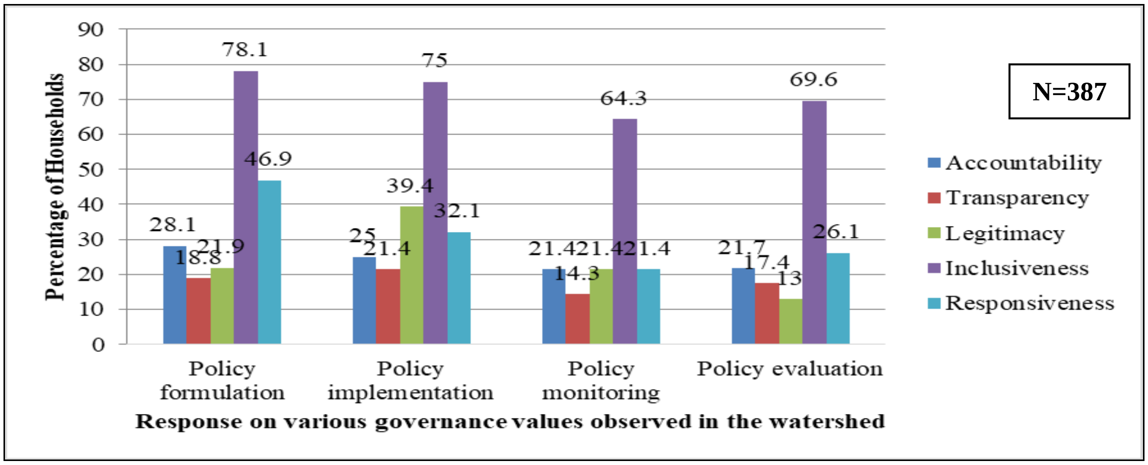


Figure 5.7: Governance Values observed at different levels of Watershed and Food policies

Source: Field data (2018)

The findings in Figure 5.7 show that 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. On contrary, the findings showed that other governance values were observed by a small portion of households: the findings showed that 18.8% (73), 21.4% (83), 14.3% (55) and 17.4% (67) of the total households 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 respectively; 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.

Table 5.9: Food security and Insecurity households' measurement comparison association amongst the governance values at stage of policy/plan

Governance values at phases of Policy/Plan	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value	Significant?
Formulation						
Accountability	66.7	13.0	-53.7	9.201	0.002***	Yes
Transparency	33.3	13.0	-20.3	1.748	0.186	No
Legitimacy	44.4	13.0	-31.4	3.732	0.053*	Yes
Inclusiveness	55.6	87.0	31.4	3.732	0.053*	Yes
Responsiveness	44.4	47.8	3.4	0.030	0.863	No
Implementation						
Accountability	50.0	18.2	-31.8	2.545	0.111	No
Transparency	33.3	18.2	-15.1	0.643	0.423	No
Legitimacy	100.0	22.7	-77.3	11.802	0.001***	Yes
Inclusiveness	50.0	81.8	31.8	2.545	0.111	No
Responsiveness	16.7	36.4	19.7	0.839	0.360	No
Monitoring and Evaluation						
Accountability	0.0	26.1	26.1	1.660	0.198	No
Transparency	0.0	17.4	17.4	1.014	0.314	No
Legitimacy	20.0	21.7	1.7	0.007	0.932	No
Inclusiveness	40.0	69.6	29.6	1.564	0.211	No
Responsiveness	40.0	17.4	-22.6	1.247	0.264	No

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

Source: Field data (2018)

A Chi-square test carried out on the households' responses presented in Table 5.9 indicated that there was a highly 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. However, unlike in Table 5.8 where households' participation was found to be significant at monitoring and evaluation phase, the findings in Table 5.9 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; Haddad, 2011; FAO, 2012). 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 resource s that CSOs can bring in, stimulate effective implementation.

5.11: Watershed Management Expertise and Households Food Security

To assess watershed management expertise that existed to support households' in adapting to socio-ecological changes, respondents were asked to list existing watershed expertise needed to enhanced households' involvement in watershed management activities in the watershed.

Table 5.10: 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

Source: Field data (2018)

The findings in Table 5.10 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 watershed. Other watershed management expertise was identified by very few households a clear indication that government and non-governmental actors did not promote the expertise.

Additional results in Table 5.11 illustrated the Chi-square test values for comparison of means association between the watershed management expertise variables and households' food security in the watershed. Based on the findings, variables that were used to measure watershed management expertise including water quality monitoring, laws enforcement, policy making and influencing decisions, advocacy and lobbying expertise were found to be insignificant to households' food security. Implying that the study never found any influence of the four variables in determining the status of household food security.

Table 5.11: 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	Significant?
Watershed planning	3.7	31.2	27.5	53.677	0.000***	Yes
Traditional expertise	27.6	42.8	15.2	9.805	0.002***	Yes
Land management	29.0	41.0	12.0	6.177	0.013*	Yes
Water quality monitoring	3.7	5.2	1.5	0.488	0.485	No
Stream restoration	1.9	10.4	8.5	12.999	0.000***	Yes
Law enforcements	1.4	2.3	0.9	0.446	0.504	No
Wetland restoration	1.9	5.2	3.3	3.274	0.070*	Yes
Forest Management	5.1	4.6	-0.5	0.055	0.815	No
Fund raising	1.9	1.2	-0.7	0.319	0.572	No
Sustainable Agricultural production	7.0	13.9	6.9	4.973	0.026**	Yes
Information and communication	7.9	14.5	6.6	4.187	0.041**	Yes
Farmers coordination	6.1	20.2	14.1	17.646	0.000***	Yes
Policy making and influencing decisions	0.0	1.2	1.2	2.487	0.115	No
Research and Training	0.5	2.9	2.4	3.679	0.055***	Yes
Advocacy and lobbying	0.9	1.2	0.3	0.046	0.830	No
Other	34.6	0.6	-34.0	70.786	0.000***	Yes
The overall score for watershed expertise						
Mean(SD)	8.32 (4.98)	12.39 (8.29)	4.1 (3.3)	F=51.709	0.000***	Yes

*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
Source: Field data (2018)

However, 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 at 99% level of confidence while traditional watershed expertise (d=15.2; p-value=0.002 at 99% level of confidence), implying that consideration of this watershed management expertise in watershed governance results in enhanced status of households' food security in the study area. On the other hand, the statistical analyses show 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 at 90% level of confidence.

Further, statistical analysis indicated that sustainable agricultural production and 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 at 95% level of confidence, meaning consideration of this watershed management expertise in watershed governance at household level translates into households' food security in the Lower Sio River Basin. More statistical analysis showed that forest management and fundraising watershed expertise were insignificant to households' food insecurity meaning that the two expertise also determined the status of households' food security while watershed research and training expertise was found to be significant to households' food security at d=2.4; p-value=0.055 at 99% level of confidence.

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 at 99% level of confidence) was significant in ensuring the adaptive capacity of households towards food security in the Lower Sio River. This indicated that consideration of watershed expertise in watershed governance at the household level contributes to enhanced households' food security in the watershed. Colonelli and Simon (2013) postulates 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.

5.12: Sources of finances for Watershed Management and Food Security Activities

Results in Figure 5.8 illustrate that majority (95.9% (371) of the households in the watershed depended on household income to implement watershed management and food security activities. As earlier indicated in Section 4.2.7 the household income for the majority (54.3%) of the household was less than KES. 3000= (USD 30) per month. Therefore, compared to various household needs, too low incomes left or no funds were left 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 fund for watershed management and food security activities. On the other hand, 13.4% (52) and 10.6% (41) households reported that civil societies and nongovernmental organizations and CDF were among other devolved funds which also acted sources of funds for household watershed management and food security in the Lower Sio River Basin.

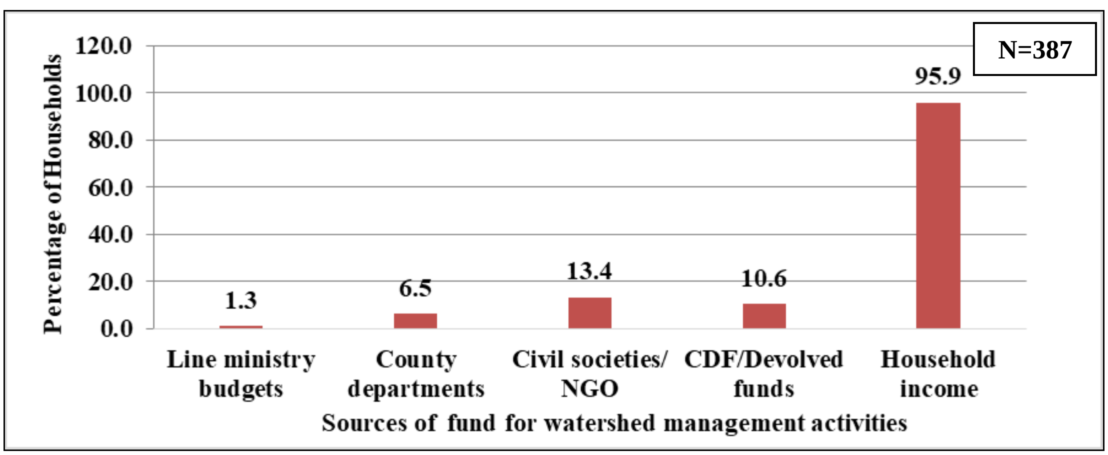


Figure 5.8: Sources of finances for Watershed Management and Food Security Activities
Source: Field data (2018)

Availability and accessibility to financial assistance are necessary conditions for watershed governance and food security 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). Furthermore, the study assessed views of households on various sources of funds for watershed management activities based on the availability, accessibility, sufficiency and utilization of the funds. In Table 5.12, findings indicate that only 0.5% (01) of the households who identified line ministry budgets as the source of funds felt that the funds were rarely available, difficult to access and moderately sufficient and poorly utilized in the watershed governance issues.

Table 5.12: Comments on the sources of funds for watershed management and food security activities

	How funds are available				How funds are accessible				How is the sufficiency of funds				How is the utilization of funds?			
Ranks	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Percent																
Line ministry budget	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.0
County department	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.3	0.0
Civil societies/ NGO	0.8	0.5	0.0	0.5	0.8	1.0	0.0	0.0	0.5	1.0	0.0	0.0	1.6	0.3	0.0	0.0
CDF/ Devolved funds	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.3	0.3	0.3	0.0	0.0
Household income	0.8	58.4	8.8	9.0	4.4	54.0	7.2	11.6	0.0	25.6	10.9	40.1	33.9	26.6	12.9	3.6

Note:
Available: 1=widely available 2=rarely available 3=don’t know 4=Not available
Accessibility: 1=easily accessible 2= Difficult to access 3= don’t know 4=Not accessible
Sufficiency: 1=More sufficiency 2=moderately sufficiency 3= don’t know 4= Not sufficiency
Utilization: 1= Well utilized 2= poorly utilized 3= don’t know 4=Not utilized

Source: Field data (2018)

Similar, views were reported by the majority of those who identified county department funds. On civil societies and NGO funds, 0.8% (01) of the household who identified them as the source of funds indicated that the funds were widely available and easily accessible while 1.6% (01) that the funds were well utilized. On the contrary, 0.5% (01) of those households who identified CDF and other devolved funds as the main source of funds for watershed management and food security activities noted that the funds were rarely available and difficult to access respectively. The study by Namenya (2012) found that in Funyula sub-county CDF was not used to finance watershed management approaches for sustainable development projects.

Finally, on the household income, 58.4% (217) of the respondents reported that the fund was rarely available, 54.0% (200) of the respondents felt that the funds were difficult to access, 40.1% (149) reported that the funds were not sufficient, and 33.9% (126) of the respondents reported that the household income was well utilized on watershed management and food security activities. 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.

5.13: Sources of Watershed Management Information

The study sought to examine avenues for watershed management information that were preferred by the households in the watershed as a key impetus in an adoptive situation. The findings indicate in Table 5.13 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 forums. 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.

Table 5.13: 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

Source: Field data (2018)

During focus group discussion the ward officers were blamed for failure to perform their responsibilities of providing relevant extension information to farmers. 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 frequency of their interactions. On the other hand, 72.1% (280) of the households did not prefer other sources of information including television, newspapers, social media, funeral gatherings, market open days and neighbours. Reasons given in focus group discussions were that the sources were given the low level 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.

CHAPTER SIX

IMPACTS OF DEVOLVED GOVERNMENTS WATERSHED GOVERNANCE STRUCTURES ON RURAL FOOD SECURITY

6.1: Introduction

This chapter places food security at the centre of watershed governance initiatives. In particular, it assesses the sustainability of domains of food security as it relates to policy intervention aimed at enhancing watershed management. The chapter argues that without a clear and inclusive watershed governance to guide peoples' agricultural production, water and soil resources utilization behaviour, it will be impossible to achieve food security in the watershed. First, the section examines existence and knowledge on institutional developments such as a collective food security goal, policies supporting incentives, and watershed management structures; and seventeen (17) variables for testing food security used in the inferential analysis in the study. Secondly, the section discusses the drivers of food security that was well known to the households which are characterized by high levels of food security. The last part draws attention to the contribution of existing governance structures to food security factors in Lower Sio River Basin.

6.2: Households Food Security Goals

Data analysis from household interviews in Figure 6.1 revealed that the main household heads individual food security goal known by the majority (53.5%) (207) of the households was to improve rural livelihoods through food and agricultural systems. The households were able to associate their agricultural activities to the fact that agriculture was the main economic activity and occupation for the households.

The interviews with local administrative leaders such as assistant chiefs and chiefs revealed that at the village level and thus household level, the government or even key stakeholders in agriculture sector had not instilled a culture of a common food production purpose to the farmers in the watershed. This resulted in fragmentation of farming activities and abandonment of a large percentage of farmers from governmental and non-governmental actors' watershed and agricultural activities. More so, the leaders confirmed that lack of a common purpose in farming occasioned unsustainable food production practices since every household had to struggle on its own with the resources at their disposal.

On the other hand, 43.4% (168) of the households observed that the common goal for food security was to engage and educate farmers on sustainable food and agriculture, while 14.7% (57) observed that food agricultural research innovation to feed the county was the goal for food security. In group discussions, the argument focused on these goals since most of the respondents indicated that a small portion amongst them who worked closely with the county government thought about the county as a whole, an example given was a slogan "*food in the mouth and money in the pocket*" which respondents associated with the County Executive Member of Agriculture and Livestock Development who used the slogan to mobilize farmers during county agricultural workshops. The Constitution of Kenya (2010) aims to rally all Kenyans to zero tolerance to hunger in Article 43 (1) (c), as food security is regarded as a key indicator of the nation's level of development (GoK, 2010b). The qualitative analysis from both group discussions and key informants agreed that this was a vision that was far from realization in the study area.

This was attributed to emerging challenges to food security in the watershed such as increased negative impacts of climate change on watershed resources such as land which was the basis for food production as well as a rapidly growing population. On the other hand, 11.6% (45) of the households identified encouraging a new generation of food agricultural leaders while 6.7% (26) indicated advancing new food and agricultural product solutions as goals for food security as shown in Figure 6.1.

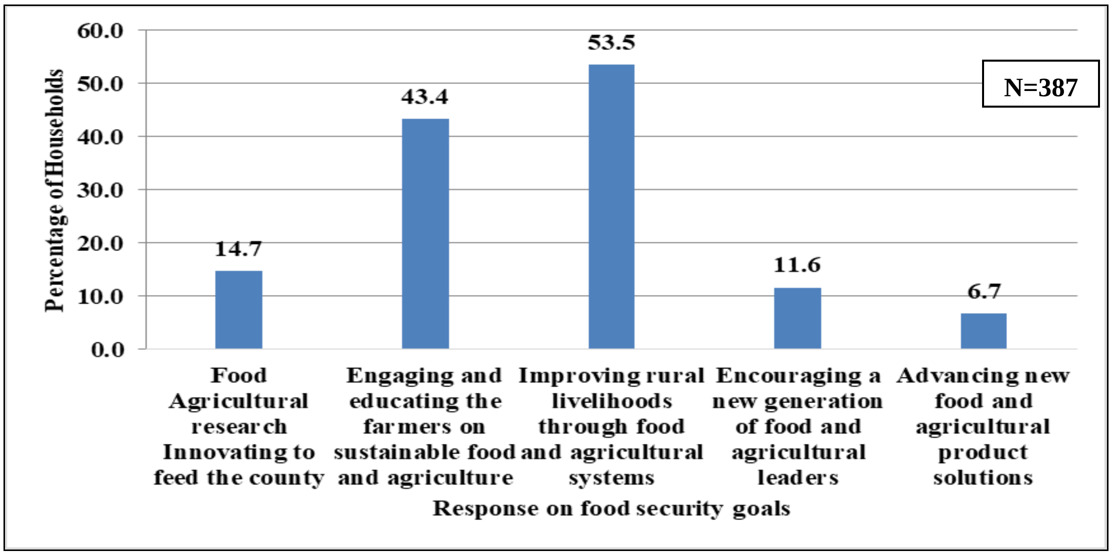


Figure 6.1: Food Security Goals in the Lower Sio River Basin
Source: Field data (2018)

Studies showed that globally, efforts to eradicate poverty and to ensure sustainable economic growth, the key developmental goal of all governments has been to eradicate hunger and poverty, ensuring access to basic needs such as clean water, access to food, and medical treatment (World Bank, 2007; Grobler, 2016). However, the findings showed that food security as a development goal has never been realized in the Lower Sio River Basin.

6.3: Watershed Management Policies that Contribute to Food Security Goals

The study sought to examine households' knowledge of watershed-related policies and their contribution to food security in the watershed. The results (Figure 6.2) indicated that 43.4% (168) of the households did not agree that existing watershed management policies and programmes contributed to food security while 41.9% (162) indicated that they did not know whether watershed management policies in the watershed contributed to food security. Only 14.7% (57) of the households agreed that policies for watershed management also contributed to food security. Elsewhere, Grobler, (2016) in the study on perception of poverty; a study of food secure and food insecure households in the urban areas in South African found that food insecure households who also happened to be poor households, felt that the government was responsible for their predicaments and therefore, the study concluded that the government should provide social security to lift them out of the food insecurity situations.

Rajaonarison (2014) suggested that failure to achieve food security is due to ignorance of the agricultural sector in the national building agenda. On the other hand, policies directed towards addressing food security are often politically instigated and manipulated to control all aspects of food from production to distribution and utilization in any socio-ecological set-up. However, it’s important to note that the Lower Sio River Basin has been a beneficiary of the implementation of government and donor agricultural policies and programmes related to environmental protection and food security in the past decades. The results from such policies or co-management have not translated in improved watershed governance or improvement in households’ food security status.

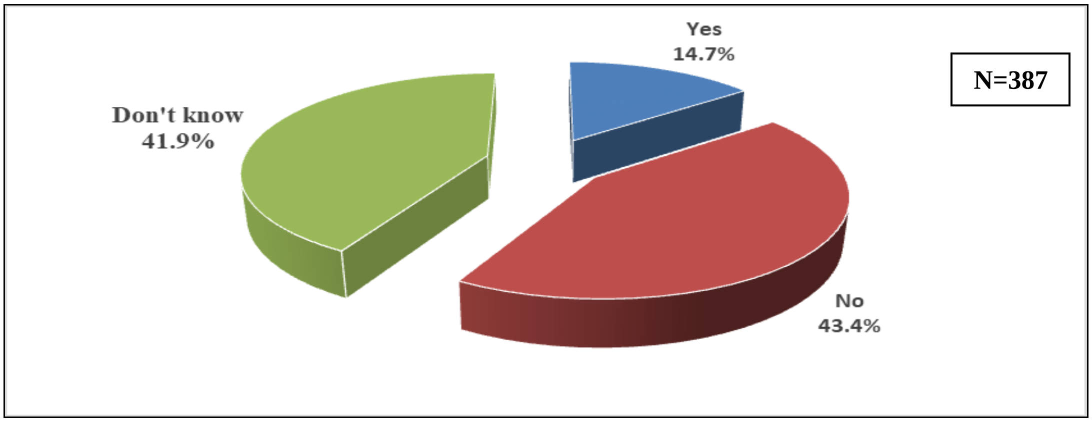


Figure 6.2: Contribution of Watershed Management Policies and Programs to Shared Food Security Goals
Source: Field data (2018)

The Constitution of Kenya (2010) under the Bill of rights, states that national security includes the protection of the fundamental rights and freedoms of every Kenyan. Thus Kenyans in the study area have and need to enjoy the freedom from hunger, access to information and participation in decision making on matters that pertain their lives (GoK, 2010). The results of this study clearly indicate that majority of households in the watershed do not contribute to legitimizing watershed management policies hence experience trickledown effect to ensuring food security.

The Kenya National Food and Nutrition Security Policy (2009) recognized the importance of environmental management in food security thus watershed management and climate change adaptation and mitigation were identified as key determinants of food insecurity in the country (GoK, 2009b). In addition, the long-term national development blueprints, such as the Vision (2030) and the Strategy for Revitalization of Agriculture in Kenya are just a few of the national frameworks that recognize the importance of environmental management and people's participation for ensuring sustainable agricultural development in the country.

At the county level, the Constitution of Kenya (2010) in the Fourth Schedule devolved agricultural functions and what was left at the national level is national policy and research. Thus, the counties are mandated to domesticate and modify ratified international conventions, national policies on agriculture and watershed resource utilization with the knowledge of primary beneficiaries to fit into local needs and conditions (GoK, 2010b). In order to deliver, the First Busia County Integrated Development Plan (BCIDP) (2013) also indicated the necessity of environmental management and climate change adaption and mitigation strategies and involvement of the people in all matters directly or indirectly relating to their lives as key elements in ensuring food security for the citizens of Busia County (GoK, 2013a).

The finding indicated that most of these efforts were only on paper have not been implemented by the inhabitants of Lower Sio River Basin. As noted earlier, ineffective governance and political will and the on-going negative impacts of donor policies such as Structural Adjustment Programmes (SAPs) of the World and IMF continue to hinder governments at both levels (National and Counties) from providing incentives and support systems to farmers to improve in their production capacities (Kimani-Murage *et al.*, 2014).

6.4: Drivers of Food insecurity and Households Food Security

It is worth to note that '*it's the wearer of the shoe, who knows where it pinches*.' Food insecurity is a major threat to human development and human security in the watershed. During the field study when households were asked to list drivers of food insecurity the question was positively answered by the respondents who were able to identify several factors. Results in Figure 6.3 revealed that majority 86.8% (336) blamed low farm yield recorded in recent years as a key driver of food security. This was attributed to various factors that were also mentioned to contribute to food insecurity in the basin including the prolonged droughts reported by 58.7% (227) of the households; failure of traditional food systems reported by 11.1% (43) households; weak early warning systems mentioned reported by 25.6% (99); land degradation reported by 52.5% (203); and watershed resource degradation mentioned by 24.8% (96) of the respondents respectively.

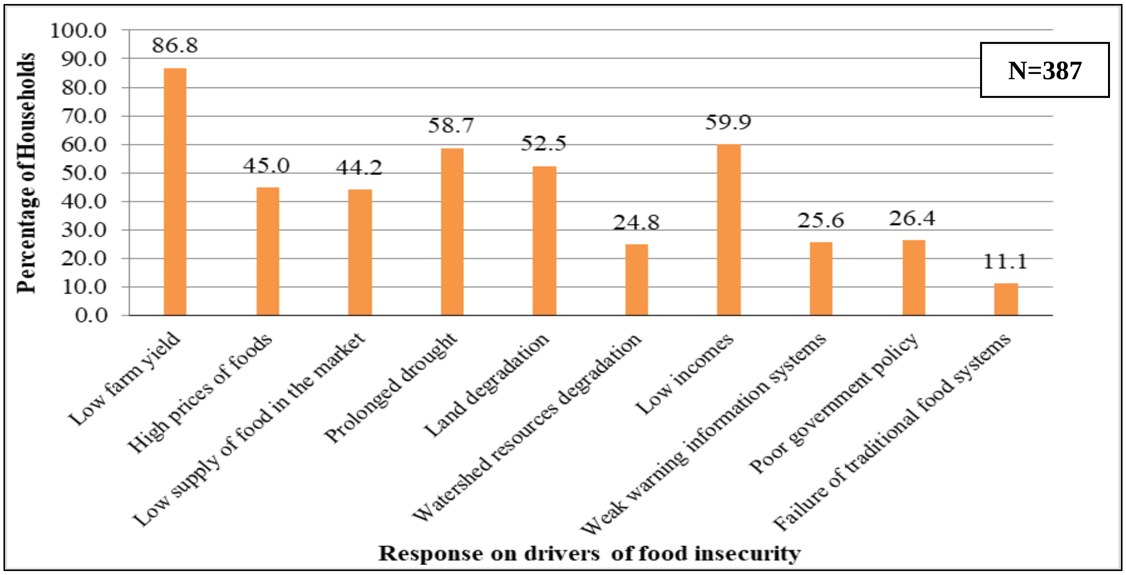


Figure 6.3: Drivers for food insecurity in the Lower Sio River Basin
Source: Field data (2018)

An earlier study by Makalle *et al.* (2008) found that in the Sio basin, Kenya, land productivity had been declining over time due to various reasons; this was confirmed by 42% of the respondents who indicated that land productivity was currently lower than that of 30 years back. The main reasons that were advanced for the declining land productivity included; over cultivation due to land fragmentation and thus reduction in cultivated land in the Sio River basin and overgrazing. Further, poor cultivation techniques, use of fire to clear land, inadequate use of fertilizers, mono-cropping and drought were also experienced in the watershed (Makalle *et al.*, 2008). Elsewhere in

Kapingazi, Embu Kenya, studies showed that farmers preferred adoption of riparian area management by removing eucalyptus planted along the rivers, capacity building on good environmental practices and diversification of income base by introducing nature-based enterprises like beekeeping that would lead to a win-win in economic and environmental impacts (Balana *et al.,* 2011; Kagombe *et al.,* 2018). Other factors that contributed to food insecurity in the Lower Sio River Basin that were identified by the respondents included; low levels of income in the study which was identified by 59.9% (232) of the households. Furthermore, 44.2% (171) of the households observed that there was a low supply of food in the market. This resulted in elevated food prices which were indicated by 45.0% (174) of the households as a driver to food insecurity.

Further, a Chi-square test carried out on the households' responses shown in Table 6.1 indicate that there was a highly significant variation among the households with food security and the households with food insecurity with the four drivers of food insecurity namely: high prices of foods, low supply of food in the market, incidences of prolonged droughts and low levels of income at p-value=0.000 while poor government policy at p-value=0.007. However, the Chi-square test on respondents' socio-demographic characteristics found that the various levels of households' incomes were insignificant to households' status of food security. This is attributed to the fact that food security is determined by multiple factors and the household with low levels of income might depend on other factors such as their farming activities or relatives' donations for food. Therefore, low levels of households' income in the basin might not necessarily mean households food insecurity.

Other drivers of food insecurity that showed significant variations among the two types of households included; weak warning information systems at p-value=0.030 and failure of traditional food systems at p-value=0.089. These findings implied that the mentioned drivers for food security were significant in determining the status of households' food security in the Lower Sio River Basin. However, results showed that low farm yield, land and watershed resources degradation were found to be insignificant in determining the household food security status.

Table 6.1: Food security and Insecurity households' measurement comparison association amongst households drivers for food insecurity

Drivers to food insecurity	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value	Significant?
Low farm yield	85.5	88.4	2.9	0.715	0.398	No
High prices of foods	31.3	61.8	30.5	36.059	0.000***	Yes
Low supply of food in the market	31.3	60.1	28.8	32.190	0.000***	Yes
Prolonged drought	50.5	68.8	18.3	13.238	0.000***	Yes
Land degradation	51.4	53.8	2.4	0.213	0.645	No
Watershed resources degradation	22.0	28.3	6.3	2.075	0.150	No
Low incomes	68.2	49.7	-18.5	13.656	0.000**	Yes
Weak warning information systems	29.9	20.2	-9.7	4.704	0.030**	Yes
Ineffective government policy	31.8	19.7	-12.1	7.243	0.007***	Yes
Failure of traditional food systems	13.6	8.1	-5.5	2.886	0.089*	Yes
Other Specify	6.1	5.2	-0.9	0.136	0.712	No

*p<0.1 **p<0.05 ***p< 0.01 statistically significant difference between the households with food secure and insecure
Others included; political instability, conflicts among neighbours including from Uganda.

Source: Field data (2018)

During the transect walk in various study sites, it was observed that crop production practices in the watershed were characterized by traditional methods such as the use of hoe for Ploughing, burning farms for clearance with very few farmers practicing improved farming methods due to low affordability of farm inputs. A large percentage of farmers practiced intercropping or mixed cropping systems which utilize a combination of crops on the same piece of land, with the aim of intensifying crop production both in time and space. The crops mostly intercropped by the small-holder agricultural producers were legumes and cereals specifically beans and maize.

Overgrazing was another major important land use practice witnessed and identified in focus group discussions as well as key informants' interviews that contributed to watershed issues and food insecurity in the basin. The major types of livestock kept were cattle, goats, and sheep. During the periods of pasture shortage, most of the interviewed livestock keepers along the streams and the river bank indicated that they moved their livestock from one place to another in search of pasture especially in the riparian wetland of the Sio River and its streams and water in the river banks. In Mango sub-location, it was disclosed that the same practices applied to colleagues from the Uganda side. Those with one to three animals practiced tethering at the homesteads where they searched and transported fodder.

However, the respondents observed that in recent years, there has been changes in vegetation cover along the river banks which they attributed to severe negative impacts of climatic changes such as frequent drought and flooding in addition, to increased poor land management practices such as increased homesteads, use of inorganic fertilizers, clearance of land for farming, burning of farms, destruction of soil cover on adjacent farmlands that resulted to siltation, sedimentation, eutrophication, soil erosion, and deforestation. However, the study did not establish the amount of reduction in the pasture and some of the listed impacts since the data were not available at the respective authorities.

Irrigated agriculture was not widely practiced in the Lower Sio River Basin despite the existence of several streams and rivers that were potential for irrigation. During interviews with the County Irrigation Officer said: -

> “The limited investments and support to farmers by the county and national governments agencies in the provision for water of irrigation has left farmers in this basin to rely on unreliable rain and rudimentary technologies at their disposal for agricultural production. Hence there is low uptake of irrigation development from nongovernmental organization and programmes such as PALWECO and WKCDD/FMP.”

Further, the major challenges affecting watershed management and food security identified in the focus group discussion included: high levels of poverty that made most households to sell portions of their land thus increasing land fragmentation reinforced by lack of community involvement in the development projects decision making and planning; poor infrastructure for social amenities such as roads, impacts of HIV and AIDS, collapse of agricultural marketing; high cost of farm inputs; lack of access to production assets; delay in payment of sugarcane; inhibitive cultural practices; corruption in county government service provider offices; collapse of cotton industry; crime and insecurity. These results were similar to Wabwoba (2017) findings that established small land size for farming, non-use of fertilizer and certified seeds, soil infertility, poor infrastructure, and disorganized marketing system were significant in determining households’ food security in Bungoma County.

6.5: County Governance Impact on Watershed Management and Households Food Security

Overall, the results showed that the county government through its activities had insignificant impact on watershed management for food production in the watershed. The results (Figure 6.4) indicate that only 11.1% (43) of the respondents highlighted farmland as the watershed aspect that the county government activities have impacted. From the discussions with groups it was reported that although not all respondents had benefited from the county government agricultural production investments, the county had invested in: tractors for ploughing, grading and murram of rural roads, subsidized fertilizers and lime for farmers, in some areas supplied improved seeds, banana tissue cultured seeds and soil testing were activities that targeted improving food security in the watershed. However, 10.1% (39) of the respondents felt that the county government had impacted the river stream. For example, siltation and sedimentation along the streams where the county roads and bridges were done, and eutrophication that resulted from fertilizers washed to the streams and rivers. The respondents were concerned that the roads opened all over the basin without proper drainage systems were leading runoff leading to sedimentation and erosion in the farmlands and streams.

Based on the study, only 4.4% (17) of the respondents felt that the county government activities had impacted negatively on hilltops and hill slopes. Much of the noticed impact was that roads had been opened on the hill slopes without proper runoff drainage systems especially in Matayos and Funyula Sub-counties. At the hilltops quarrying activities for building stones had increased as the county government spending and increased construction of buildings throughout the county. According to the respondents, activities at hilltops had contributed to increased gullies in the hilltops since no rehabilitation efforts had been put in place by the county government (Figure 6.4).

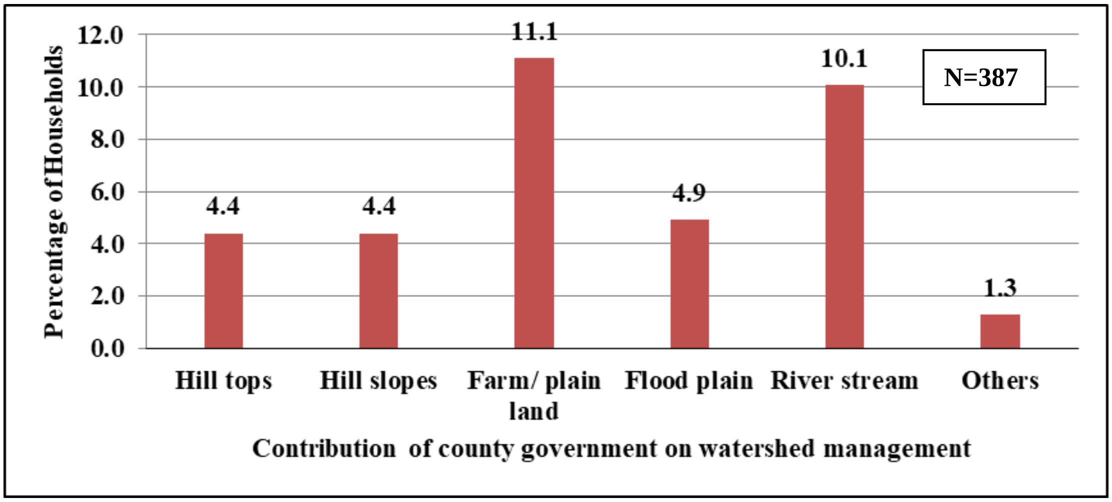


Figure 6.4: Contribution of County Government on Watershed Management for Food Production and Distribution
Source: Field data (2018)

On the other hand, 4.9% (19) of the respondents observed that the county had impacted on the floodplain along River Sio. The main reason given during discussions was that sedimentation in the floodplain with runoff from farms ploughed by tractors and graded roads were deposited on the floodplain causing the floods to increase towards farms especially during heavy rainfall seasons. According to 1.3% (05) of those interviewed other watershed resources such as forests were also impacted by the county government activities since most of the construction contracts were awarded to local people who went on using local resources such as timber from the local private forest for construction. Therefore, there was a general feeling from respondents that the negative impacts of increased county government activities if unchecked, in the long run, the projects will be unsustainable due to ignored consideration of watershed management approaches in planning and implementation of the projects.

This finding is similar to Namenya (2012) findings where it was concluded that due to lack of adoption of watershed management approaches in Constituency Development Fund Projects in Funyula Constituency, the projects were not sustainable, although studies indicate that economic gains from environmental rehabilitation are realized in the long term (Gebregziabher *et al.,* 2016). Kagombe *et al.* (2018) found that in Ndakaini Dam watershed, there was a significant relationship between farmers' acceptance of environmentally conservation practices and incentives given by water providers. Similarly, there may be delays in economic impacts from the county governance arrangements in Kenya due to the low net value of changes in watershed governance investments in the Lower Sio River. Some economic gains related to watershed management as well as food security are short-term and may have been realized in the first five years after the devolved system of governance.

Although it was acknowledged by majority respondents in both households' interviews and focus group discussions that the county government had put in place efforts to improve food production, results in Table 6.2 show that 42.4% (164) of the households pointed out that the existing watershed governance structures such as policies did not have impact on the rural agricultural crop production while 16.5% (64) did not know if such impact existed in the watershed. It was observed by 44.7% (173) of the respondents that there was no impact on rural agricultural livestock production as well. This was a result of low investments by the county government in these food security domains. Only 39.0% (151) of the respondents observed that the watershed governance structures had positively contributed to rural food trade. This was attributed to opening up of access roads and establishment of smallholder market centres in the watershed, the reasons which the county government was praised for.

Table 6.2: Impact of Watershed Governance Structure on the Domains of Households food security

	Ranks			
Domains of food security	**Positively**	**No impact**	**Negatively**	**Don't Know**
	Percentage of HH (N=387)			
Rural agriculture crop production	40.8 (158)	42.4(164)	0.3(01)	16.5(64)
Rural food trade	39.0(151)	39.8(154)	2.1(08)	19.1(74)
Rural agriculture livestock production	34.9(135)	44.7(173)	1.6(06)	18.9(73)
Traditional production systems	28.9(112)	37.5(145)	4.1(16)	29.5(114)
Ecosystems/Environmental activities	28.2(109)	40.8(158)	3.6(14)	27.4(106)
Development cooperation	15.5(60)	46.0(178)	3.6(14)	34.9(135)
Aquaculture activities	13.2(51)	43.7(169)	1.0(04)	42.1(163)

Source: Field data (2018)

On the other hand, only 13.2% (51) of the households felt that the watershed governance structures in the Lower Sio River Basin contributed positively to aquaculture activities, while 40.8% (158) observed that the structures had not impacted on ecosystems and environmental activities. Nevertheless, 46.0% (178) and 37.5% (145) concluded that the watershed governance structures had no impact on development cooperation and traditional production systems respectively. Governments' policies are meant to carry out watershed and food security interventions on behalf of the households, to avoid a situation whereby the governments are blamed for watershed resources degradation and households' food insecurity problems. Therefore, policies to eradicate food insecurity and poverty, in general, should take note of food insecure household's perception that the households are not responsible for food insecurity situation, and that it is the sole responsibility of government to solve food insecurity situation (Grobler, 2016).

Table 6.3: Variables Measuring the Impact of Watershed Governance Structures on Various Factors of Households Food Security

Factors of Households Food Security	**HH reported Yes (N=387)**	**HH (%) reported Yes**
Foods are available		
HHs willingness to change food production practices	214	55.3
HH farmers access to productive technologies and practices	161	41.6
HH farmers access to resources, labour, finance, agricultural inputs	129	33.3
HH farmers secure and timely access to fertile land, water and ecosystem services	140	36.2
HHs knowledge and skills to improve food production	192	49.6
On Average, Availability of food	**167**	**43.2**
Foods are accessed		
Women have a strong say in HH economic decision making	192	49.6
Increased HH income	126	32.6
HH engage in secure income generating activities	133	34.4
On Average, Access to food	**142**	**36.7**
Food stability		
Farmers grow climate adapted crops	191	49.4
HH are energy efficient	110	28.4
Land restoration including soil and water conservation and management	160	41.3
HHs have and implement preparedness plans to protect lives and assets	87	22.5
HH have coping strategies	126	32.6
Resource assets, income exists which can be mobilized by HHs	123	31.8
On Average, food stability	**198**	**51.2**
Foods are utilized effectively		
Access to clean water	273	70.5
HHs willingness to change diets	198	51.2
HHs skills and knowledge to ensure good nutrition, food safety and sanitation	179	46.3
On Average, utilisation of food	**220**	**56.8**
The overall Index Score of food security		
Mean (SD)	**41.21 (30.0)**	
Median	**41.2**	
Food insecurity	**214**	**55.3**
Food Security	**173**	**44.7**

Source: Field data (2018)

The results show that on average 55.3% (214) of the households in the watershed were foods insecure (Table 6.3), slightly higher level of food insecurity than the Government of Kenya estimation of food insecurity in Busia County which placed it at 54% (GoK, 2013a; GoK, 2016b). This implied that the situation of food insecurity was worsening despite recent changes in the governance system that is expected to have positive impacts on watershed governance and food security. Only 44.7% (173) of the households observed that the watershed governance interventions by the national and county governments and other stakeholders had made the households' food secure.

Based on the study findings, on average 43.2% (167) of the households indicate that the current watershed governance structures have ensured that food is available. On specific variables that were used to measure food availability in the study area, 55.3% (214) reported that the recent watershed governance interventions by actors had enhanced their willingness to change food production practices in their farms. In addition, 41.6% (161) reported that the interventions had promoted farmers access to productive technologies and practices, 33.3% (129) reported that household farmers' accessed resources such as labour, finance, agricultural inputs to name afew.

Evidence from the neighbouring Bungoma County showed a highly significant association between access to credit, finance and agricultural with food security (Wabwoba *et al.,* 2015). Moreover, 36.2% (140) reported that the interventions ensured that household farmers' secured and timely access to fertile land, water and ecosystem services while 49.6% (192) reported that the interventions provided the households with knowledge and skills to improve food production. The study by Wabwoba (2017) in Bungoma County revealed that there was a significant relationship between physical factors such as soil fertility, the state of infrastructure and organization of the market system and food production levels in the county. Elsewhere, Meaza (2015) found that in Adwa watershed, Ethiopia, in efforts to promote watershed management activities for food security interventions, the government introduced 1 to 5 households' network which had a great contribution to household's social interaction and adoption of new technologies. The study revealed that one farmer adopts the new technology successfully and allows other farmers to learn from him or her (farmer field school approach) as an advisor and or a teacher thereby maximizing on the multiplier effect.

In their findings, Elias *et al.* (2015) alluded that family size, credit, off-farm income, perceived economic return and frequency of extension contact were significant determinants of farmers' satisfaction with agricultural extension services. However, other proposed predictors such as age, education, livestock ownership, extension experience, training, participatory nature of the program, perceived package appropriateness and use of multiple communication methods were not significant in North West Ethiopia. Similarly, in the Chi-square test established that age, education and sex did not have any significant relationship with food security.

On the other hand, the findings showed that watershed governance structures in the Lower Sio River Basin had not done much in ensuring that the households had access to food. Only 49.6% (192) of the households indicated that the watershed governance structures had ensured that women have a strong say in household economic decision making. Wabwoba *et al.* (2015) found that household head decision making on land allocation, crop processing, marketing of farm produce and using proceeds from the crop sales had a statistically significant association with food security in Bungoma County.

Moreover, 32.6% (126) reported that the interventions had increased household income levels, while 34.4% (133) noted that the watershed governance structures had ensured that the households engaged in secure income generating activities. Thus on average, the study indicates that only 36.7% (142) of the total population of households in the study area had access to food as a consequence of the current watershed governance structures.

Further, studies show that soil preparation and ridging tended to be done predominately by males early in the cropping seasons while weeding and harvesting of crops were predominately women's tasks and thus women work more than men in the rural food production (African Women's Studies Centre, 2014). Moreover, farming decisions at the watershed level have a higher level of influence based on the gender and hence the need to integrate gender issues in agricultural and watershed management programmes for successful implementation and uptake of new adaptive technologies and crops. As recommended by the African Development Bank (2004), poverty reduction strategies in rural agricultural economies must focus on influencing the factors that affect women participation in decision-making process since it ultimately affects access to resources and ability to generate income at the household level.

In addition, based on the analysis from the study, on average 51.2% (198) of the total population of households in the Lower Sio River Basin found that the watershed governance structures would contribute to the general stability of food in the watershed. Analysis of specific variables that contribute to food stability showed that 49.4% (191) indicated that the watershed governance structures had ensured that farmers grew climate adapted crops, while 28.4% (110) of the households were energy efficient, 41.3% (160) were engaged in land restoration including soil and water conservation and management, 22.5% (87) household had and implement preparedness plans to protect lives and assets, 32.6% (126) household had coping strategies, and 31.8% (123) resource assets, income exists which can be mobilized by households. Wabwoba *et al.,* (2015) found that there was a significant variation in households' assets and households' food security status in Bungoma County.

The study by Jacobs and Saggers (2011) found that where assets and property rights for women are viewed as key to economic progress, like in the Lower Sio River Basin, women continue to own just a fraction of land worldwide. Additionally, despite laws that protect women rights to property, men together with women often are unaware of their rights (African Women's Studies Centre, 2014). Furthermore, the study by Ahmed *et al.* (2010) revealed that increasing vulnerability to environmental conditions such as diminishing biodiversity, soil degradation, growing water scarcity can easily threaten the stability of food security for populations which depend on the products of the land, forests, pastures and marine environments for their livelihoods (Wabwoba, 2017). Therefore, limited investments by the stakeholders in the management of the mentioned activities as revealed in the study implied low levels of food stability in the Lower Sio Basin.

Finally, on the last aspect of food security which entails ensuring that foods were well utilized, the findings show that on average (56.8%) (220) of the households in the Lower Sio River Basin indicated that the watershed governance structures had contributed to food utilization in the watershed. More specifically, 70.5% (273) reported that the structure had impacted on access to clean water for domestic and livestock consumption, 51.2% (198) reported that the structures had impacted on households' willingness to change diets, while 46.3% (179) indicated that the watershed governance structures had contributed to households' skills and knowledge to ensure good nutrition, food safety and sanitation. In focus group discussions, it revealed that the county government had drilled shallow wells and rehabilitation of springs to ensure that clean and safe water was available for domestic use. This was in support of Lake Victoria North Water Service

Board and non-governmental organizations such as Sustained East Africa, World Vision among others.

Another factor given was the devolution of health functions whereby the county has employed enough public health officers who offered extension services to the households in collaboration with Community Health Workers who were trained and facilitated by AMREF and UNICEF. The findings on the current state of food security in the Lower Sio River Basin contributes to the findings from earlier studies which warned that both poverty levels and household food insecurity were rising across East Africa (Charles *et al.,* 2010; Kristjanson *et al.,* 2010; Thornton *et al.,* 2011; Patti *et al.,* 2012) despite the fact that governments are heavily investing in measures to combat hunger threats in the region.

6.6: Regression Analysis Results on Watershed Governance and Food Security

The bi-variate analysis done in the previous chapters between dependent and independent variables showed varied results. Therefore, to confirm if both background and controlling variables have the effect on households' food security both linear and logistic regression analyses were run. Linear regression analyses were carried out separately, using the explanatory variables such as; age in complete years, sex, and religion, land tenure (freehold and communal), watershed governance structures, watershed expertise, satisfaction towards watershed governance and co-management of watershed index scores towards watershed governance in the Lower Sio River Basin. Since R^2 is affected by the sample size and number of variables, the adjusted value of R^2 was used to explain the variation in predictors on the indices used.

Results indicate that age (significance=0.667), sex (significance=0.106) and land tenure system had no effect on the status of households' food security (Table 6.4a). Other than age and sex, Table 6.4a presents the regression results using food index score against explaining variables (items) retained as most coherent i.e. showed a significant difference in the bivariate analysis. The results show that religion, watershed expertise, level of satisfaction towards watershed governance and co-management of watershed could only explain 20.8% variation between households' food security and food insecurity differences at household levels, implying that religion, satisfaction, watershed expertise and co-management had the effect on households' food security.

Interestingly, watershed governance structures did not have an effect on households' food security and in reverse order the higher the score of watershed governance the lower the level of households' food security. This is attributed to the study findings which showed that watershed governance structures in the Lower Sio River Basin did not contribute to household's satisfaction, households' adaptive capacity and adaptive co-management respectively. The watershed governance structures which include policies, plans and pieces of legislation are not implemented and remain in government offices shelves as tools for public relations. Further, regression results show that the households' food security score increased with increased watershed expertise, satisfaction towards watershed governance and co-management of watershed scores, meaning that these variables had a positive influence on households' food security. Thus, an increase in the levels of watershed expertise, co-management and households' satisfaction means an increase in levels of food security in the Lower Sio River Basin (Table 6.4a).

Table 6.4a: Linear regression results

				95.0% Confidence Interval for *B*	
	B	**Std. Error**	**Sig.**	**Lower Bound**	**Upper Bound**
Constant	18.153	9.93	0.068	-1.372	37.678
Age (in completed years)	0.046	0.106	0.667	-0.163	0.255
Sex	-4.512	2.785	0.106	-9.988	0.964
Religion	9.824	4.724	0.038	0.535	19.113
Land tenure: "freehold"	-10.961	7.035	0.120	-24.793	2.871
Land tenure: "communal"	-9.126	7.155	0.203	-23.195	4.943
Index score: watershed governance structures	-0.112	0.337	0.740	-0.775	0.551
Index score: watershed expertise	0.99	0.214	0.000	0.568	1.411
Index score satisfaction: questions on satisfaction towards watershed governance	0.207	0.047	0.000	0.114	0.299
Index score: Co-management of watershed	0.272	0.061	0.000	0.152	0.391
R^2	0.227				
Adjusted R Square	0.208				
ANOVA F Value	12.295				
Significance	0.000				

Note: B stands for Beta Coefficient value

Source: Field data (2018)

To carry out a robustness check, an alternative logistic regression was run using a categorised (binary) household's food security variable (food security and food insecurity) with the one with linear regression, in relation to age, sex, religion and land tenure against retained independent variables (Table 6.4b). The results show that male-headed households were 1.42 times more likely to be food secure than those headed by the females. This was attributed to inequalities between men and women in engagement in economic activities and decision-making process. In focus group discussions it was revealed that men who were perceived to be household heads had more access to economic opportunities compared to women. This made men to access diverse employment opportunities which translated to more incomes that could be invested in food security activities. A study by Wabwoba *et al.* (2015) revealed that household heads decision making on land allocation, crop processing, marketing of farm produce and using proceeds from the crop sales had a statistical significance on households' food security status.

Similarly, on background factors analysis, households with Christian heads scored better in food security than those with heads of other religions – they were twice likely to be food secure. Results show that for communal and lease land tenure system households scored better in food security than those with freehold land system. During key informant interviews, it was revealed that communal land was better managed collectively by either the community landowners or the leasers. Therefore, the use of such lands for food production was subject to community collective regulations which do not exist in privately or freehold land system.

Table 6.4b: Logistic Regression results

	B	**S.E.**	**Wald**	**Sig.**	**Exp(*B*)**
Age	-0.001	0.009	0.024	0.877	0.999
Sex(1)	0.351	0.23	2.339	0.126	1.421
Religion(1)	0.684	0.44	2.412	0.120	1.981
Land tenure system			4.861	0.088	
Land tenure system (1)	0.37	0.24	2.383	0.123	1.448
Land tenure system(2)	1.149	0.602	3.643	0.056	3.156
Index score: watershed governance structures	-0.021	0.03	0.487	0.485	0.979
Index score: watershed expertise	0.088	0.021	17.303	0.000	1.092
Index score satisfaction: questions on satisfaction towards watershed governance	0.011	0.004	7.308	0.007	1.011
Index score: Co-management of watershed	0.015	0.005	8.79	0.003	1.015
Constant	-2.669	0.713	14.023	0.000	0.069
Cox & Snell R Square	0.155				
Nagelkerke R Square	0.207				

Note: ***B*** stands for Beta Coefficient value

Source: Field data (2018)

This finding is similar to Economic Commission for Africa (2004) finding that land held by groups of individuals under freehold tenure systems and by the state attracted the least regulation while customary systems attracted numerous land use regulations. Therefore, collective land use regulations were used to prevent what Hardin in 1968 posited as "The Tragedy of Commons". Security of land tenure is inherent to having control over major decisions on land use such as what crop to grow, what techniques to be used, what to consume and what to sell. In addition, the security of land tenure also determines soil and land management practises (Economic Commission for Africa, 2004).

Finally, empirical evidence showed that watershed management activities when supplemented with water harvesting technologies in the rural areas increased the availability of water for irrigated agricultural production. This was implemented together with improved agronomic practices contributed to increased land and crop productivity. This was observed in Abraha-Atshaba, Kereba and Bechyti watershed in Ethiopia where the implementation of watershed management increased crop production up to 200-300% (Gebregziabher *et al.*, 2016). This implies that enhancing food security in the Lower Sio River Basin needed to be approached through watershed governance practices promoted through watershed management. These include; watershed expertise, satisfaction towards watershed governance and co-management of the watershed.

CHAPTER SEVEN

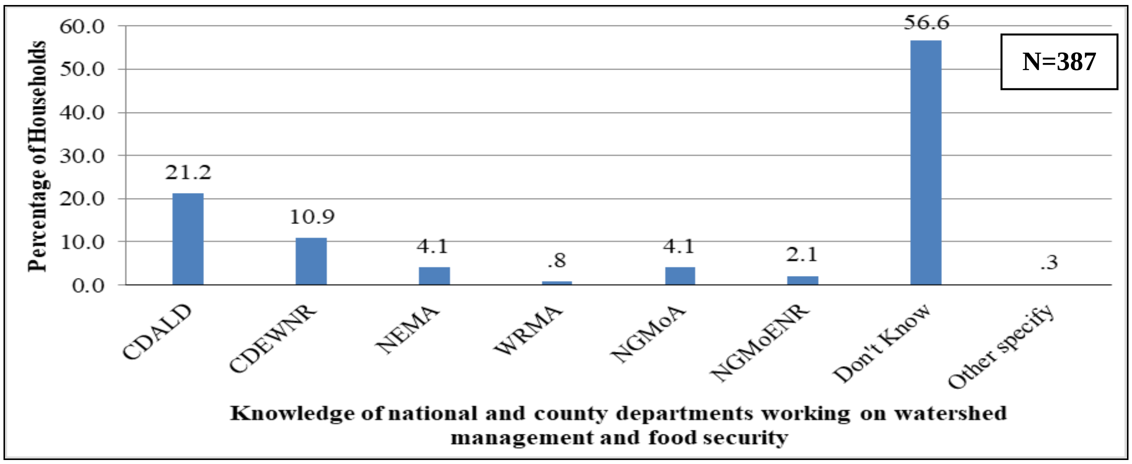
EFFECTIVENESS OF ADAPTIVE CO-MANAGEMENT OF WATERSHEDS FOR SUSTAINABLE FOOD SECURITY

7.1: Introduction

This chapter presents results of the process of watershed governance through co-management of watershed resources with the aims of enhancing food security in the Lower Sio River Basin. The study evaluated the effectiveness of adaptive co-management by using variables including role played by multi-level actors, collaboration, coordination, policies and plans, legislation, equity, responsiveness, and inclusiveness in watershed resource management approaches. The evaluation focused on water governance policies; the existence of various actors, different approaches used by various actors to deliver services to the people as well as promoting ecosystem services and establishing the status of adaptive co-management.

7.2: Co-ordination in Watershed Resource Management and Households Food Security

The study findings in Figure 7.1 indicated that, majority 56.6% (219) of the households in the Lower Sio River Basin did not know which department either at the county or national government level was tasked with coordinating the work of other departments and stakeholders towards a number of watershed management and food security goals. On the contrary, 21.2% (82) and 10.9% (42) of the households revealed that the County Department of Agriculture and Livestock Development (CDALD) and the County Department of Environment, Water and Natural Resources (CDEWNR) respectively were mandated to coordinate activities of other stakeholders in watershed management and food security activities at the county level. However, 4.1% (16) and 4.1% (16) of the households related the same functions with the National Government Ministry of Agriculture (NGMoA) and the National Environment Management Authority (NEMA) respectively.



Note: Other included; State department of social services (due to vulnerable groups cash transfer program)

Figure 7.1: Households Knowledge of Government Departments Tasked to coordinate other departments in Watershed and Food security activities

Source: Field data (2018)

Based on the study by Komakech (2013), an effective co-ordinated management of water resources at a river basin as stipulated in IWRM depended on the presence of an institution whose regulatory mandate and tasks are known and accepted by a majority of stakeholders. However, in the study area it was evident from this finding that such institutions are lacking as well as unknown to the primary stakeholders. This shows unco-ordinated watershed management functions in the watersheds which go against the tenets of IWRM. Further, the findings provided evidence that six years after devolution and eight years after promulgation of the Constitution of Kenya (2010), many Kenyans were neither part of the devolution process nor lacked knowledge on devolution and the devolved functions that directly impacted on their livelihoods. Sentiments from the focus group discussions showed that this made it difficult for them to participate in watershed management and demand for accountability from the service providers. To make it worse, Water Resources Authority (WRA) an institution mandated to manage all waters resources in Kenya did not have a decentralized and operational office in Busia County at the time of the study.

A Chi-square test carried out on the households' responses presented in Table 7.1 established a significance difference among the households with food security and households with food insecurity with the households' knowledge on various departments tasked to coordinate other departments in the watershed at p-value=0.000.

Table 7.1: Food security and Insecurity households' measurement comparison association amongst households knowledge on departments tasked to coordinate other departments in watershed management activities

Departments	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value	Significant?
The county Department of Agriculture and Livestock Development	12.1	32.4	20.3	48.408	0.000***	Yes
The county Department of Environment, Water and Natural Resources	7.5	15.0	7.5			
NEMA	7.0	0.6	-6.4			
WRA	0.9	0.6	-0.3			
National Government Ministry of Agriculture	2.3	6.4	4.1			
National Government Ministry of Environment and Natural Resources	1.9	2.3	0.4			
Don't Know	67.8	42.8	-25			
Other specify	0.5	0	-0.5			

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

Source: Field data (2018)

This implied that household's knowledge of the department that co-ordinated watershed management in the county significantly contributed to the status of food security. In the focus group discussions, it was revealed that the households' knowledge of departments contributed to their involvement in departments' activities at the grassroots or even sought assistance from various departments at times of needs.

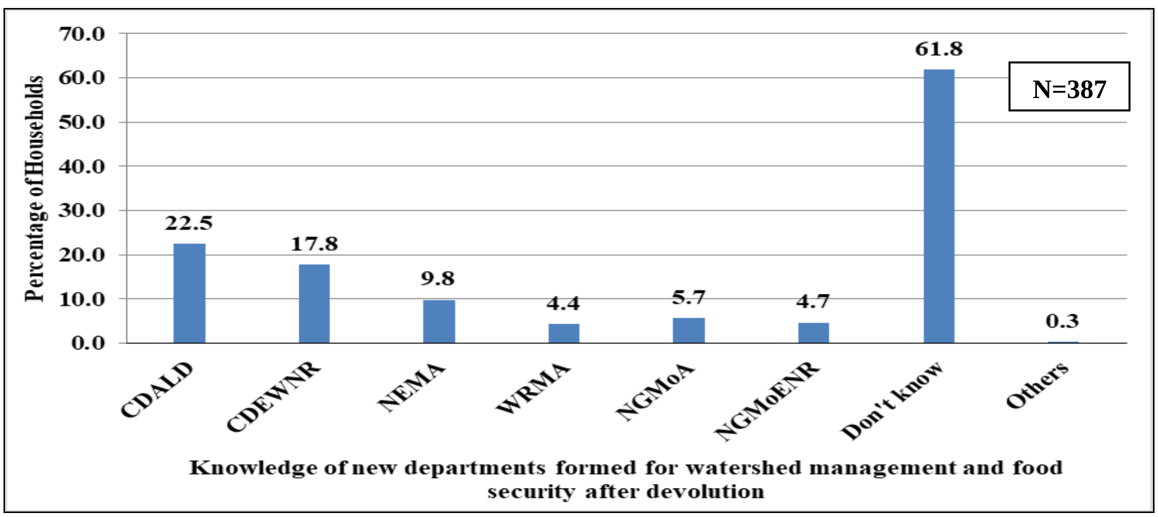
In regard to water resources management in Kenya, the Water Act of (2016) provided for the creation of WRA. The responsibility of the authority is to manage water resources. The authority is mandated to monitor water resources alongside administration of water regulation, for example, issuing water abstraction and discharge permits countrywide through its main six catchment regional offices. For the Lower Sio River Basin, this is done by Lake Victoria North Catchment Area (LVNCA). The vision for LVNCA is that "The people in the catchment conserve to ensure adequate quality water for all". During analysis of data from LVNCA and WRA, this vision was found to be consistent with the national vision which state that: "To manage, regulate and conserve water resources judiciously, involving stakeholders for enhanced equitable allocation and environmental sustainability."

As part of institutional decentralization and to ensure effective water resources management at the grassroots in Kenya, the Water Act (2016) also provide for the establishment of Water Resources User Associations (WRUAs) under WRA. This was inherent in ensuring that water users participate in decision making concerning the management of local water resources in sub-catchment areas for the benefit of all. The main mandate for the WRUAs was to prevent and solve conflict over water. Further, on institutional development, Section 16 of the Water Act (2016) provided for the formation of Catchment Area Advisory Committee (CAAC) for every region. The mandate for CAAC was to advise the regional authority on proper water resource management. Key among the principles that guided the formation of WRUAs and CAAC were gender parity, right-based and pro-poor approaches in order to ensure improved water resources management for the benefit of all.

The study did not find the presence of any active operational WRUA in the study area during the period of study. Nevertheless, WRUAs were expected to report to WRA a national government agency and not the CDWENR. Although the gap was identified and addressed in the revised Water Act of 2016, there exists a governance gap since the WRUAs are formed under an Act of the National Parliament and remains the grassroots agency of WRA yet expected to be under the CDWENR. To regularize formulation and responsibilities, facilitation and ownership of WRUAs at the county level, there is a need for them to be formed under an Act of the County Assembly and report directly to CDWENR.

The study found that watershed governance values such as accountability, inclusiveness and legitimacy were the basis for the formulation of WRUAs and CAAC as grassroots governance structures. Sustainable communal resource management through governance structures as WRUAs is attained by seeking people's participation and devising resource management approaches according to the local socio-cultural settings (Lise, 2007). On the other hand, among the core functions of LVNCA, according to the Water Act of (2002) section 15 and now Water Act (2016) is to formulate and operationalize the Catchment Management Strategy (CMS). The strategy as a governance tool is an instrument for achieving proper co-ordination of the use, development, conservation, protection, control of water resources within a catchment area. This was not the case in the study area as evident from households' responses.

Further, the respondents were asked which new departments, ministries or agencies created to enhance watershed management for food security activities in the Lower Sio River Basin. The results in Figure 7.2 show that 61.8% (229) of the households in the study area did not know the newly formed departments after devolution that was mandated to enhance watershed management and food security activities in the watershed. Although, 22.5% (87) identified the CDALD; 17.8% (69) of the respondents identified the CDEWNR while 9.8% (38) and 4.4% (17) of the respondents identified NEMA and WRA respectively as departments created to foster watershed management and food security in the watershed.



Note: Other included; State department of social services (due to vulnerable groups cash transfer program)

Figure 7.2: New Departments at the National and County Governments Known to the Households

Source: Field data (2018)

Furthermore, 5.7% (22) and 4.7% (18) of the households mentioned that the NGMoA and National Government Ministry of Environment and Natural Resources (NGMoENR) respectively as recently created departments to promote watershed management and food security. Although the findings showed mixed responses, in order to adjust systems to social and environmental issues, make and implement the right decisions at a watershed level, institutions need to be changed, adjusted, expanded, or created for consistency with the watershed governance system (Koontz *et al.*, 2015). This finding shows that although departments such as CDALD and CDEWNR were formed under the devolved system of governance, their formation and functions had not been legitimized by the beneficiaries of their responsibilities.

It is vivid to note that collective action needs to be taken by a group, either directly or on its behalf through an organization, in pursuit of members perceived shared interest (Marshall, 1998). Therefore, departments as organizations are supposed to pursue watershed management for the benefit of the households especially in ensuring that soil and water resources provided food for the population. Foerster (2011) argued 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. Therefore, the new departments formed the basis for adaptive governance due to their nature since as suggested by researchers that such an adaptive tool is thought to help a governance system cope with uncertainty and complexity (Huntjens *et al.*, 2012).

A Chi-square test carried out on the households' responses shown in Table 7.2 indicate that there was a high variation among the households with food security and the households with food insecurity knowledge of the CDALD, and CDEWNR as new departments created to enhance watershed management for food security at p-value=0.000. Similarly, there was a significant difference among the households with food security and households with food insecurity who indicated that they did not know the new department created to enhance watershed management for food security at p-value=0.000. In addition, households' knowledge of NEMA and WRA showed a significant difference between the two types of households and food security. This implied that knowledge of CDALD and CDEWNR, NEMA, WRA and ignorance of the new departments determined the households' food security status in the basin.

Table 7.2: Food security and Insecurity households' measurement comparison association amongst households knowledge on new departments created to enhance watershed management for food security

Department	Food insecurity (n=214)	Food Security (n=173)	Difference	χ^2	p-value	Significant?
The County Department of Agriculture and Livestock Development	9.8	38.2	28.4	44.080	0.000***	Yes
The County Department of Environment, Water and Natural Resources	8.4	29.5	21.1	28.984	0.000***	Yes
NEMA	12.1	6.9	-5.2	2.936	0.087*	Yes
WRA	2.8	6.4	3.6	2.878	0.090*	Yes
National Government Ministry of Agriculture	4.7	6.9	2.2	0.914	0.339	No
National Government Ministry of Environment and Natural Resources	5.6	3.5	-2.1	0.987	0.320	No
Don't Know	77.1	42.8	-34.3	47.733	0.000***	Yes
Other specify	0.5	0.0	-0.5	0.811	0.368	No

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

Note: Other included; State department of social services (due to vulnerable groups cash transfer program)

Source: Field data (2018)

On the other hand, the Environment Management and Coordination Act (EMCA) of 1999 now EMCA (2015), resulted to the formation of NEMA, an institution mandated to manage all matters relating to environmental management in Kenya. Consequently, NEMA plays a crucial role in providing guidance on regulation during interactions with stakeholders in watershed management activities such as the CDEWNR and CDALD. One of NEMA's limitation identified during interviews with the county director was that, at the county level, NEMA had only two permanent technical staff (the County Director and an Environment Officer) who worked closely with private individual registered consultants (Environmental Impact Assessment Experts) to provide Environmental Impact Assessments (EIAs) at inception of programs and projects as stipulated under EMCA (2015).

During key informant interviews, it was established that NEMA's capacity to monitor and respond to all complaints on environmental management issues raised by the public, as well as unreported issues was extremely limited. Additionally, as a primary national stakeholder in environmental management matters, NEMA county office had considered drawing public support for increased budget allocation on environmental management programmes from both the national government and county government support through the CDEWNR. Further, there were reports of discomfort in the county government environment department as reported in key informants' interviews. This was based on the allocation of budgets and working relations since NEMA was a national government agency thus served the interest of national government at the county level therefore expected to get all its allocation and staff from the national government. The Fourth Schedule of the Constitution of Kenya (2010) placed environmental management as a shared function between the national and county government, thus NEMA county office has an upper hand to negotiate for budgetary allocations to support staff or use the CDEWNR staff to ensure that programmes on proper management of watershed resources are prioritized during planning and budgeting at the county level.

The study found that the water reforms in Kenya since the year 2002, led to the establishment of Water Services Boards (WSBs) in the seven catchment areas with the aim of spearheading the development of domestic and industrial water supplies in integrated and coordinated development interventions, and avoid socio-political and administrative fragmentation. Therefore, the Lower Sio River Basin falls under the Lake Victoria North Water Services Board (LVNWSB). The board is mandated to provide water for domestic and industrial use through the Water Services Providers (WSP).

Currently, in the watershed, Busia Water and Sewerage Company (BUWASCO) an institution formed under the Act of the County Assembly of Busia is the main water services provider. Under the Water Act (2016), the WSPs signed Service Provision Agreements (SPAs) with the WSB to provide water and sanitation services to the specific areas. Before the county governments were put in place, the areas without WSP, the District Water Officers were mandated to operate water supply systems on behalf of the board. This was more specific to the urban areas while in the rural areas water supplies were managed by the members of communities through the establishment of Water Users Associations (WUAs). Similarly, in Tanzania, Komakech *et al.* (2011) observed that WUAs were quite essential for facilitating water resources governance at local level. For example, in Pangani River Basin in Tanzania, WUAs facilitated water management decisions, by-laws formation, supervision and development of water resources infrastructures that endured equitable allocation of irrigation water through water rationing and collection of water user fees from smallscale farmers (Makarius *et al.*, 2015).

The Water Act (2016) also allowed for private sector participation in the water service provision. Like in other developing countries, the Water Act (2002) and revised Water Act (2016) decentralized institutional frameworks necessary for local stakeholders' involvement in watershed governance in Kenya. Elsewhere, studies on institutional linkages, Gebregziabher *et al.* (2016) noted that hydrological relationships across a watershed influence a large number of stakeholders in the use and management of the watershed resources. On the other hand, the relationships in watersheds go beyond administrative boundaries, ownership rights with limited regulations and institutions governing the rights and duties of different stakeholders.

For example, the study carried out in Bedesa, Kela and Kereba watersheds in Ethiopia, community members had concerns that their upstream investments in watershed management formed swampy areas and perennial river in the downstream thus benefiting the downstream users without the contributions of the downstream communities. According to the study, this showed that managing watershed externalities required cooperation among various stakeholders and establishment of institutions and by-laws that address the benefits and cost-sharing systems at the watershed across different scales (Gebregziabher *et al.,* 2016).

7.3: Water Resources Management Plans in Use

According to the findings, Busia County Integrated Development Plan (BCIDP) (2013-2017) resulted from participatory inputs from all agencies both the national, county and non-governmental organizations in the county as well as input from sector-specific professionals and the communities at large. The BCIDP envisages improving the livelihoods of the people of Busia County, Lower Sio River Basin. The plan also aimed at helping the communities realize socio-economic and environmental potentials by mobilizing and equitably distributing resources as well as providing support and enabling policy and legal environments for the sustainable development and a green economy. As a result, under the county development priority programmes and projects, the BCIDP acknowledged and prioritized watershed management and food security interventions under the CDALD; and the CDEWNR with support from other key departments and agencies working in Busia County. As a development planning tool for the county, it is a key document to link the international and national development priorities to the local community development priorities thus necessary for both top-down and bottom-up planning processes as watershed governance roles (GoK, 2013).

On the other hand, Lake Victoria North Catchment Management Strategy, under which the Lower Sio River Basin falls, acknowledged high population growth rate as a major challenge facing management of underdeveloped water resources in the catchment area. Other challenges outlined included: Climate variability, underdevelopment of the available renewable fresh water, catchment degradation, degradation of water resources, poor groundwater recharge, competing needs for the diminishing water resources, a crumbled water resources assessment and monitoring programme, HIV and AIDS and gender issues related to water (GoK, 2007).

The results indicate that WRA recognized three key mechanisms for improving water resources management which encompasses watershed governance efforts. First is the regulation and enforcement which included setting standards and procedures that must be followed in water resource management. Influencing community behaviour through; awareness, incentives and other options to encourage better use of the water resources is the second mechanism (GoK, 2007). Finally, enhancing co-governance of water resource management in which other state agencies or institutions have a mandate and coordination is important to maximize the impact of cooperative efforts (Foerster, 2011). The strategy recognized that as a source of water in the catchment, the springs and wetlands attracted several activities such as cultivation through irrigation, water abstraction for livestock watering, domestic and commercial use. Out of which some activities were not controlled leading to degradation of the spring sources, reduction of water quality among others.

The interviews identified gaps in watershed governance in the Lower Sio Basin, WRA representative said: -

> "Land adjudication system leads to allocation of springs and wetland areas to individual community members together with unprotected and undeveloped springs throughout the catchment is a major hindrance. To make it worse, encroachment of the recharge areas of springs which are swamps, wetlands and forested hill areas contribute to the degradation of the quality and quantity of water yield from the streams and springs. Another gap is lack of an organized system of drawing water from the springs which cause both animals and humans accessing water at the same time which is worsened by cutting down of water-friendly indigenous trees leading to drying up of streams and springs."

During the transect walk, it was observed that fertile soils from the hill-slopes were washed away by surface runoff and finally deposited along banks of River Sio, and streams, wetlands and dams. This was attributed to unprotected riparian lands. The eroded soils deposited in the streams and rivers resulted in the reduction of water quality, reduced capacity of river or storage facilities, overflow of river banks that resulted in high incidences of floods and quick depletion of the water resources in the basin.

Similarly, under the Nile Trans-Boundary Environment Action Project (NTEAP) of the Nile Basin Initiative (NBI), the Sio-Siteko Trans boundary Community-Based Wetland Management Plan was developed in 2009 (NBI, 2009). Like other watershed governance tools, the study noted that the plan was made in a participatory manner whereby several stakeholders at the international level and national level were involved. At the international level, the financial support from the Canadian International Development Agency (CIDA) and the Netherlands Government, through the Nile Basin Trust Fund managed by the World Bank, the plan was made possible. At the local level, the team made up of stakeholders from Busia County (Kenya), Busia District Uganda, other wetland management experts were involved including; community resource users, local administrators, political leaders and extension workers in the watershed. These findings show that there was co-management at the watershed plan formulation level.

The Lower Sio River Basin being part of the Sio-Siteko trans-boundary wetland plan showed that the guiding vision for the communities in the watershed is “A well conserved Sio-Siteko Wetlands, sustainably utilized for both socio-economic and ecological benefits in a harmonized trans-boundary relationship.” The findings show that the vision was consistent with WRA vision although the plans did not refer to each other. Figure 7.3 presents the Sio-Siteko Sub Basin. The study observed that given a wide geographical coverage of the wetland, only six sites were sampled for community participation during formulation of the plan.

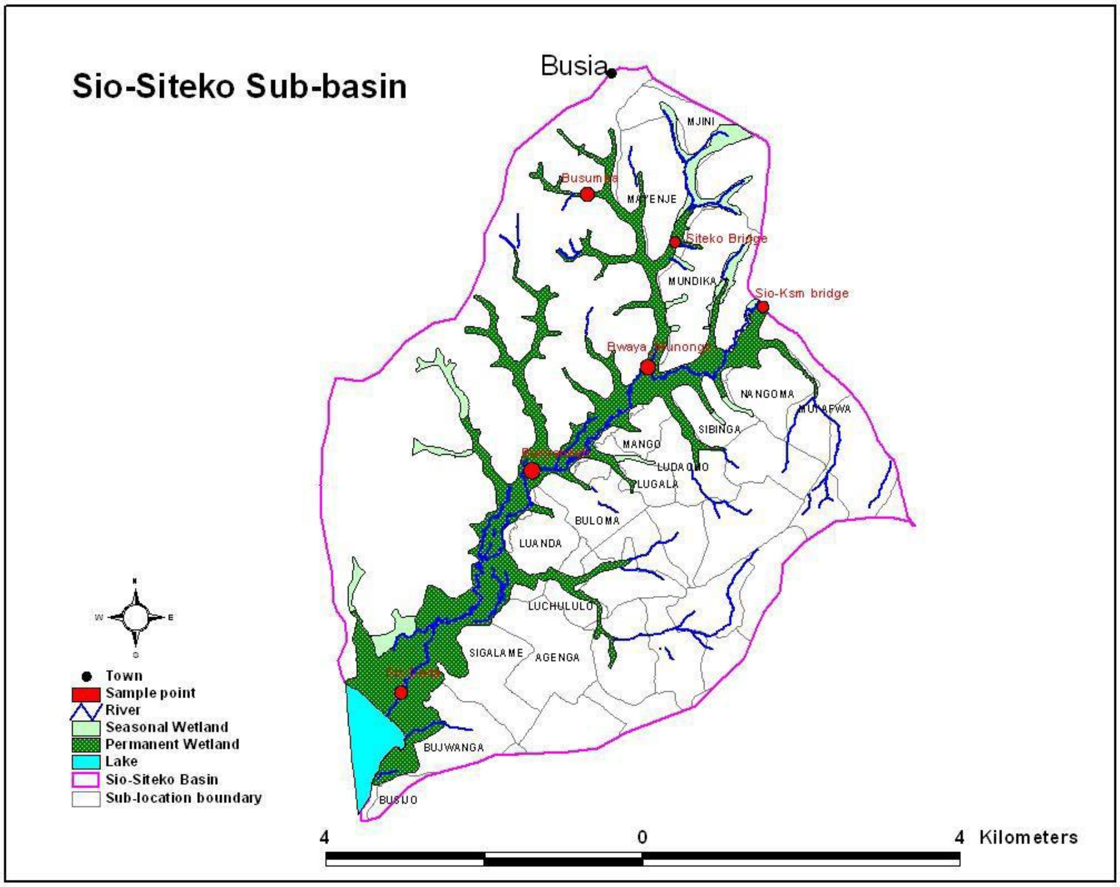


Figure 7.3: Sio-Siteko Sub Basin Plan part of the Lower Sio River Basin
Source: Nile Basin Initiative (2009)

Further, analysis from the Sio-Siteko Sub-basin plan noted that the vision was to be realized through the implementation of the seven outlined community objectives. First, sustainable management of fisheries resources with the aim of increasing productivity and alleviate poverty. Second, mitigating adverse effects of water pollution and reducing waterborne diseases. Third, conserving wetland habitats aimed at reducing wetland biodiversity loss. The fourth objective was to reduce human-wildlife conflict by introducing sustainable conservation measures and alternative sources of income. A fifth was to improve livestock production and security through enhanced health care. Sixth to resolve conflicts and create a harmonious environment that promotes cross-border trade.

Seventh, set up, facilitating and monitoring management plan implementation structures and mechanisms (NBI, 2009).

Among the key issues proposed in the plan was involvement of all stakeholders with emphasis on community participation in monitoring of ecological and socio-economic indicators and implementation structures. However, during the study, it was evident that majority of households in the Lower Sio River Basin did not have any understanding or the existence of this plan. As reported from the interviews with the local administrators the Chiefs and Assistant Chiefs, the process of formulating the Sio-Siteko Community Wetland Management Plan was not all-inclusive, only the assistant chiefs and the households whose land border the Sio River main channel were targeted and participated in the formulation meetings. The sentiments were further acknowledged in the focus group discussions and interviews with the local elders at Nang'oma Sub-location. The chief of Nang'oma Location said: -

> "It was perceived by the organizers of community forums that after training and meetings with the sampled immediate neighbours of the Sio River channel who border the riparian land and the area local administrators, the chiefs and assistant chiefs could use their barasas and other networks to reach other households, especially those who resided on main tributaries of the river. However, without facilitation, inadequate training on the wetland issues and without follow-ups, the intended meetings spill-over effect was never realized. This is the reason why almost all household in the Lower Sio River are not aware of the plan and the plan has never been implemented."

On the other hand, the interviews with the Busia County Principal Environment Officer confirmed that there was lack of ownership of the plan although key departmental heads were involved in its formulation. It was also noted that the plan lacked a practical implementation framework including a committee to oversee its implementation. A study by Komakech and van der Zaag (2011) concluded that watershed conservation and governance can be achieved through improving river committees. In addition, it was confirmed in the interviews that in the first five years of the county government no investments were made to implement the plan since most of the county agriculture and environment stakeholders associated the plan with the Nile Basin Initiative whose projects were closed in the year 2012 in the county. As a result, the principal environment officer said: -

> “There are arrangements to review the plan and make it more adaptable by the county government system before implementation.”

Warner *et al.* (2008) argued that water management approaches are not cast on stone but outcomes of political choices which are based on values and preferences. The choice of a river basin as the most appropriate scale of water management is just a political one; it can be made differently. This is a typical case in the Lower Sio River Basin, adoption and adjustments in the previous non-implemented watershed management plans are needed to enhance the management of watershed resources.

Further, the study noted that there was a possibility of a spillover effect in the reasoning of the management of watershed resources from the neighbouring Yala Swamp Integrated Environmental Management Plan 2016-2026. The plan was produced with the financial support from the Global Environmental Facility (GEF) through United Nations Environment Programme (UNEP). The catchment area of the Yala Swamp is in Siaya and Busia Counties. The plan proposes various management interventions for the watershed resources with a broad vision for the communities and stakeholders in the

Swamp. In addition, the plan provides mechanisms for resource mobilization and a monitoring and evaluation framework.

Nevertheless, this study noted that apart from Sio-Siteko Community Wetland Management Plan, there was lack of a proper adaptable, implementable watershed resource management plan at the Lower Sio River Basin based on the recently formed administrative levels; the county, sub-counties, wards and villages. These are the constitutional administrative levels through which devolution is implemented in Kenya. According to Paavola *et al.* (2005) and Parry *et al.* (2005), in most cases, adaptation activities are more local (that is the district, regional or national) issues rather than international. 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). Therefore, there is need to have watershed resources management plans at these levels for easier resource mobilization and capacity building at grassroots level.

The review of the plans showed that the plans were '*Standalone*' whereby no plan referred to the other; key issues such as common vision and goals, harmonization of implementation, resource mobilization, collaborations, community capacity building were separately addressed in the plans. Although all plans indicated that the processes of producing them were participatory and the target community was the same. The study also noted that there was no proper implementation structure and monitoring framework for the plans either from bottom-up or top-down levels of planning thus failure or non-implementation resulting to poor watershed governance. Consequently, the primary beneficiaries were not aware of the existence of such plans out of which some such as Sio-Siteko Wetland Management Plan had lasted for more than five years prior to the study period. Fiona *et al.* (2013) argued that developing the action plans and concretizing them in work plans enabled the stakeholders to collectively agree on practical solutions to the problems in the basin.

Table 7.3: Summary of the Watershed Management Plan and Governance issues

Watershed Plan	Key Management and Governance Issues addressed
Busia County Integrated Development Plan	• Linking watershed resources management and legislative issues to the socio-economic development of the communities. • Acknowledged the need for capacity building and resource mobilization to enhance watershed resource management. • Called for the integrative approach, guided by the participation of all key stakeholders in watershed resource management. • Acknowledged the need to monitor the impact of development on watershed resources. • Called for equitable distribution and sustainable management of land resources as well as forestry and wildlife resources for improved livelihood and food security. • Called for promoting, conserving and protecting the environment and improving access to water for sustainable development.
Lake Victoria North Catchment Management Strategy	• Outlined a broad vision for the catchment in line with the national vision for catchment management. • Used a rights-based approach and poverty reduction to formulate the management objectives. • Classified the catchment management unit as part of decentralization of the management interventions. • Estimated the water balance and water demand management, water allocation and water use management. • Outlined water resources protection issues, catchment protection and conservation strategy. • Areas for institutional development and collaborations were identified. • Resource mobilization and development of water infrastructure and finally, monitoring and information management.
Sio-Siteko Community Wetland Management Plan (NBI)	• Management vision for the community wetland activities. • Formulated wetland management objectives for the community. • Formulated management actions and activities for the community. • Formulated an implementation strategy for community monitoring and evaluation framework.
Yala Swamp Environmental Management Plan	• Outlined the vision and objectives for the stakeholders in the environmental management of the swamp and its environs • Outlined the management interventions for the Yala Swamp ecosystem • Outlined the resource mobilization strategy, implementation matrix and the monitoring and evaluation framework.

Source: Field data (2018)

Unlike in the Lower Sio River Basin, empirical evidence from Morocco show that watershed management plan is a result of a complex and time-consuming iterative process involving baseline studies, demonstration actions, specialized studies and significant interventions by line agencies under their regular programme of action (FAO, 2017). The Table 7.3 shows the summary of watershed management plans that exist in the Lower Sio River Basin and highlights watershed governance issues in the plans.

Further, studies on watersheds in Ecuador, Morocco and Mauritania proved that well-planned actions and mobilization of different funding sources facilitated the inclusion of all possible partners in plan formulation process. As a result, local people and associations, technical line agencies, local authorities, NGOs, universities and international partners were brought together. The inclusive approach enhanced the trustworthy partnership obtaining observer status in relevant regional and provincial committees (FAO, 2017).

7.4: Policies that Support or Hinder Watershed Management and Households Food Security

When the respondents were asked to name the new social policy programs which were created under devolution that enhanced watershed management for food security in the study area, it was interesting to note (Figure 7.4) that the majority 70.8% (274) of the households in the watershed did not know any new policy not created at the county level or the national level that enhanced watershed management for food security. More findings indicated that 20.9% (81) of the households in the watershed acknowledged the presence of the county environmental policy while 11.4% (44) acknowledged the presence of water services provision policy. Out of the interviewed respondents in the study, 7.2% (28) felt that agricultural development policy existed as a new social policy to guide watershed management activities towards food security.

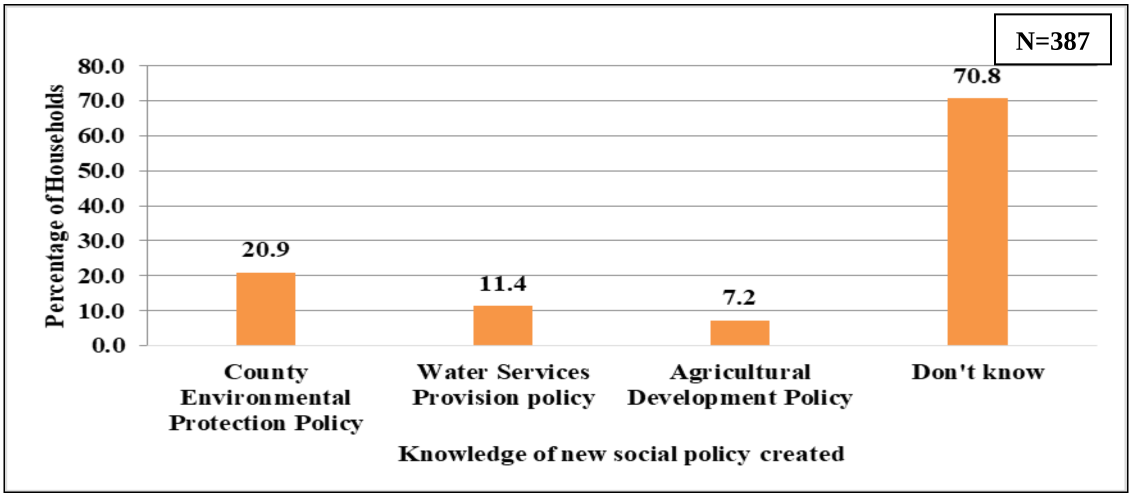


Figure 7.4: New Social Policy Identified at National and County Governments level by the Households
Source: Field data (2018)

FAO (2006) noted that some of the policies whether at macro or micro levels may affect agriculture more than other socio-economic sectors of the economy, hence, policies can be classified into pricing and marketing, including marketing institutions; research and extension; land, credit and financial institutions, including the role of cooperatives; infrastructure investment, including transport and irrigation; food security and self-sufficiency; and agricultural input policies (Kang'ethe, 2006). Although county government policies such as Agriculture Development Fund Act 2014 and Co-operative Development Fund Act 2014 and Busia Water and Sewerage Company Act 2015 were formulated after devolution, the study established that there lacked a direct policy in county environmental management reason being that the functions were not fully devolved to the counties. These policies were envisioned to provide adaptive assistance to the households in agriculture, water and environmental management sectors, the majority of the household beneficiaries were not aware of such policies, their functions and how they could be assisted.

The findings revealed that the service providers for the period 2013 to 2018 of devolution in Busia County did not build the knowledge of the households on various policies at the grassroot. Consequently, there was lack of ownership of the policies at the county level by the primary beneficiaries which in most cases compromised implementation and sustainability of the watershed management and food security policies and programmes. Success in environmental policy should be redefined by how it promotes and facilitates resilience, and by how it promotes legitimate, a broad-based development that allows individuals and societies to cope with risk and adapt to changing circumstances over time (Adger, 2003).

Although the above findings show that majority of the households did not know the new social policy created under devolution that enhanced watershed management for food security, a Chi-square test carried out on the households responses presented in Table 7.4 indicated that there was a high variation among the households with food security and households with food insecurity on knowledge of the county environmental protection policy, water services provision policy as well as those households who indicated that they did not know any new social policy at p-value=0.000. These findings implied that the knowledge of the new social policy on watershed management and food security activities was important in determining the status of household's food security.

Table 7.4: Food security and Insecurity households' measurement comparison association amongst households knowledge on the new social policy created under devolution that enhanced watershed management for food security

Policy programs	Food insecurity (n=214)	Food Security (n=173)	Differences	χ^2	p-value	Significant ?
County Environmental Protection Policy	5.1	40.5	35.4	72.121	0.000***	Yes
Water Services Provision policy	4.7	19.7	15.0	21.304	0.000***	Yes
Agricultural Development Policy	5.1	9.8	4.7	3.130	0.077*	Yes
Don't know	87.4	50.3	-37.1	63.673	0.000***	Yes

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

Source: Field data (2018)

Like in other watersheds in the modern world, sustainable development and environmental management policies in the Lower Sio Basin are no longer an affair of a single local and national government but rather a global and or international affair. The policy frameworks in most developing countries are driven by international nongovernmental organizations with interest in perpetuating the demands of their mother nations. Mfune (2012) argued that a key danger to the developing countries like Kenya is that these organizations leave little room for the countries to articulate their own visions of the future which end up raising the questions of ownership of the policies and initiatives planned in areas such as local watershed management. For example, the World Bank and International Monetary Fund (IMF) Structural Adjustment Programmes (SAPs) policies in the late 1980s and 1990s contributed to the reduction in government expenditure and expansion of private sector in the provision of services to the public, affected to a larger extent is provision of government agricultural extension services which contributed negatively to watershed management and food security (Nyangito, 2001).

Moreover, the introduction of the demand driven approach under the same policies has never worked effectively in communities characterized by low level of education, lack of information and low public participation in government-owned development forums such as the Lower Sio River Basin communities. According to Nyangito (2001) policies that affect agriculture are made up of government decisions that influence the level and stability of input and output prices, public investments, costs and revenues, and allocation of research and development funds to improve farming and agriculture-related processing technologies. Some of these policies fail due to lack of political will, low technical and financial capacity and weak institutional arrangements, in addition to lack of harmony with local realities (Mfune, 2012).

The analysis of development policies and legislation indicate that since independence in 1963, Kenya has been attempting to address issues of environmental sustainability and food security all together in its economic and social planning processes through national policies and development plans. These efforts have yielded fruits in some cases while in others not much has been achieved, more emphasis put on efforts to promote food security without much consideration of soil and water management which are the basis of food production. Currently, there are various policies and legislative frameworks that aim at promoting watershed governance and food security that have undergone transformations to adapt to the requirement of the Constitution of Kenya 2010 and changing socio-ecological circumstances as presented in Table 7.5.

Table 7.5: Policy Derivatives of Watershed Governance under the New Devolved System in the Lower Sio River

Key Element of watershed governance	County framework	Kenya (National) framework	International Framework
Decentralized environment and natural resources management thus contributing to adaptive capacity	Agriculture Development Fund Act, 2014; Cooperative Development Act 2014; Public Participation Act 2016; Water and Sewerage Services Act 2015	Constitution of Kenya (2010), EMCA 2015, Forest Conservation and Management Act (2016), Intergovernmental Relations Act (2012), National Government Coordination Act (2013),National Drought Management Authority Act (2016), National Land Commission Act (2012),Wildlife Conservation and Management Act (2013), Environment and Land Court Act (2011), County Government Act (2012), Draft National Wetlands Conservation and Management policy (2013), Agriculture and Food Authority Act (2013),CDF Act(2017), Climate Change Act (2016), Water Act (2016) NEAP, National Food and Nutrition Security Policy, 2011; National Biodiversity Strategy and Action Plan, 2007	Agenda 21 Chapter 28 on the role of major groups and Local Agenda Rio Declaration (Subsidiary Principle) Forestry Principles
Sustainable Land use Conservation Agriculture, Agro-forestry for food security	Water and Sewerage Services Act, 2015; Agriculture Development Fund Act, 2015; County Road Infrastructure, 2016;	Vision 2030, National Land use Policy, Agriculture Policy, National Environmental Policy (NEP), Constitution of Kenya 2010, County Government Act (2012); Kenya Agriculture, Fisheries and Food Authority (AFFA) Act	Agenda 21 on Sustainable Agriculture UNFCC, Convention on Biological Diversity

Source: Field data (2018)

Watershed governance includes action at the national, county, sub-county, ward and village levels. Thus sound national and county policies and efficient institutions at all levels are essential in setting up a coherent normative framework aimed at guiding local arrangement and interventions in a consistent way (FAO, 2017). The Constitution of Kenya (2010) presents the boldest move by National and County Governments towards the achievement of watershed governance and food security goals. The constitution spells out the responsibilities of both governments. Under the Bill of rights: every person has a right to a clean and healthy environment, which includes the right; to have the environment protected for the benefit of the present and future generations through legislative and other measures, particularly those contemplated in Article 69; and to have obligations relating to the environment fulfilled under Article 70 (GoK, 2010b).

On the other hand, the constitution provides for the right to food for all Kenyan people. Therefore, both levels of governments must not take actions that result in increasing levels of hunger, food insecurity and malnutrition. Further, the government must use its resources to eradicate hunger (African Women's Studies Centre, 2014). As evidence of an adaptive institution, all major pieces of legislation (Acts) and regulations that existed before the Constitution of Kenya (2010) have undergone through ratification and amendments to conform to the spirit of the constitution thus calling for a shift in watershed governance in Kenya.

During the study, household respondents were also asked whether watershed management policies and programs mutually reinforce food production and distribution in the Lower Sio River Basin. The illustration in Figure 7.5 shows that 51.7% (200) of the households did not know, 34.6% (134) of the households indicated that watershed management policies and programs did not mutually reinforce food production and distribution in the watershed. However, only 13.7% (53) of the respondents agreed that watershed management policies and programs mutually reinforce food production and distribution in the watershed. The findings are similar to Makarius *et al.*, (2015) finding who found out that in Pangani River Basin in Tanzania, the majority of the smallholder farmers and their water users' association leaders did not know or were not aware of water rights policies.

According to focus group discussions the respondents in the study area attributed this to their exclusion in the policy-making process and lack of implementation of policies at the local level for all. There were also concerns that soil and water management were never considered in the local level policies. Fiona *et al*. (2013) in the study in Ngenge watershed in Uganda noted that during the implementation of Local Government Act (Uganda Government, 1997). It was found that decision making power to the people to solicit stakeholders' views resulted to democratically elect local councils at various administrative levels, and empowerment to develop and implement policies. Consequently, bylaws were enacted and passed on agriculture and food security; however, complementary policies were needed concerning the use of soil and water resources (Opio *et al.*, 1998, Fiona *et al.*, 2013).

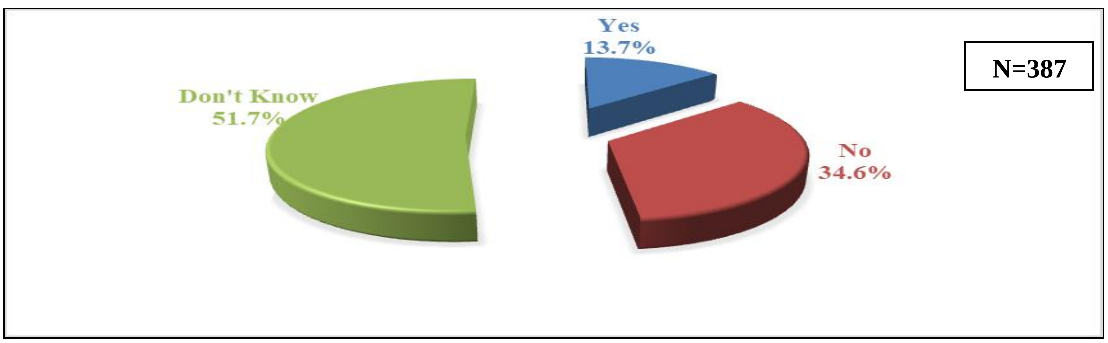


Figure 7.5: Contribution of Watershed Management Policies to Food Production and Distribution
Source: Field data (2018)

From the analysis of the policies and pieces of legislation, the study found that the process of devolving watershed resource management to local communities in Kenya appears to have taken three different paths: the management of natural resources spearheaded by the national agencies such as Kenya Forestry Services, Kenya Wildlife Services, NEMA, Kenya Water Towers Agency among others who draw their budgets directly from the national government treasury. Second, those initiatives spearheaded by the county government departments whose budgets are appropriated by the county assemblies and drawn from the county treasury. Third, are the conservation and management initiatives by the civil societies and non-governmental organizations that draw their finances from donor funding. It emerged from the key informants' interviews that, each of the actors struggles to embrace the donor at the expense of the common man who is the intended primary beneficiary. The challenges as earlier noted are the new policy initiatives that arose as a result of devolution in these three categories of actors that are poorly linked and are characterized by overlapping conflicting mandates. This was confirmed during the interview with one of the local administrator who said: -

> "These people (NGOs) who come here to help us, are always conflicting with each other in the manner in which they provide farming services to us. We understand their aim is not to help us solve our soil resources management problems but to promote the interests of their donors and make the profit from us. For example, we have had WKCDD/FM and PALWECO here, barely a year ago, and we cannot trace anything they left behind. At the same time One Acre Fund is here purporting to help us access to farm inputs through credit, but when the season weather patterns fail to support good yields, we cannot afford to pay them. They auction our property and in most cases, my colleagues who were members to such schemes have suffered unintended loss leading to increased poverty around here."

Further analysis showed that as a result of uncoordinated agricultural production farmers and the environment have suffered to a greater extent. Existing evidence showed that to provide coordination in agriculture sectors in Kenya under the Constitution of Kenya 2010, the Kenya Agriculture, Fisheries and Food Authority (AFFA) Act 2013 provides for the establishment of the Agriculture, Fisheries and Food Authority to administrate matters of agriculture, preservation, utilization and development of agricultural land and related matters (GoK, 2013). Given that agriculture is a fully devolved function, the Act provides that the Authority shall in consultation with the county governments among other stakeholders: administer the Crop Act No. 16 of 2013 and the Agriculture, Fisheries and Food Authorities Act No. 13 of 2013. This is aimed at promoting best practices in, and regulating; the production, processing, marketing, grading, storage, collection, transportation and warehousing of agricultural and aquatic products (GoK, 2013; African Women's Studies Centre, 2014).

At the county level, there are several government departments and non-governmental organizations involved in watershed management and agricultural production with the presence of the national level in the Lower Sio River Basin. During the interviews with the CDALD staff, it was said:-

> "Although agriculture and environment management policy functions are supposed to be handled by the national government, the national government was in the process of decentralizing national operations through various departments and authorities to the county levels; sub-counties and wards levels."

As Koontz *et al.* (2015) puts it collaborative governance shares many features with polycentricism, a similar situation to Kenya today. For example, collaborative governance for environmental issues such as watershed management is marked by overlapping boundaries (watersheds that cross political jurisdictions such as wards, sub-counties and counties in Kenya and trans-boundary in case of Sio River between Kenya and Uganda) requires a polycentrism policymaking approach. The focus is needed on a particular issue, and power sharing across multiple jurisdictions (Schlager and Blomquist, 2008). Such political jurisdictions make it complex for adaptive co-management of the watershed thus requires collective and integrated approaches across scales.

It emerged from the interviews with key informants that there were a limited integration and collaboration between non-governmental and governmental organizations, most organizations worked in the same areas and duplicate programs (GoK, 2016b). One of the key informants said: -

> "To harmonize the work of all stakeholders operating in the agriculture sector at the county level, the CDALD has been developing a Sector Co-ordination Concept which has since stalled due to differences in political interests."

Studies in governance indicate that institutional fragmentation across jurisdictions, unequal power among river basin actors in different jurisdictions, a potential for high levels of political conflict, and differences in a culture of decision making contribute to problem contexts and can undermine efforts to make the science and policy interface work better (Levin *et al.,* 2012; Armitage *et al.,* 2015). A male respondent in the group discussions in Nang'oma location said: -

> "The devolved services at the county level are characterized by politics, tribalism and nepotism. The county leaders are blamed to take development and more so watershed conservation interventions to their home communities and in areas where they received much support during the elections."

Due to conflict of interest, the CDEWNR concentrated more on the rehabilitation and management of River Malakisi and not Sio River by engaging the women and youth groups to form WRUAs. While along Sio River there lacked an active WRUA to be utilized by the County government in watershed management, WRUAs under the Water Act 2016 are formed and facilitated by WRA. This was attributed to the fact that the Committee Member for Environment Water and Natural Resources equivalent to the

Minister in the National government came from Teso North Sub-county where River Malakisi is the main source for domestic water and where the Governor received many votes in 2013 general elections.

According to African Women's Studies Centre, (2014) due to the highly cross-sectorial nature and the multiple dimensional food security related issues and initiatives, a very large number of relevant legislation, policies and strategies were carefully reviewed and considered. Most sectors of the national economy, during the formulation of the Food and Nutrition Security Policy (2011) as part of the institutional memory in the process were included. Nelson and Stathers, (2009) note that institutional memory of past climate events and traditional knowledge have dominated adaptation experiences among local communities in Kenya. The aim was to understand and build from existing Government and partner initiatives rather than duplicate such efforts, identifying and building on such complementation. The FNSP is framed in the context of the Constitution of Kenya 2010 therefore, providing for basic human rights, child rights and women's rights including the universal Right to Food (GoK, 2011).

On the other hand, Kenya Vision (2030) although diverted environment management as one of the key pillars of sustainable development to include political as a key pillar in addition to economic and social pillars of development; it is a long-term development blueprint and a significant government policy document that aims to boost sustainable food security and watershed management in the country through various flagship projects. The outlined development projects include; improvement of infrastructure, conservation of soil and water resources and development of irrigation schemes, among others. The vision for agriculture sector is to be innovative, commercially-oriented and to develop a modern farm and livestock sector (GoK. 2007) while taking into consideration soil and water resources management. Therefore, Vision 2030 forms a key driver for watershed governance and food security policy tool upon which both national and county government activities are supposed to be housed. In Kenya, like any other country where the central government provides an annual development budget to local communities and county governments to finance part of their local development plans. It is more prudent to enrich existing plans with principles, elements and practices of watershed management (FAO, 2017).

7.5: State and Non-State Actors in Watershed and Food Security Activities

During the analysis of the LVNCMS it was evident that there was a general common understanding of the root causes for deficiencies in integrated co-operation in water resources management in the catchment at policy level, including Lower Sio River Basin: Insufficiency in resources; lack of adequate co-governance; inadequate knowledge and skills at the community level; inadequate community engagement; lack of public awareness of the values of the catchment assets; and lack of integrated concept for water resource management (GoK, 2007). Similarly, Sanginga *et al.* (2004) found that despite considerable progress in local government reforms in Uganda, policy-makers sought information only to a limited extent from communities in formulating policies. When asked to identify the main actors in watershed governance the participants in key informants' interviews and FGDs response was summarized in Table 7.6a and 7.6b.

Table 7.6a: Actors involved in Watershed Governance and Food Security

Actor category	Actors	Role in watershed governance	Objectives in watershed governance implementation
Local community members, farmers associations	Households and farmers groups	Resource users, implementers of activities	Improve livelihood through food production
Local National government administration	Chiefs and Assistant chiefs	Resource users, enforce national government policies	Improve livelihoods, mobilize community to implement policy
Local County government officers	Village and ward, administrators, and managers, ward Agricultural extension officers	Implementers of county government policies and plans	Act as mobilizers, technical advisors and oversee county policy implementation
Sub-county county government officers	Environment, Water, Agriculture, Fisheries officers	Implementers of county policies and plans	Technical advisors, capacity building, mobilization of resources and farmers
County and District, National governments officers	County Commissioner, Assistant county commissioners	Implementers of national government policies	Coordination and administrative roles, enforcement and oversee implementation of national government policies
National government departments and agencies	KFS, NEMA, WRUAs, KWS, KALRO, KEFRI NIB, IWUAs, CAAC, LVBA, County Meteorology National Assembly and Senate representatives	Management of natural resources, Formulate national government and policy advisors Appropriation of national government budgets	Technical implementers of national government policies. Enforcement of national policies Formulates national legislations and regulations
County government departments	Environment, Water, Agriculture, Fisheries, Irrigation, BUWASCO, ADF, Cooperative, Social services officers, and County Assembly	Utilization and management of natural resources, Formulate county government policies and advisors Appropriate county government budgets	Technical implementers of county government policies, Training and capacity building of community members, Formulate legislations, Enforcement, and oversights implementation of county policies,
Financial Public and Private institutions	KCB, Equity, National Banks, KWFT, CDF, UWEZO and Youth Funds, AFC	Financing watershed and food security activities	Providing financial support to community groups and individuals and trainings on agri-business management

Source: Field data (2018)

Table 7.6b: Actors involved in Watershed Governance and Food Security

Actor category	Actors	Role in watershed governance	Objectives in watershed governance implementation
Private entrepreneurs	Agrochemicals and seed companies value chain	Supply of agricultural farm inputs	Trade in fertilizers, seed, pesticides
Donor/International NGOs programmes	PALWECO, (WKCDD/FM), ASDSP	Funding, implementers of policy	Mobilize funds for projects, offer technical advice to county and community
Local NGOs	ADS western, One Acre Fund, IPA, Hand in Hand, SIMPACT	Support environment and agriculture policy implementation	Provide financial support, mobilize resources and educate the community
CBOs, FBOs	Community groups, Churches	Empowerment of members on policy	Training, education and awareness creation

Source: Field data (2018)

Based on the study findings in Table 7.6a and 7.6b, in the Lower Sio River Basin, there are various actors involved either directly or indirectly in watershed governance and food security activities (see full list Appendix II). The stakeholders include; Community members and groups, National Government departments and authorities, County government departments, programmes co-funded by international donors and Kenya National Government, International and local nongovernmental organizations, financial institutions private business enterprises, research institutions.

Studies reveal that multi-stakeholder initiatives are increasingly established globally to promote collective forms of watershed governance as well as creating discussion platforms where diverse stakeholders from the public, private and civil sectors can collaborate to improve the management of natural resources and, more broadly, to address complex development challenges that cannot be solved by one party alone (FAO, 2017). During interviews with various key informants and community participatory workshops, the study established that the actors have different operational models and approaches to watershed management and food security. Some have different interests and targets as well as means of mobilizing resources and the community towards watershed management and food security.

The study found that throughout the watershed, households were largely composed of farmers who had mobilized themselves into groups by the help of own initiatives and actors from the non-governmental organizations. Thus formed Common Interest Groups (CIGs) whereby community members organized themselves together to achieve a common purpose (FAO, 2005a; 2017). Examples of community groups listed by the respondents were groups mobilized to engage in activities of WKCDD/FMP, PALWECO, One Acre Fund, and ADS Western, Hand in Hand among others. One of the Female respondents at Syekunya Location said: -

> "Most farmers' groups are trained and capacity built by the mobilizing organizations in their areas of interest. Examples, One Acre Fund groups we are trained in land preparation, seed planting, harvesting and storage of farm produce. While Hand in Hand and ADS Western, groups are trained on table banking, merry-go-round for financial mobilization and financial management alongside the formation of farmers groups to access government and other donor services."

Based on Jayne *et al.* (2006) and Patt *et al.* (2012) argument, farmer-driven organizations success depend on how well they coordinate with both public and private sector players to streamline food and natural resource systems and without excluding smallholders. This plays a key role in whether or not small farmers were able to take up improved practices that will allow them to adapt to their changing circumstances and, in the longer run, to a changing climate and social systems as well.

Further, interviews and group discussions revealed that the organizations also linked the community to the county and national government technical officers. For example, the groups were mobilized by ADS to register and license by the County Department of Social Services and Department of Cooperative Societies Management, and obtained legally recognized certificates of registration. This was done after the groups were trained to come up with group operational by-laws and group constitutions for regulation of members' activities and behaviour. Evidence shows that working with individual households requires more attention, resources and efforts than working with households organized in a group (FAO, 2017). One of the female respondents at Kisosko Location said: -

> "Before community groups are legally recognized, the groups elect the leaders to manage groups' affairs. After the registration, the groups open bank accounts where monies from members' contributions or donor-financed activities are channeled. The same was done in community interest groups (CIGs) which were used to implement and benefited from the WKCDD/FM and PALWECO programs."

Fiona *et al.* (2013) found that in Ngenge watershed in Uganda, apart from associations, farmers mainly interacted through farmers' groups that were not successful except in a few areas midstream. Therefore, to facilitate the groups, building capacity for co-operation with government departments was necessary. Another important strategy was to form partnerships within the watershed and link farmers to other stakeholders who have the knowledge they needed (Kessler, 2006). A male respondent in Namboboto Location said: -

> "Community groups have failed to integrate all community members interested in the activities. As a result, the majority of those not in groups do not benefit from the group activities. In addition, there are concerns that the community groups in most cases benefit from multiple donor actors for the same activities resulting in duplication and embezzlement of funds for projects from donor organizations."

The finding was similar to the situation found in Ngenge watershed (Fiona *et al.*, 2013) during the stakeholder analysis; it was found that categories of key stakeholders were always avoided at the community level watershed forums. Among them were highly influential people such as elders, religious leaders, retired civil servants, and the security forces, and specific types of farmers living under marginal socio-economic conditions, such as tenant farmers, who may not be interested in soil and water conservation. This is because they did not own the land, and landowners, who may not be very much involved in land management because they mostly hire out their land. Moreover, the majority of the households during the focus group discussions felt that the groups were formed for short-term agendas and collapsed upon the end of the main donor engagement. Rastogi *et al.* (2009) contended that it was possible within one stakeholder group such as a community, diversity of perception to occur, making the possible further breakdown of other groups and thus bringing other factors into play.

The interviewed community members were concerned that they did not prioritize most of watershed management activities such as soil and water management activities, including: as terracing, the building of gabions, tree planting, use of organic manure, cover cropping among others because these activities were not the main project agenda of the donor organizations. Similarly, it was argued that some of the soil and water conservation projects were easy targets for corruption after the allocation of funds by the County government and donors. One male respondent in Nang'oma Location said: -

> "There was an allocation of KES. 20 Million= USD 20,000 for tree planting on the hilltops in Matayos and Funyula Sub-counties by the County government in 2014/2015 county budget. The tree planting was never implemented while funds were allocated and disbursed; the matter was forwarded to the Senate for investigation and sanctioning of the culprits by Kengele Forum a civil society group in Busia County. Until now, no response has been given to people of us concerning the matter at the Senate."

Such misallocation and corruption are governance problems (Mathews, 2012) which need to be addressed for future efficiency of watershed management. Furthermore, a male respondent at a focus group discussion held at Musoko Location said: -

> "Organizations such as One Acre Fund and Innovation Poverty Action whose programme approach is to offer farm inputs on credit or inform of loans to us farmers were harassing us when it comes to repayment of the loans. The household heads attributed this to the fact that farming activities in the watershed are dependent on weather conditions. In most cases, we incur losses when crops fail due to unfavourable weather conditions such as insufficient rainfall."

However, the farmers were expected to repay the loans as agreed at the inception of the contract. The organizations neither insured nor waived loans during unfavourable weather conditions which resulted in farmers' losses, the perpetuation of poverty and collapsing of the farmers' groups. Thus the households raised concern with the manner in which such actors' activities were not regulated by the county to stop the exploitation of poor farmers. Another key actor in the study was the County Government of Busia. According to the Constitution of Kenya (2010), in the Fourth Schedule on the distribution of functions between the national government and the county governments is captured in

Part 2. The functions and power of the county covernments in relation to watershed management and food security include development of agriculture both crop and animal husbandry and to develop county transport including the establishment of county roads.

Trade development and regulation include cooperative societies together with county planning and development including land survey and mapping. Implementation of specific national government policies on natural resources and environmental conservation, including soil and water conservation and forestry, county public works and services, including storm water management systems and water and sanitation services. Disaster management and ensuring and coordinating participation of communities and locations in governance at the local level and assisting communities and locations to develop the administrative capacity for the effective exercise of the functions and power and participation in governance at the local level (GoK, 2010).

To deliver the constitutional mandates, the County Government Act (2012), established the County Executive and County Assembly arms of the county governments. The county executive is made up of county government departments that are mandated to provide devolved functions services to the citizens while the county assembly is mandated to represent, legislate, oversight, appropriate county budgets and approve development plans made by the county executive departments (GoK, 2012). However, one male youth respondent at Nambuku Location said: -

> "Members of the County Assemblies (MCAs) who are the elected members at the ward level have not invested in legislation and oversight on programmes related to watershed management and food security at the ward level. MCAs are allocated Ward Development Funds (WDF) to enable the wards they represent prioritize community developments but still, watershed management is not prioritized. This is made worse by low levels of knowledge and skills among the MCAs in watershed management and food security strategies."

The discussions proved that some of the MCAs do not possess higher levels of education and majority had the only secondary education. The County Government Act (2012) did not spell out the minimum qualifications for the MCAs. An example given at Nambale group discussion was the failure of the County Assembly to pass the Busia County Biodiversity Policy, (2016). The policy was developed by KALRO in collaboration and funding from FAO. The failure to enact and pass the policy in the County Assembly was attributed to low levels of knowledge on the importance of the drafted policy in conservation, management and preservation of watershed resources at the county level for food and nutritional security. This is despite the fact that losses of biodiversity and food insecurity were main developmental challenges in the county.

Another concern from the community workshops was that the county departments were not working in harmony since there was lack of coordination for collective delivery of the devolved functions that was occasioned by the struggle based on tribal lines. For example, what goes to the Luhya side and what goes to the Teso side, the main communities in Busia County among the County Executive Committee Members (CECs) and Chief Officers (COs) over control departmental financial resources. A key interviewee who worked with the county government said: -

> "The departmental directors and other technical staff are not well facilitated to provide services to the ordinary citizens in the watershed. Although there is a County Integrated Development Plan (CIDP), the county departments lack a common vision and goal on the utilization and management of watershed resources for food security. An example is the housing of the County Directorate of Irrigation, initially, the directorate was housed under the CDALD, and however recently, the directorate was transferred to the CDEWNR."

This led to confusion and misunderstanding of roles and responsibilities of the Directorate of Irrigation, how it was supposed to be facilitated to provide services to the citizens. Further, some key informants urged that the directorate was responsible for the provision of water for crops and thus played a key role in ensuring food security and thus should be housed under the CDALD. While other key informants observed that the Directorate of irrigation utilizes water resources, therefore, for its effectiveness and efficiency in the allocation of county resources it was worth to be housed under the CDEWNR. Adaptability of the departmental structures at the county level with the aim of delivering intended services to the citizens is important. Since adaptive institutions are able to cope with multiple ambiguous objectives inherent in such social-ecological systems (Pahl-Wostl, 2009). The respondents felt that the lead county departments such as CDALD and CDEWNR had not put in place a mechanism to regulate watershed activities of other actors such as local non-governmental organizations a reason for advancing watershed resources degradation in the Lower Sio River Basin.

Alongside the departmental limitations, the county assembly was also blamed for failing to make laws, appropriate budgets, represent and provide oversight on watershed management and food security in the county. During the group discussions at Namboboto shopping Centre, community members indicated that the grassroots county officers such as Ward Agricultural Extension Officers were not well facilitated to provide extension services to the farmers in watershed management; alongside carrying out other functions the majority were left at the mercy of the MCAs thus perpetuating partisan interests and exclusion in provision of service to the farmers.

Under the Fourth Schedule of the Constitution of Kenya (2010), Part 1; the National Government functions that relates to watershed management and food security include: the use of international waters and water resources, securing sufficient residual water, hydraulic engineering and the safety of dams; protection of the environment and natural resources with a view to establishing a durable and sustainable systems of development, including fishing, wildlife, water protection; disaster management; and agricultural policy development. As a result, various national governments ministry departments and authorities are mandated to operate in the Lower Sio River Basin to actualize the constitutional mandates of the national government. These include; KFS, NEMA, WRUAs, KWS, KALRO, KEFRI, NIB, IWUAs, CAAC, and LVBA. During the key informant interviews, the study found out that some departments including NEMA, KFS and KWS were understaffed at the county level.

The study noted the need to tackle the challenge of low community engagement in forestry services and environmental management in the Lower Sio River Basin. The County Director of Forestry indicated that the KFS County Department had promoted the establishment of Eco-Green Kenya, a local based Youth-led non-governmental organization. KFS helped the organization in the mobilization of youths, capacity building and networking with other actors in environment and forestry conservation and management. The respondent further observed that the NGO was housed in county KFS compound so that it promotes community engagement in environment and forestry services in collaboration with KFS. KFS County Directors said: -

> "Eco-Green Kenya NGO in 2016 secured KES.6 Million=USD 60000 from Kenya Commercial Bank (KCB) as cooperate social responsibility. The funds were used by the NGO and KFS to engage the community in tree planting and soil conservation activities at Siteko wetland areas thus contributing to the implementation of the Sio-siteko Community Wetland Management Programme. In addition, the NGO is being used by KFS and KEFRI to promote the planting of the bamboo tree and Eco-tourism across the watershed and the county in general."

The findings from key informants' interviews including the local administration such as Assistant County Commissioners, Chiefs, and Assistant Chiefs showed that there was a gap left in enforcement and implementation of national environmental conservation and agriculture development laws at the grassroot created by the devolved system of governance. It was revealed that the former district, division and location level agriculture committees under the provincial administration were used to ensure that all stakeholders in agricultural production were coordinated and activities regulated. However, the best practice was missing upon devolution in the year 2013.

It was further reported that the grassroots committees were well integrated into the Provincial Agricultural Board and National Agricultural Board which were mandated to make agricultural decisions at different level of jurisdictions. Furthermore, it was reported that the committees were all inclusive and comprised of the representative from; farmers at the location and divisional committees, district agricultural officer and other key agricultural stakeholders at each level. More so, the respondents singled out a gap in watershed governance that resulted from the abandonment of the famous Chiefs Act in Kenya. Assistant County Commissioner at Funyula said: -

> "The Chiefs Act gave the Chiefs and their Assistants powers to enforce, soil and water conservation and management activities such as terracing, the building of gabions, maintaining 30 Meter Buffer zone in the riparian zones which promoted watershed management in the riparian zone. They also prevented farmers from harvesting and selling food crops before maturing such as green maize as a measure to food security. Currently, under the national and county governance system, the Chiefs and their Assistants do not have same powers to enforce soil and water conservation and management activities leading to the increased destruction of soil and water resources in most parts of Kenya."

According to the interviews with the Assistant County Commissioners, the current National Government Co-ordination Act (2012) does not expressly give any powers to the establishment, roles and responsibilities of the chiefs and their assistants' thus promoting negligence of watershed conservation at the community level. The researcher witnessed a chief at Musokoto location adjudicating on sand harvesting matter that had been presented before the chief by a widow who alleged that two male youths had trespassed to her land to harvest sand. During the hearing of the matter, the chief had only to use threats to stop the youth from such activities but could not arrest and sanction the culprits as before the current governance system. The interviewed chiefs and assistant chiefs also blamed the county system for neglecting their role in the governance at the wards and village levels. The Chief at Musokoto Location said: -

> "We and our assistants' roles were taken away by the county ward administrator and village administrators who do not understand very well their role in soil, water management and food security. The wards and villages administrators are blamed for promoting exclusion and partisan interests at the expense of service delivery for all at the community level and serve the interests of their bosses at the county headquarters."

On the other hand, the study revealed that the existence of Intergovernmental Act of (2012), spelt out how the national and county governments were supposed to work together to ensure good governance and service delivery to the citizens under devolution. However, there was total lack of proper co-ordination between the national and county government departmental functions at the county level. This was attributed to differences that arise on who should control financial resources although the target primary beneficiaries were the community members. The example given during the interviews with key informants was the working relationship between the National Irrigation Board (NIB) and the County Directorate of Irrigation. The NIB was created by an Act of parliament as an independent institution mandated to carry out irrigation water supply projects for large-scale irrigation schemes countrywide.

According to the interviews, the NIB activities were regulated by the NIB Act, which mandated the board to implement huge flagship irrigation projects with the aim of providing water for crops and thus promoting food security. However, it was noted during the interviews that the board operates in the county using same community members and resources that are under the jurisdiction of the county government, but the county government could not hold the board accountable for irrigation activities in the county nor the board was mandated to work with the County Directorate of Irrigation to implement the projects such as the Lower Sio River Irrigation Project. Empirical studies show that investment in irrigation increases yields of most crops by between 100 and 400 per cent (FAO, 2009). In Kenya, there was the need to harmonize irrigation policies to have an arrangement (regional irrigation water boards) whereby provision for irrigation water is decentralized similar to the provision for domestic water under the Water Act of 2016.

The governance structure formed to manage irrigation water was parallel to community structures that manage water resources under the Water Act, 2016. The study observed that under irrigation practices, Irrigation Water User Associations (IWUAs) were formed at the community level as key community structure in the management of irrigation waters, however, IWUAs were supported by neither the county nor national legislations although were considered as a subset of (WRUAs) which were establishment of the Water Act (2012) now Water Act, (2016) formed at the community level. Based on the interviews, this was a potential source of conflict in the watershed over the use and management of water resources due to different interests among irrigation and non-irrigation water users.

Key informants were concerned that harmonization of irrigation legislation was required for the efficient and effective provision of water for crops. More so, the draft National Irrigation Policy had not been enacted. To make it worse it was reported that the County Directorate of Irrigation was not supported by any legislation at the county level making it difficult for resource allocation under devolution. The respondents also noted that in the Lower Sio River Basin, lacked a registered and active WRUA as envisaged in the Water

Act (2016); the County Director of Forestry also confirmed absence of Community Forestry Associations (CFAs) to help in watershed management through forestry management despite the report that the tree cover in the county was below the required 10% (GoK, 2013b).

Based on the key informant interviews it was also indicated that different political interests at the watershed level were possible due to the existence of the actors from the national and county government. The reasons advanced for this argument was that the national government was implementing the Jubilee rulling party (National government political alliance) government manifesto or development agenda, while the county government was implementing its own agenda inclined towards the National Super Alliance (NASA opposition political alliance) development agenda. As a result, the interviewees indicated that there were possibilities of conflicting projects at the watershed level based on political rivalry on watershed management for food security. An example given was the stalled Lower Sio Basin Irrigation Scheme Project, which was the national government project financed and implemented through NIB.

It was reported that the county government and other county leaders such as the Members of Parliament (MPs) did not have the direct mandate to hold NIB accountable to complete the project. Elsewhere, the Colorado Basin Study pointed at multi-agency and multi-government effort to offer an example of how a broad array of non-state and state actors in a watershed, along with diverse scientific expertise, can be brought together to re-define watershed management problems, and to incorporate science into decision making about current and projected challenges (United States Department of the Interior, 2012). This was not the case at the Lower Sio River Basin where actors' conflicts were always expected. Elsewhere, FAO (2017) observed that managing collaborative action and planning at the watershed level is an increasingly popular approach for balancing local needs, global challenges and addressing both environmental protection and food production goals.

7.6: Collaboration and Approach in Watershed Governance and Food Security

Results showed in Table 7.7 that in the Lower Sio River Basin, there were collaborations among actors. These included; Government of Kenya and other International Governments; National and County government departments, Western Kenya Community-Driven Development and Flood Mitigation (WKCDD/FMP); Programme for Agriculture and Livelihoods in Western Communities (PALWECO); Agricultural Sector Development Support Programme (ASDSP); Anglican Development Services (ADS-Western) and Agriculture Development Fund (ADF) among other actors. This is exhibited by the global requirements of Agenda 21 that called for effective participation of a broad range of stakeholders in the management of natural; environmental resources; Our Common Future on another hand that called for the strengthening of the interaction between governments, NGOs and scientist (UNEP, 2007). The departure opened a forum for multiple stakeholders' involvement in watershed management activities of a given locality at a given time. Evidence showed that promoting collaborative action at the watershed has been proved to have many advantages other than making the planning, implementation and supervision of activities easier, more concentrated faster and more cost efficient (FAO, 2017).

The new county and national watershed management policies in Kenya do not only seek to involve many stakeholders but also devolving watershed resource management to appropriate local level institutions (GoK, 2015). In order to devolve watershed management to the local population, the Constitution of Kenya (2010) requires the full involvement of the public in the decision-making process on matters that directly affect their livelihoods. This is translated to the county government where the emphasis is placed on public participation in all development processes. According to Fiona *et al.* (2013) the success of collaboration processes in the watershed planning workshops, result in action and work plans, and the general satisfaction among the participants in the process. The study interrogated the key actors' programmes that were identified by the majority of the households during household interviews, key informant and focus group discussions and documented as case studies in Table 7.7:

Table 7.7: Major Actors Collaborating in Watershed Governance and Food Security

Actor/ Organization	**Objective**	**Delivery Approach**	**Donation source**	**Achievement**	**Contribution to watershed governance and food security**
WKCDD/FMP	To empower local communities' men and women to engage in sustainable and wealth creating livelihood activities and reduce their vulnerability to flooding	Co-financing GoK and the World Bank Worked with all stakeholders in agriculture value chains and environment Community capacity building through training and financing identified projects County technical staffs were experts. Demand –driven approach was used	GoK and World Bank	Empower community groups within the flood zone to mitigate the flood impacts. Disaster Risk Reduction and Extensions Services Providers (DRRESP) groups were formed especially in the lower region of the county Groups' participation in a project such as mapping out flooding zones. Formation of Early Warning Systems (EWS) together with other lead government agencies. Dairy farming, cassava farming, poultry farming, table banking, fish farming, rabbit farming, tree planting, milk cooling plants, slaughter housing and hatchery among others were financed. Activities including slaughter housing, hatchery and milk cooling plants were implemented. Common Interest Groups were capacity built, organized and legally registered.	Different agriculture value chains were trained on production and financed. Environment management issues such as soil and water management, and tree planting were mainstreamed as cross cutting issues in the projects Water infrastructures such as micro irrigation projects were financed. Common Interest Groups were formed which could be used to promote watershed governance
PALWECO	To improved livelihood and living standards of the poor population of Busia County through improving productivity and	Co-financing GoK and The Finland Government An approach based on prioritization and sequencing of activities	Government of Finland and GoK	Targeted marginalized and vulnerable groups, such as female-headed households, orphans, unemployed youths, people living with HIV/AIDS and the disabled. Interventions were implemented through	Water infrastructures such as micro irrigation projects were financed. Different agriculture value chains were trained and financed Environment Management

	incomes from agriculture	Promotion of co-operation with other development projects and donor agencies. Use of community planning cycle tools Use of local labour and resources. The demand-driven approach was used		the service providers, including national and county government technical staff, private service providers, common interest groups and NGOs. Programme contributed to the development of county integrated development plan, Routinely maintenance of rural roads Training and financing different agricultural value chains	activities were mainstreamed as cross cutting issues through the value chains. Common interest groups were capacity built on engagement in county governance such as county planning and budgeting process.
ASDSP	To facilitate the development of agricultural value chains	Co-financed by the Kenyan government through the Ministry of Agriculture and the Sweden Development Agency convening and coordinating stakeholder forums, Providing training and facilitating linkages between various agricultural value chain actors Operated on a cost-sharing basis, with the major forums funded by ASDSP at the initial stages and progressively by other stakeholders	GoK and Sweden governme nt	Facilitated the development of agricultural value chains in Busia County. Farmers in fish, groundnut and improved poultry agricultural value chains were supported through training Organization of Participatory Scenario Planning (PSP) forums (MET, MoA departments, CBOs), development of various value chain concepts, and dissemination of scientific and traditional early warning weather and climatic information	Agriculture value chains were organized and capacity built through trainings Weather and climatic information were disseminated to farmers through barazas. Watershed governance issues were implemented as cross-cutting issues through environment resilience management component.
ADS-western	Focus on building	Co-financing of activities	Bread for	Formation of Common Interest Groups	Linked farmers to key

	self-reliant communities in which participating rural communities have a sustainable socio-economic development	The overall strategy of the organization is to influence and strengthen local communities' capacities to mobilize and access equitable resources towards sustainable development and good governance. Farmers to farmers' approach	the World, Germany, USAID KAVES	(CIGs), Training on business management (such as on tree nursery management) and linking rural farmers with County departments and other development stakeholders. Linked farmers to national and county departments and other stakeholders in agriculture, environment, water, health and research institutions for accessing services offered Organized farmers field days and field demonstration for technology uptake	departments of agriculture, water and environment where services such as tree planting, improved agricultural production were targeted..
Simpact Kenya NGO	Promote the conservation of the environment through organic farming	Worked together with the county department of agriculture, and other stakeholders such as NGOs in promoting organic farming	Adventist Developm ent Organizati on (ADRA)	mainly promoting organic farming of Sesame (Simsim) production	Domestication of international and national organic farming concepts through use of local language and practices to conserve soil and water resources *See Appendix IX*
Agriculture Development Fund (ADF)	Formed through the Act of Busia County Assembly to provide agricultural based credit to small and medium scale farmers in the county	Provided cheap financial credit to farmers at 4% interest rate per year.	County governme nt of Busia	Mainly provided cheap financial support to farmers of different value chains in all wards of Busia County.	Agricultural value chains supported were expected to mainstream watershed management and conservation activities.

Source: Filed data, (2018)

Findings in Table 7.7 showed that there is enough evidence that the collaboration among actors exhibited: Co-financing of agriculture and livelihood development interventions between the government of Kenya and international governments' organizations, local nongovernmental and international nongovernmental organizations, the national government of Kenya and the County government. For example, ADF provided cheap loans for farmers at a rate of 4% per annum with no collateral as compared to commercial banks which provide loans at 14% per annum in addition to collateral. The selected cases mainly targeted livelihoods improvement through agri-business agricultural production projects. Studies by FAO (2017) have shown that development assistance provides a safe operating space to demonstrate and field-test innovative practices, approaches and forms of cross-sectoral collaboration for the sustainable management of natural resources and to facilitate adoption and uptake by local stakeholders through national programmes.

Based on the findings, the approach targeted households in Common Interest Groups (CIGs) where an integrated approach of service delivery bringing together; CIGs, local leaders, sub-county, county, national technical expertise and international donors were involved in the programmes cycle. However, the study noted that environment and watershed governance and management issues in the identified programmes were targeted as cross-cutting issues. This resulted, in reducing the gap between the county service providers and the rural farmers. Nambuku Ward Agricultural Officer said: -

> “The project has involved me as a technical expert in agricultural extension at the ward level. We currently face a problem of getting to farmers through the needed ‘demand driven’ approach the government is using to help farmers. Most of our framers have since been left out, our county government does not facilitate us with necessary resources to get to the farmers, we only earn salaries with empty motorcycles, and these have made most of us to neglect our roles. I used to wake up in the morning but I did not know where

> to start from. With ADS Western intervention, my work has been made easier and more organized; I can now plan for the activities and reach out to farmers through meetings in CIGs and with little facilitation from ADS and partners like USAID KAVES."

The study also revealed that the main actors identified used demand-driven approach to deliver programme activities. The approach according to the respondents' disadvantaged watershed management activities. The majority of households were farmers with the primary level of education, did not have sufficient knowledge to mainstream or demand effectively for watershed management services from government extension officers. Designing of CIGs proposals and implementation of the activities missed watershed governance and management priorities and the interest of agri-business override the need to ensure that soil and water resources were well utilized for sustainable agri-business activities.

Consequently, households who did not belong to CIGs were left out and most CIGs were dominated by opinion leader households who depended on almost all programmes at the same time in training, demonstrations and finances leading inequalities. These crowd out a large number of households as well as limited the multiplier effect of the programmes. Studies in Ecuador, Morocco and Mauritania showed that collaboration with several partner institutions fostered the integrated dimension of the watershed management plan, triggered specialized studies in various areas such as forest regeneration, transhumance, rangeland management and value chain development which supported plans formulation (FAO, 2017).

7.7: Capacity offered by Actors in Watershed and Food Security Activities

Table 7.8 shows that 36.7% (142) of the households indicated that actors' activities contributed to land management. On the other hand, 8.0% (31) and 18.3% (71) agreed that the actors contributed to forest management and watershed planning respectively. Although most of the state and non-state actors' activities targeted farmers who had been organized in groups or in some cases the CIGs and specific to agricultural products value chains, only 24.3% (94) of the total households acknowledged that the actors' activities contributed to farmers' co-ordination in the basin. However, interviews with representatives of various non-governmental organizations in the basin revealed that most of the organizations used integrated approaches that targeted to address the whole agricultural production value chains, from farmers' groups formation, capacity building through training, to demonstrations' on land, water and crop management to marketing and agri-businesses. Other resources and capacities offered by the actors.

Table 7.8: Watershed Management Knowledge and Resources Created by Actors to contribute to Food Production and Distribution

Watershed management knowledge and resources	Frequency (N=387)	Percentage of HH
Land management	142	36.7
Farmers coordination	94	24.3
Sustainable agricultural production	76	19.6
Information and communication	76	19.6
Watershed planning	71	18.3
Agri-business marketing	46	11.9
Forest Management	31	8.0
Stream restoration	20	5.2
Water quality monitoring	20	5.2
Watershed law making	19	4.9
Research and training	13	3.4
Advocacy and lobbying	8	2.1
Fund raising	8	2.1
Wetland restoration	5	1.3
Policy making and influencing decisions	0	0.0

Source: Filed data, (2018)

Makarius *et al.* (2015), and Lein and Tagseth (2009) contended that it is essential to improve watershed conservation through water governance and strengthening water user associations through training and financial provision for modernizing infrastructures. The interviews with the household respondents indicated that 41.3% (160) households did not know whether the watershed management knowledge and resources created by various actors enhanced the legitimacy of and public support for food security interventions. In addition, 30.0% (116) households indicated that the watershed management knowledge and resources created by actors did not enhance the legitimacy and public support for food security intervention in the study area. However, only 28.7% (111) households agreed that the watershed management knowledge and resources provided by various actors in the watershed enhanced the legitimacy and public support for food security interventions as shown in Figure 7.6.

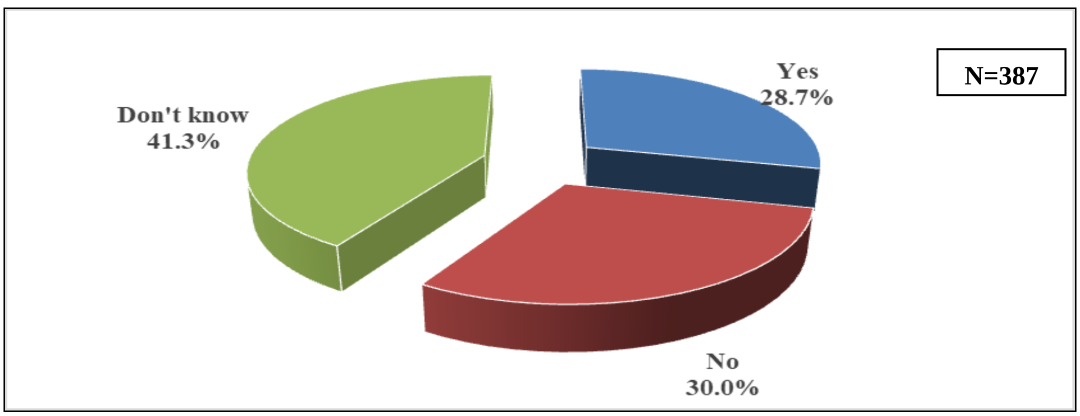


Figure 7.6: Role of Actors in Watershed Management Knowledge and Resources in enhancing Food Security Interventions
Source: Field data, (2018)

However, Chi-square test carried out on household responses and presented in Table 7.9 showed that watershed management knowledge and resources created by various actors enhanced the legitimacy, and public support for households' food security interventions showed a highly significant differences (d=23.4; p-value=0.000 at 99% level of confidence) with households' food security.

Table 7.9: Food security and insecurity households' measurement comparison association amongst the watershed management knowledge variables

Watershed Management Knowledge	**Food Insecurity (n=214)**	**Food Security (n=173)**	**Difference**	χ^2	**p-value**	**Significant?**
Watershed management knowledge and resources created by various actors enhance the legitimacy of, and public support for food security interventions, yes	18.2	41.6	23.4	25.595	0.000***	Yes
Non-State Actors bridge the watershed management gap between government agencies and various governance levels (global – national, national – local, global – local), yes	11.7	29.5	17.8	19.201	0.000***	Yes
Is there political will for support of Non-state Actors in watershed management and food security activities in this basin?, yes	22.9	25.4	2.5	0.337	0.562	No
Are there conflicts among actors in watershed management and food security that may lead to exclusion of other actors?, yes	14	10.4	-3.6	1.150	0.284	No
Are watershed management policies and programs mutually reinforcing food production and distribution in the Lower Sio River basin?, yes	6.5	22.5	16	20.723	0.000***	Yes
The overall score for management knowledge of watershed						
Mean(SD)	14.67 (19.76)	25.90 (26.94)	11.22(7.18)	F=33.385	0.000***	Yes

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

Source: Field data, (2018)

This finding implied that households with food security attributed their status of food security to the watershed management knowledge and resources.

When the respondents were asked whether the Non-State Actors activities bridged the watershed management gap between government agencies and various governance levels (global – national, national – local, global-local), the findings in Figure 7.7 illustrates that 46.5% (180) households did not know while 33.9% (131) said did not. Only 19.6% (76) households answered in affirmative. The findings are attributed to low levels of knowledge on actors' programmes visions and goals as well as low levels of involvement of the households in policies and programme formulation, planning, implementation and evaluation as earlier indicated.

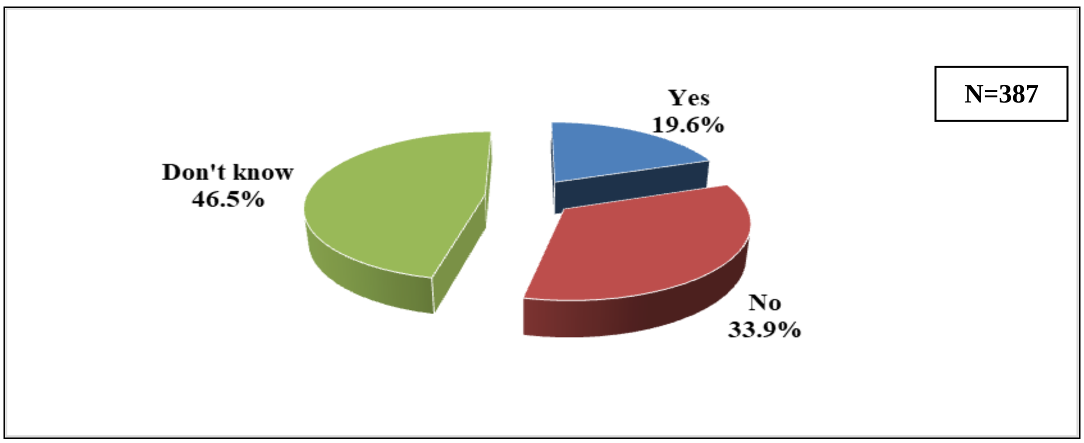


Figure 7.7: Role of Non-State Actors on the Watershed Management Gap between Government Agencies at various Governance levels
Source: Field data (2018)

The Chi-square test presented in Table 7.9 indicate that watershed management gap bridged by Non-State Actors between government agencies and various governance levels (global – national, national – local, global-local) showed a highly significant differences with household food security at d=17.8; p-value= 0.000 at 99% level of confidence meaning that for those households who were food secure, it was reported that watershed management gaps were bridged by Non-state Actors more than those households who reported to be food insecure.

Further, when the respondents were asked whether there was political will for support of Non-State Actors in watershed management and food security activities in the watershed, the study findings in Figure 7.8 depicts that 46.5% (180) respondents did not know while 29.5% (114) responded no. Only 24.0% (93) households in the watershed responded yes implying that they agreed that there was a political will for support of Non-State Actors in watershed management and food security activities.

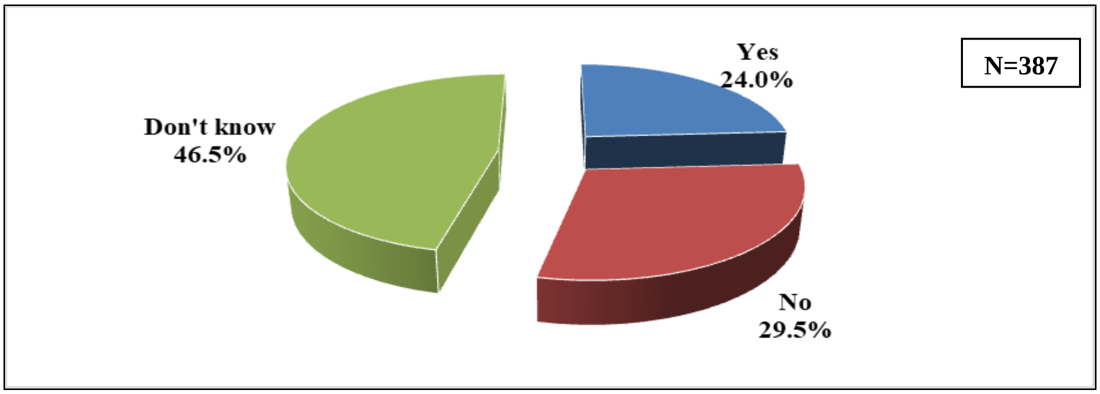


Figure 7.8: Influence of Political Will in Support of Non-state Actors in Watershed Management and Food Security Activities
Source: Field data (2018)

The Chi-square test presented in Table 7.9 did not find any significant influence of political will support for Non-State Actors in watershed management and status of households' food security. World Bank (2010) indicated that politicians provide public services and support to clients in exchange for political advantage. Furthermore, Elias *et al.* (2015) cited earlier studies in Ethiopia by Cohen and Lemma (2011) and Berhanu (2014) who found that the implicit goal in establishing uncontested monopoly over Ethiopia's agricultural extension system was driven by the lust for obtaining legitimacy and acceptance from smallholders whose support was instrumental in averting threats and boosting prospects for unhindered regime survival and security under the façade of periodic electoral exercises.

7.8: Conflicts in Watershed Governance that Hinder Food Security Goals

Based on the findings in Figure 7.9, the study indicated that 43% (167) households were able to identify human to human conflicts that resulted from watershed governance issues to be the major hindrance to food security goals in the basin. On the other hand, 46% (178) respondents identified human-wildlife conflict as a hindrance to food security. The respondents were able to identify conflict with monkeys which were the major problem since the Wildlife Conservation and Management Act, 2013 did not allow people to kill monkeys who destroy crops in the farms. More so, 5% (19) indicated that there were conflicts with the county government, especially when it came to opening up county roads, trees along the roads were cut down while road drainage systems were directed to people's farms causing sedimentation and gullies in farms.

As a result, in Figure 7.9, 4% (15) respondents indicated that there were conflicts with local government policies on watershed governance. Only 1% (04) respondents agreed that there were citizen-national government conflicts as well as 1% (04) of the respondents who indicated they did not know of any conflict in the Lower Sio River basin. Further, the Chi-square test presented in Table 7.9 did not find any significant difference in households with food security and food insecurity with conflicts in watershed management in the study area.

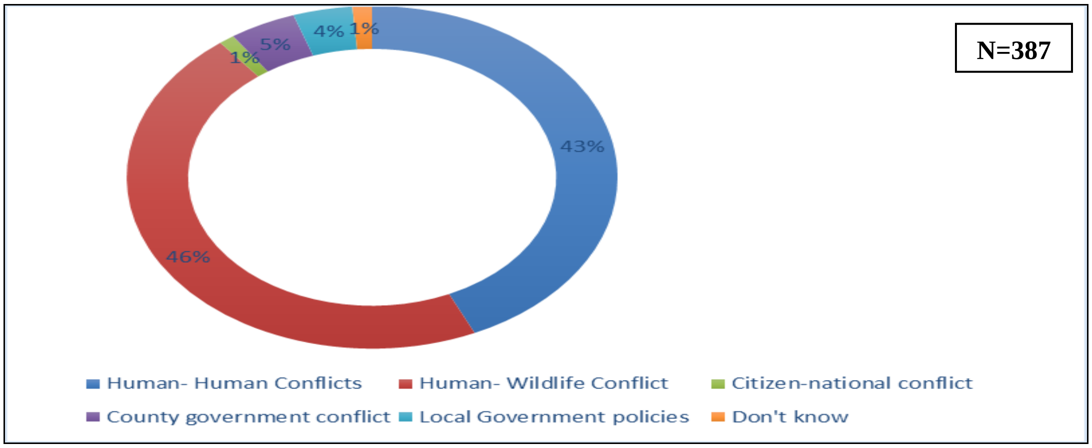


Figure 7.9: Conflicts in the Watershed Governance Systems that Hinder Food Security Goals
Source: Field data (2018)

Furthermore, the study also assessed whether there were inter-actor conflicts observed by households which could negatively influence watershed governance by leading to exclusion of other actors in the study area. The study findings in Figure 7.10 illustrates that 64.9% (251) of the respondents did not know whether there existed inter actor conflicts while 22.7% (88) indicated that there were no such conflicts in the watershed governance. On the contrary, 12.4% (48) of the respondents agreed that there were conflicts among actors that could result in the exclusion of others in watershed management activities.

An example given during the focus group discussion meeting was that of the farmers who extended sugarcane farming to the riparian land (wetlands along Sio River) without observing the 30 Meter buffer zone regulation for economic benefits while the government needed farmers to preserve and conserve the riparian lands through several authorities as NEMA and WRA. Studies have proved that effective watershed management provides a framework for understanding and reconciling the interconnections among various land-use systems and for collaborative action and decision making in the face of competing claims on resources (FAO, 2017). However, the Chi-square test carried out and presented in Table 7.9 did not find any influence of conflicts among actors in watershed management and food security.

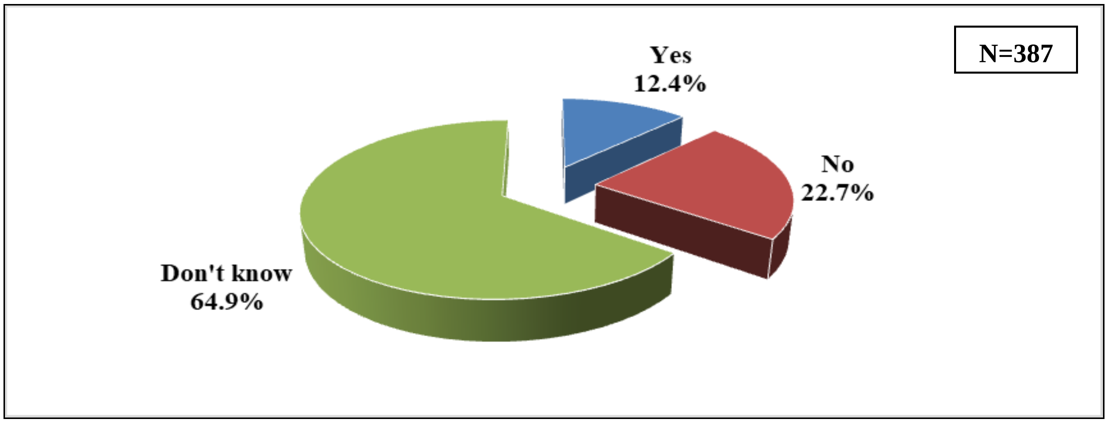


Figure 7.10: Inter-actor Conflicts in Watershed Management and Food security that Lead to Exclusion of other Actors
Source: Field data (2018)

The follow-up on the causes of identified inter-actor conflicts established that differences in actor policies, struggle for same donors among the civil societies, watershed resources competition, lack of proper co-ordination framework at the county level, and to some extent government officers and political interference in watershed management activities of the other actors were responsible for inter-actor conflicts in the Lower Sio River basin as shown in Figure 7.11. According to Komakech (2013), boundaries problems related to political responsibilities and social sphere of influence, along these boundaries, the jurisdictions and interests of actors' overlap causing conflicts between institutions involved in watershed governance.

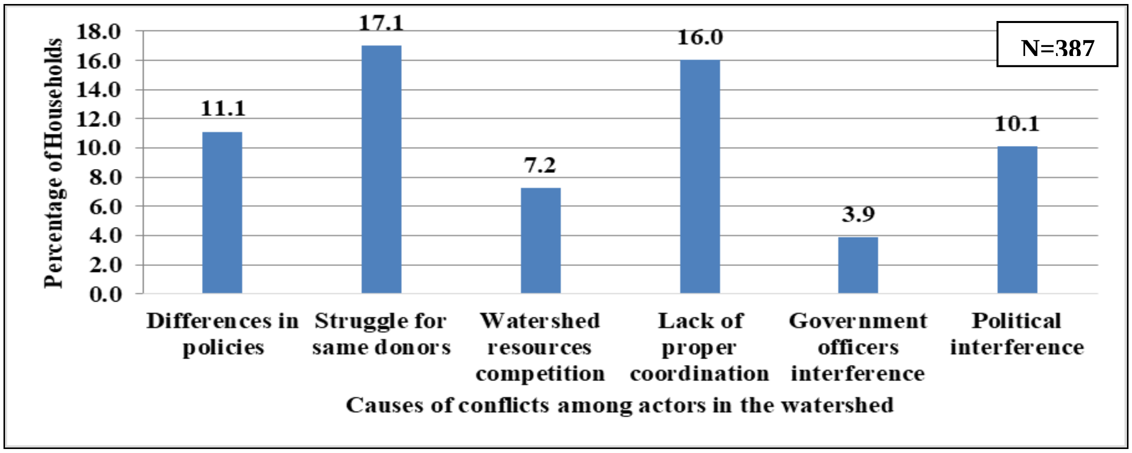


Figure 7.11: Causes of Inter- Actor Conflicts in Watershed Management and Food Security Sectors
Source: Field data (2018)

As a Common Pool Resource (CPR), where the Tragedy of Commons is likely to occur from the use of the river water resources, according to the focus group discussions in Syekunya and Namboboto locations, it was reported that in the recent years there has been fear and extended conflict in the abstraction and use of the water of the Sio River. Economic elites in the name of investors in Sugarcane processing factories at Busibwabo Ward (Busia Sugar Factory) and Olepito Sugar Factory at Olepito Location have abstracted water at the middle point of the river thus raising fear and uncertainty of water availability and protection of ecological functions in the downstream of the river.

These factories are additional stress on the river water that has recently reduced due to poor management at the upstream, increased impact of unsustainable agricultural practices and impacts of climate change such as droughts that affect the quantity of water in the river channel. To make it worse, the expanding demand for domestic water in Busia town and neighbouring towns along the river has also put stress on the river water abstraction without considering the demand of downstream communities. The Lower Sio Irrigation project is also expected to abstract and draws a lot of water from the river channel; the action requires damming of water during flooding seasons so as to protect the interests of the downstream communities. A male respondent at Syekunya location said: -

> "NEMA and WRA betrayed us when we demanded accountability from the Olepito Sugar Factory investors before abstracting Sio River water at Syekunya location point. None of us or our local leaders including the chiefs and their assistant was consulted prior to water abstraction."

The interviews with the chiefs and their assistants indicated that the orders came from senior national government officers' i.e. the County Commissioners who ordered that the factory is allowed to abstract water. Lack of public consultation led to public demonstrations demanding the share of water as a community resource through the co-corporate social responsibility of the factory. However, the local politicians, the factory management, NEMA and WRA representatives were reported to promise the locals jobs in the factory. Eventually, the factory went on abstracting water without an agreement with the community or a water resource management plan to address pertinent river management and conservation issues.

On the same, due to downstream communities fears on increased abstraction of river water in the upstream, one of the community governance activists: Mr. Kenneth Olulu from Namboboto location petitioned Busia Sugar Factory (Busibwabo) at the National Environment Tribunal in 2015 a national institution mandated under EMCA, 2015 to hear and determine environmental resources conflicts. The factory was stopped from abstracting water until the matter was addressed. However, the national and local politics dominated the hearing and determination of the petition. Political elites from Matayos sub-county and Busia county felt that the move to block the factory from abstracting river water could make the county to lose potential investors and result in loss of job opportunities.

According to the petitioner, due to economic disadvantage, his life was threatened and he was denied an equal opportunity and justice during the tribunal hearings. The petitioner could not afford to hire a good environmental advocate while the local community members feared to support the petitioners due to political threats. As a result, the petitioner lost the case and his property was auctioned. This contributed to increased fear in the community to hold such investors accountable on the use of Sio River water resources.

Like in the Olepito Sugar Factory, the Busia Sugar Factory was allowed to go on without a proper framework in place to address River Sio water issues between the upstream and downstream communities on one side and the investors on the other hand. Consequently, the watershed management framework was never realized. Therefore, short-term economic benefits outdid the long-term ecological benefits of Sio River ecosystem management and conservation. The respondents showed that the downstream community feared that the tragedy of water abstraction might escalate in the near future leading to a bigger conflict between the upstream and downstream water users in the Lower Sio River Basin. The study also noted that legal structure such as WRUAs did not exist to help handle water resources conflict as envisaged in the Water Act 2016.

Due to its rivalry and non-excludability characteristics, Sio River basin resources stand to be categorized as common property resources (Ostrom and Gardner 1993). The location asymmetry between upstream and downstream users, the rich and the poor, economic elites and non-economic users, whereby the upstream, the rich and the economic elites claim and utilize the water first (Van der Zaag, 2007). All the water users need a collective action over the water resources of Sio River as a common pool resource management. However, various interpretations may dominate the involvement of various actors and complex set of rules and institutions arising out of historical, ecological and other structural processes in such watersheds (Ostrom, 1993; Ostrom, 2000; Naidu, 2009; and Komakech, 2013).

To establish the legitimacy and support of various actors in the watershed, the study assessed the level of public support for key agencies in watershed management and food security in the study area. The findings in Table 7.10 indicate that 30.5% (118) of the households in the watershed offered high support to the grass root groups. Forty-nine point nine per cent (49.9%) (193) of the households indicated that they did not offer any support to the county government departments while 66.7% (258) did not offer support to the national government departments. The majority 70.0% (271) and 85.8% (332) of the households indicated that they did not offer support to NEMA and WRA respectively. Based on earlier findings this is attributed to the low level of engagement and knowledge created by NEMA and WRA in form of public capacity building on their roles at the grassroots level necessary for public support. The study noted that WRUAs were not present in the watershed. During the focus group discussion at Syekunya in Nambale sub-county a male respondent said: -

> "We usually see very expensive vehicles pass here with labels NEMA and WRA but we have never known what they deal with. When we had a problem with water abstraction in our mainstream here for Olepito Sugar Factory, we protested the move to take our scarce water without engaging us. That's when we saw those vehicles stopping here. Nevertheless, we did not get any support from them and our water continues to be abstracted by using force. In November, December, January and February we usually have problems with water scarcity due to long dry spells yet the little water are taken to the factory."

Table 7.10: Ranking of Public Support for the Watershed Management Institutions

Institutions/organizations	**Ranks (N=387)**				
	Less support	**Moderate support**	**High support**	**Very High support**	**No support**
Grass root Groups	13.7 (53)	20.7(80)	30.5(118)	15.0(58)	20.2(78)
County government dept.	26.1(101)	16.8(65)	4.4(17)	2.8(11)	49.9(193)
National government min.	14.7(57)	12.9(50)	4.4(17)	1.3(05)	66.7(258)
NEMA	8.8(34)	12.1(47)	7.2(28)	1.8(07)	70.0(271)
WRA	5.4(21)	4.7(18)	2.8(11)	1.3(05)	85.8(332)
Nile Bain	4.7(18)	1.8(07)	1.3(05)	0.0(00)	92.2(357)
Lake Basin Dev. Authority	3.6(14)	1.0(04)	1.8(07)	0.5(02)	93.0(360)

Source: Field data (2018)

Based on the findings in Table 7.10, regional development initiatives such as the Nile Basin Initiatives and Lake Basin Development Authority did not receive support from 92.2% (357) and 93.0% (360) of the households respectively. It was revealed that factors requiring greater attention in efforts to initiate adaptive co-management in the future include community perceptions of support from outside agencies, access to long-term funding for adaptive management, and access to reliable information (Cundill and Fabricius, 2009).

The findings in this study reveal gaps in the institutional and organizational framework to implement watershed governance in the basin. Consequently, following recommendations from earlier studies, enabling environment for watershed governance for food security in the watershed could include the institutional set-up of both national and county governments, their implicit and explicit rules, power structures, policy and legal framework environment in which individual households and local organizations function (FAO, 2017). The recommended changes may involve policy reforms, changes in legislation, strategic exercises at the national and county level planning and prioritization, and changes to incentive systems (FAO, 2010).

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMEMDATIONS

8.1: Introduction

This chapter outlines the summary of the study findings based on the four objectives. Based on the findings, the chapter also gives conclusions and recommendations for each objective and suggests further areas of research.

8.2: Summary of Findings on Watershed Governance for Food Security in the Lower Sio River Basin, Busia County

The overall objective of the study was to determine the status of watershed governance and its place in enhancing food security in the Lower Sio River Basin. The findings indicate specific objectives:

First, on the actors' perceptions towards watershed governance for food security, the study revealed that: the majority (81.9%) of the household agreed that watershed governance determines food security. More so, the majority of the households reported that were not satisfied with the aims of watershed governance. However, the study revealed that the nine watershed governance variables used to measure aims had positive significance with food security p-value=0.000 at 99% level of confidence. The study also revealed that majority (86.3%) of the households needed changes in watershed governance systems to ensure water resource management is treated as a public trust.

Second, the study found that 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 were significant to households' food security status. On the other hand, 68.5% (265) of the households reported that there were observed socio-economic and environmental changes in the watershed governance after 2010. The study also found that: water resources management plans at p-value=0.000, water resource institutions at p-value=0.001 and water resources policies at p-value=0.000 were watershed governance structures that showed significance to households' food security.

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, lack of financial resources for investment in watershed management at p-value=0.027 showed statistically significance difference in determining households' food security. Moreover, 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 while traditional expertise and land management expertise were highly identified by 34.4% as present in the watershed. Furthermore, 87.3% of the households did not participate at any phase of watershed management and food security policy, plan or programmes.

Third, the study revealed that the main household heads individual food security goal known by the majority (53.5%) (207) was to improve rural livelihoods through food and agricultural systems while 41.9% (162) indicated that they did not know whether watershed management policies contributed to food security. Majority (86.8%) (336) blamed low farm yield recorded in recent years as a key driver to food security whereby, four drivers of food insecurity namely: high prices of foods, low supply of food in the market, incidences prolonged droughts and low levels of income at p-value=0.000 and poor government policy at p-value=0.007 were significant in determining household food security status. Only 11.1% (43) of the respondents highlighted farmland as a watershed aspect that the county government activities have impacted while 42.4% (164) pointed out that the existing watershed governance structures such as policies did not have positive impacts on the rural agricultural crop production. The status of food insecurity had arisen from earlier government estimate of 54% in 2013 to 55.3% at the time of the study an indication that the state of food insecurity was worsening.

Results indicate that age (significance=0.667), sex (significance=0.106) and land tenure system had no effect on the status of households' food security. Further, the results showed that religion, watershed expertise, level of satisfaction towards watershed governance and co-management of watershed could only explain 20.8% variation between households' food security and food insecurity differences at the household level. Interestingly, watershed governance structures did not have the effect on households' food security.

Lastly, the study found out that there was collaboration among the different actors at different levels, both governmental and nongovernmental. The approaches and delivery of the projects were reported to be participatory whereby most state and non-state actors at the grassroots level were involved in planning, implementation and evaluation of the programmes. However, the demand-driven approach to the services offered by the actors left most households and watershed management activities out the project beneficiaries. More results showed that 51.7% (200) of the households did not know whether watershed management policies and programs mutually reinforced food production and distribution while 36.7% (142) indicated that actors' activities contributed to land management.

Watershed management gap bridged by Non-State Actors between government agencies and various governance levels (global – national, national – local, global-local) showed highly significant differences with household food security at p-value= 0.000. However, the study did not find any significant influence of political will support for Non-State Actors in watershed management and status of households' food security. The majority 70.0% (271) and 85.8% (332) indicated that they did not offer support to NEMA and WRA respectively.

8.3: Conclusions

Overall, the study revealed that watershed governance in the Lower Sio River Basin did not contribute to sustainable food security interventions. As a result, majority of the households in the watershed are at a risk of getting into food insecurity trap. Specifically, the study concluded that:

1. Based on the findings, majority of the households perceived that watershed governance determined food security. However, were not satisfied with the state of watershed governance and expected a change to a more collaborative, integrative approach towards watershed governance for food security.

2. Watershed governance structures, expertise, capacities created, satisfaction towards watershed governance and co-management of watershed did not contribute to the desired adaptive capacity at the household level. However, the governmental and non-governmental actors had the capacity towards watershed governance because of collaborations and diversified technical support and delivery models to enhance household's food security.

3. Watershed governance did not positively impact on food security in the rural Lower Sio River Basin resulting to increased number of households with food insecurity from 54% in 2013 based on government estimates to 55.3% in 2017 the time when the study was carried out.

4. There were supportive watershed management legislations, policies and plans to regulate and foster co-management watershed resources for food security among the households, local non-governmental, national and county government and international actors. However, there was lack of ownership, coordination and monitoring frameworks for co-management activities, as well as approaches used were not inclusive thus ineffective co-management at the watershed level.

8.4: Recommendations

The study recommends that there is need to prioritize watershed governance in food security policy frameworks at the Lower Sio River Basin. More specifically:

1. Households' perceptions, expectations and satisfaction need to be taken into consideration for an effective adaptive capacity building, co-management and ownership of watershed governance processes towards sustainable food security.

2. There is the need for state actors to enhance adaptive capacities of households and local non-governmental organizations through formulating and implementing policies towards improving and integrating watershed governance structures, expertise, knowledge given the ongoing socio-ecological changes such as changes in governance arrangement, land use, ecological and climate to enhance food security.

3. Watershed governance needs to be improved in food security policy to positively impact on the status of food security in the Lower Sio River Basin.

4. Watershed structures, expertise, level of satisfaction towards watershed governance together with coordination, participation and monitoring framework of actors' activities as well as village management plans are needed to ensure effective co-management of the watershed for sustainability of food security interventions in the Lower Sio Basin.

8.5: Suggested for further study

From the study findings its worth to recommend the following further studies:

i. A study is recommended on food security governance and its impact on watershed management in the upper watershed contributes to the well-being of the downstream/ Lower Sio River Basin.

ii. The Lower Sio River is a trans-boundary basin; a study needs to be conducted to establish the status of watershed governance in Uganda side to contribute to the collective management of the basin.

iii. Finally, it will be prudent to carry out a study to quantify variables such as levels of sedimentation, siltation, water quality and loss of biodiversity and eutrophication that result increased county government activities such as subsidized fertilizers, mechanization of land Ploughing, grading of rural roads among others in order to monitor the changes for proper food security and adaptive efforts.

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APPENDICES

APPENDIX I: SAMPLE FRAME POPULATION DISTRIBUTION BY NUMBER OF HOUSEHOLDS, AREA, DENSITY AND ADMINISTRATIVE UNITS

Administrative Units	**Households**	**Area in Sq. KM**	**Density**
Matayos	**68781**	**681.0**	**481**
Township Location	**8558**	**22.3**	**1597**
Township	*8558*	*22.3*	*1597*
Mjini	6639	7.7	3434
Mayenje	1919	14.6	628
Matayos	*15268*	*173.9*	*435*
Nangoma Location	**2504**	**28.4**	**431**
Muyafwa	792	8.0	487
Murende	764	11.3	342
Nangoma	948	9.1	494
Lwanya Location	**1832**	**18.3**	**478**
Busende	638	7.7	407
Igero	665	5.6	559
Luliba	529	5.0	494
Bukhayo West Location	**6700**	**72.8**	**460**
Bugengi	2296	27.8	405
Mundika	1964	23.4	426
Esikulu	2440	21.6	568
Busibwabo Location	**2253**	**32.5**	**349**
Nasira	906	12.5	364
Alungoli	639	7.0	449
Nakhakina	708	13.0	280
Nasewa Location	**1979**	**21.8**	**452**
Mabunge	704	6.3	575
Buyama	588	7.4	391
Lunga	687	8.2	413
Nambale Sub county	**19002**	**237.8**	**398**
Nambale Township Location	**6727**	**68.7**	**470**
Nambale Township	3297	33.6	469
Kisoko	1833	21.7	412
Syekunya	1597	13.3	568
Bukhayo East Location	**4309**	**58.6**	**371**
Sikinga	1139	15.0	382
Madibo	1129	12.4	465
Buyofu	782	11.5	341
Mungatsi	1259	19.6	319
Bukhayo Central Location	**3741**	**48.0**	**379**
Malanga	1334	19.2	345
Sidende	1609	18.0	421
Lwanyange	798	10.7	371

Administrative Units	Households	Area in Sq. KM	Density
Bukhayo North Location	**2086**	**27.5**	**398**
Lupida	956	14.3	359
Kapina	1130	13.2	440
Walatsi Location	**2139**	**35.0**	**329**
Musokoto	892	12.5	379
Khwirale	1247	22.5	300
Funyula	**19395**	**265.1**	**353**
Nambuku Location	**2453**	**32.7**	**364**
Lugala	413	5.6	351
Mango	406	4.5	420
Sibinga	583	7.1	419
Ganjala	470	7.5	302
Ludacho	581	8.0	350
Namboboto Location	**3418**	**37.3**	**436**
Luanda	889	9.5	444
Buloma	721	8.2	424
Namboboto	522	4.8	507
Mudoma	640	5.2	578
Nyakhobi	646	9.7	327
Odiado Location	**2038**	**22.6**	**425**
Kabwodo	306	4.1	331
Odiado	613	8.5	354
Budalanga	246	3.4	349
Wakhungu	873	6.7	610
Nangosia Location	**2283**	**27.5**	**386**
Luchulululo	348	4.6	358
Sirekeresi	592	6.1	443
Bukhulungu	714	9.1	370
Sigulu	629	7.7	378
Agenga Location	**2902**	**44.5**	**313**
Sigalame	804	12.6	315
Agenga	897	12.5	352
Ojibo	797	10.9	335
Bukiri	404	8.6	226
Naguba Location	**2368**	**36.3**	**315**
Bujwanga	1158	14.5	394
Nanderema	625	12.0	260
Rumbiye	585	9.8	267
Bwiri Location	**3933**	**64.3**	**308**
Busembe	854	11.9	366
Busijo	814	11.1	384
Hakati	1101	20.0	283
Namuduru	1164	21.2	259

Source: KNBS. 2009 Kenya National Census Report

APPENDIX II: LIST OF ACTORS IN AGRICULTURE AND ENVIRONMENT

	Actor	Actor category
	National government level	State
1.	Ministry of Environment	State
2.	Ministry of Agriculture	State
3.	Ministry of Water	State
4.	Water Resource Authority (WRA)	State
5.	National Environment Management Authority (NEMA)	State
6.	National Irrigation Board Western Region (NIB)	State
7.	Department of Forestry/ County Ecosystem Conservator	State
8.	Location Chiefs	State
9.	Sub-location assistant chiefs	State
10.	KARI- ALUPE	State
11.	KAPAP	State
12.	Horticultural Crops Development Authority (HCDA)	State
13.	Lake Victoria North Water Services Board (LVNWSB)	State
14.	County Director, Special programme	State
15.	LVEMP	State
	County government level	
16.	Director of Fisheries	State
17.	Director of Water	State
18.	Director of environment and natural resources	State
19.	Director of agriculture (crop and animal production)	State
20.	Director of irrigation	State
21.	Sub-county environment and natural resources officers (3)	State
22.	Sub-county waters officers (3)	State
23.	Sub-county agricultural officers (3)	State
24.	Members of the county Assembly (MCAs)	State
25.	Water Resource Users Associations (WRUAs)	Non State
	Non-Governmental Organizations and Community Based Org.	
26.	Programme for Agriculture and Livelihoods in Western Communities (PALWCO)	Non State
27.	SEND A COW	Non State
28.	ACCI-GIZ	Non State
29.	Anglican Development Services (ADS) Westerrn	Non State
30.	Grass Root Poverty Alleviation Programme (GAPP)	Non State
31.	ONE ACRE FUND	Non State
32.	Integrated poverty action(IPA)/ ICS (International Child Support)	Non State
33.	KENFAP	Non State
34.	Rural energy and food security organization (REFSO)	Non State
35.	Participatory Approaches in Integrated Development-CA regional program (PAFID-CARP)	Non State
36.	Appropriate Rural Development in Agriculture Programme	Non State

	Actor	Actor category
	(ARDAP)	
37.	Farm concern international	Non State
38.	Heifer international	Non State
39.	GAPK-grow against poverty Kenya	Non State
40.	One World Development Foundation (OWDF) BUSIA	Non State
41.	Family Life Education Program(FLEP)	Non State
42.	Hand In Hand	Non State
43.	World Vision Kenya	Non State
44.	Catholic Relief Services	Non State
45.	Farm Africa	Non State
46.	Centre for African Bio-Entrepreneurship (CABE)	Non State
47.	International Crops Research Institute for Semi-Arid Tropics (ICRISAT)	Non State
48.	Lake Basin Development Authority (LBDA)	Non State
49.	KI-Wash	Non State
50.	APHIA-Plus	Non State
51.	Sustainet (EA)	Non State
52.	Community Asset Building and Development Action (CABDA)	Non State
53.	Busia Community Development Organization	Non State

APPENDIX III: INFORMED CONSENT/ INTRODUCTORY LETTER

Dear Respondent,

This is to introduce you to the study on "Watershed Governance and Food Security in the Lower Sio River Watershed, Busia County, Kenya". The study will be done in the Lower Sio River Watershed, specifically in Nambale, Matayos and Funyula Sub-counties.

The study will be helpful in shaping the policy frameworks, state and non-state actors activities in watershed management and food security in this area.

Your participation in this study is very important as one of the beneficiaries of such watershed resources, food security activities and policy frameworks. The researcher will ensure maximum level of confidentiality as well as use the information only for the academic purposes.

Thank you in advance for your positive response.

Yours sincerely,

Namenya Daniel Naburi

Researcher

APPENDIX IV: TEMPLATE FOR ANALYSIS – OBSERVATION /MAPPING

Mapping issues	**Detailed information**
Natural resources	
Water Watersheds	
Crop fields	
Rangelands	
Gardens	
Forests	
Hilltops	
Wetland	
Others (specify)	
Infrastructure	
Roads/bridges	
Settlements	
Commodity markets	
Stock feed sources	
Others (specify)	
Social services	
Health	
Schools	
Church	
Local administration	
Traditional authorities	
Extension offices	
Government/NGO/CBO offices	
Others (specify)	
Watershed resource use system	
Croplands and use of crop residues	
Communal rangelands	
Grazing reserves	
Water use	
Agro forestry practices	
Brick making	
Charcoal burning	
Quarrying	
Sand harvesting	
Others (specify)	

APPENDIX V: HOUSEHOLD QUESTIONNAIRE

STUDY TITLE: WATERSHED GOVERNANCE AND FOOD SECURITY IN THE LOWER SIO RIVER WATERSHED, BUSIA COUNTY: HOUSEHOLD QUESTIONNAIRE

Section 1: 001: General Social, Economic and Demographic Information

(Please tick/fill blank space)

Interviewer Name/Code:	**Questionnaire No:**	**Date:**
1. County:	**2. Sub-county:**	**3. Location:**
Respondent Name:	**4. Gender:** 1= Male [ ]2 = Female [ ]	

005. Are you head of household	1= Yes [ ], 2 = No [ ]
006. Land size (acres)	1= <1[ ], 2 = 2 [ ], 3 = 4 [ ], 4 = 6 [ ], 5 = 10&> [ ]
007. Educational level	1=None[ ], 2=Primary[ ], 3=Secondary[ ] , 4= Tertiary[ ]
008. Age (years)	1=18-35yrs[ ], 2=36-50 yrs. [ ],3=51-65[ ] 4=above 65yrs[ ] ____
009. Main occupation	1=Farmer [ ] 2= Civil servant [ ] 3=Employee in private sector [ ] 4= Business person [ ] 5= On farm laborer [ ] 6= off farm laborer [ ] 7=other specify_________________
010. Household size	1=Females [ ] 2=Males [ ] 3=No. below 18 [ ] 4=No. above 65years [ ]________________________
011. HH Religion	1=Christians [ ] 2= Muslims [ ] 3=Hindus [ ] 4= Traditional African [ ] 5= Other specify________________
012. HH Average monthly income	1= <3,000[ ] 2=3,000-10,000[ ] 3=10,000-20,000[ ] 4= 20,000 - 30,000[ ] 5= > 30,000[ ]
013. HH Land tenure system	1= Free hold [ ] 2= Lease[ ] 3=Communal [ ] 4= Government [ ] 5= other specify______________________
014.HH Land legal documents held	1=Owner Land Title deed[ ] 2=Family Title deed[ ] 3= Allotment letter [ ] 4= other specify______[___]
015. HH Watershed landform adjacent to	1= Plateua/plains[ ] 2= Mountain slopes[ ] 3= Hill tops[ ] 4=Valley bottoms [ ]_______________________________
016. HH Land use activities	1=Cropland (total) Rain fed[ ] 2=Cropland (total) Irrigated[ ] 3=Grazing land[ ] 4=Forest/woodland[ ] 5=Mixed land[ ] 6=settlement, infrastructure[ ]________________________
017. HH Main source of food	1= Own Farm [ ] 2= Buying [ ] 3=Government donations[ ] 4=Neighbors gifts [ ] 5=NGO [ ] 6=Other Specify____

Section 2: 002: Examining the Adaptive Capacity of State and Non-State Institutions

201. Tick in order of priority the main watershed governance goals in the Lower Sio River Watershed.

1 = Water for Nature [ ] *2 = Whole-Systems Approaches* [ ] *3 = Transparency and Engagement of Affected Parties* [ ] *4 = Subsidiary and Clear Roles for Decision-Making* [ ] *5 = Sustainable Financing and Capacity* [ ] *6 =Accountability and Independent Oversight* [ ] *7= Don't Know* [ ]

202. What are the domains/aims for watershed governance in the Lower Sio River Watershed?
1= Creating social resilience to adapt to a changing climate [ ] *2= Enhancing water-use efficiency and conservation and improving management* [ ] *3= Involving local expertise and resources* [ ] *4= Clarifying roles and responsibilities* [ ] *5= Protecting and enhancing ecological health and functions including food production* [ ] *6= Reducing or avoiding watershed related conflicts* [ ]

203. What changes have you observed in watershed governance since the year 2010 after devolution in Kenya? *Indicate if yes what the changes observed before and after devolution.*

	Changed Aspect	***1=Yes***	***2=No***	***Before devolution***	***After devolution***
a.	*Policy and Regulations*				
b.	*Planning*				
c.	*Social cohesion*				
d.	*Infrastructure*				
e.	*Financial*				
f.	*Ecological*				
G	*Other*				

204. How have the changes affected food production and distribution in this watershed?……………………………………………………………………………

………………………………………………………………………………………………

205. Which of the following watershed governance conditions are present or absent that contributes to your adaptation to social, economic and environmental changes in the Lower Sio River Watershed?

	Watershed governance conditions	**1=Present 2= Absent**	**If YES give examples and If NO give reasons**
	Grass-root by-laws		
a.	Enabling powers in county/national legislation for watershed entities		
b.	Co- management with other international actors		
c.	Support from and partnership with local government		
d.	Sustainable long-term funding		
e.	A functional legal framework for sustainable watershed management		
f.	Availability of data, information and monitoring		
g.	Independent oversight and public reporting		
h.	Assessing cumulative impact		
i.	Continuous peer to peer learning and capacity building		
j.	Mechanism for interaction between upstream and downstream water users		
k.	Traditional/cultural value systems		

206. What are watershed governance structures in the Lower Sio River Watershed that respond to food security crisis?
1= Water resources management plans [ ] *2= Water resources laws and regulations* [ ]

3= Water resources monitoring frameworks [ ] *4= Water resources financial budgets* [ ]

5= Water resource institutions [ ] *3=Water resources policies* [ ] *4=Transparency and accountability means* [ ] *5=Cultural values systems* [ ] 6= *Other specify……………………*

207. List watershed governance structures that hinder effective food production and distribution in the Lower Sio River Watershed.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

208. What are the drivers to watershed destruction in the Lower Sio River Watershed?

1=unsustainable farming practices [ ] *2=Non implementation and reinforcement of existing laws* [ ] *3= Low public knowledge in watershed management* [ ] *4=Lack of information and early warning systems* [ ] *5=Lack of financial resources for investment in watershed management* [ ] *6= Collapse of traditional systems* [ ] *7=Other……………..*

209. In order of importance, what factors contribute to the public involvement in watershed management activities in this Lower Sio River Watershed?

1= Not important 2= less Important 3= Important 4= Very important 5= Don't know

	Watershed Management Factors	**Rank**	**Give examples and give reasons**
a.	*Need to increase or sustain food production*		
b.	*Availability of financial resource*		
c.	*Local political will and support*		
d.	*Good leadership that promotes activities*		
e.	*Local watershed policies, laws, plans*		
f.	*Traditional/cultural values systems*		
g.	*Adequate knowledge and expertise*		
h.	*Collaborations and partnership with other actors*		
i.	*Working with research institutions*		
j.	*Availability of early warning systems*		
k.	*Clear conflict resolution framework*		

210. At what stage did/do you participate in watershed management plans, policies and programmes in the watershed?

	Stage	***1=Yes 2=No***	***Comment***
a	*Formulation*		
b	*Implementation*		
c	*Monitoring and evaluation*		

d	*Do not participate*		

211. Are the following watershed governance values observed in all food security policy processes in the Lower Sio River watershed? ***1= Yes 2=No 3= Do not Know***					
Values	*Policy formulation*	*Policy implementation*	*Policy monitoring*	*Policy evaluation*	*Comment*
Accountability					
Transparency					
Legitimacy					
Inclusiveness					
Responsiveness					

212. What watershed expertise exists that enhance your involvement in watershed management activities in the Lower Sio River Watershed?

1=Watershed planning [ ] *2= Traditional expertise* [ ] *3= Land management* [ ]

4=Water quality monitoring [ ] *5=Stream restoration* [ ] *6= Law enforcements* [ ]

7= Wetland restoration [ ] *8= Forest Management* [ ] *9=Fund raising* [ ]

10=Sustainable Agricultural production [ ] *11=Information and communication* [ ] *12 Farmers coordination* [ ] *13 Policy making and influencing decisions* [ ] *14=Research and Training* [ ] *16= Advocacy and lobbying* [ ] *17=Other……………………………………*

213. Comment on the following sources of funds for watershed and food security activities.

	Source of fund	***Availability***	***Accessibility***	***Sufficiency***	***Utilization***
a	*Line ministry budgets*				
b	*County departments*				
c	*Civil societies/ NGO*				
d	*CDF/Devolved funds*				
e	*Household income*				

Available: *1=Widely available* □*2=Rarely available* □*3=Not available 4=Don't know*□

Accessibility: *1=Easily accessible* □ *2= Difficult to access* □ *3=Not accessible* □ *4= Don't know* □

Sufficiency: *1=More sufficiency* □ *2=moderately sufficiency* □*3= Not sufficiency* □*4= Don't know* □

Utilization: *1= Well utilized* □ *2= poorly utilized* □ *3=Not utilized* □ *4=Don't know* □

214. What are the avenues for watershed information sharing that are preferred by the public in this watershed? ***RANK (1=Most preferred, 2= moderately preferred, 3= Least preferred, 4= Not preferred)***

	Avenue	*Ranking*	*Comment*
a	*County-wide watershed conference*		
b	*Grass-root chiefs barasas*		
c	*Open outreach /education training*		
d	*Ward agricultural offices*		
e	*Faith-based forums*		
f	*Other*		

Section 3: 003: Determining the Effectiveness of Adaptive Co-Management

301. Which department at the county or national level has been tasked with coordinating the work of other departments and stakeholders towards a number of watershed management and food security goals in the Lower Sio River watershed?

1=County department of Agriculture [ ] *2= County department of Environment* [ ] *3=*

NEMA [ ] *4= WRMA* [ ] *5= Ministry of Agriculture* [ ] *6=Ministry of Environment* [ ] *6=*

Don't Know [ ] *7= Other specify……………………………………………………………….*

302. Which new departments, ministries or agencies have been created that enhance watershed management for food security activities in the Lower Sio River watershed?

1=County department of Agriculture [ ] *2= County department of Environment* [ ] *3=*

NEMA [ ] *4= WRMA* [ ] *5= Ministry of Agriculture* [ ] *6=Ministry of Environment* [ ] *7=*

Don't Know [ ] *8= Other specify………………………………………………………………..*

303. What new social policy programs have been created under devolution that enhances watershed management for food security in the Lower Sio River watershed?

1= County Environmental Protection Policy [ ] *2= Water Services Provision policy* [ ]

3= Agricultural Development Policy [ ] *4= Don't Know* [ ] *5= Other*

Specify……………………………………………………………………………………………

304. Who are the main Non State Actors in watershed management activities in this watershed?

………………………………………………………………………………………………

……………………………………………………………………………………………..

305. What watershed management knowledge and resources created by these actors that contribute to food production and distribution in the Lower Sio River Watershed?

1= Watershed planning [ ] *2= Watershed law making* [ ] *3= Land management* [ ]

4= Water quality monitoring [ ] *5= Stream restoration* [ ] *6= Advocacy and lobbying* [ ]

7=Wetland restoration [ ] *8= Forest Management* [ ] *9= Fund raising* [ ]

10=Sustainable Agricultural production [ ] *11=Information and communication* [ ]

12=Farmers coordination [ ] *13=Agri business marketing* [ ] *14 Policy making and influencing decisions* [ ] *15= Research and training* [ ] *16= Other…………………………*

306. Does the watershed management knowledge and resources created by various actors enhance the legitimacy of, and public support for food security interventions?

1=Yes [ ] *2=No* [ ] *3=Don't know* [ ] *if yes specify*………………………………………

307. Does the Non-State Actors bridge the watershed management gap between government agencies and various governance levels (global – national, national – local, global – local)?

1=Yes [ ] *2=No* [ ] *3=Don't know* [ ] *if yes specify*………………………………………..

308. Is there political will for support of Non-state Actors in watershed management and food security activities in this watershed?

1=Yes [ ] *2=No* [ ] *3=Don't know* [ ] *if yes specify*………………………………………..

309. What conflicts in the watershed governance systems exist in the Lower Sio River Watershed that may hinder food security goals?

1= Human- Human Conflicts [ ] *2= Human- Wildlife Conflict* [ ] *3= Citizen-national conflict* [ ] *4= Citizen- County government conflict* [ ] *5= Locals –government policies*

6= Don't Know [ ] *7= Other Specify………………………………………………………*

310. Are there conflicts among actors in watershed management and food security that may lead to exclusion of other actors?

1=Yes□ 2=No□ 3=Don't know □ if yes specify…………………………………………..

311. What are the causes of conflicts among actors in watershed management and food security sectors?

1= Differences in policies [ ] *2=Struggle for same donors* [ ] *3= Watershed resources competition* [ ] *3= Lack of proper coordination* [ ] *4= Government officers interference* [ ] *5= Political interference* [ ] *6=Do not Know* [ ]

312. Are watershed management policies and programs mutually reinforcing food production and distribution in the Lower Sio River Watershed?

1=Yes [ ] *2=No* [ ] *3=Don't know* [ ] *if yes specify*……………………………………..

313. Rank and comment on the public support for the following institutions in watershed governance in the Lower Sio River Watershed.
(***RANKING: 1= Less support, 2=Moderate support, 3= High support, 4= Very High support 5= No support***)

Institution	**Ranking**	**Comment**
Grass root Group		
County government dept.		
National government min.		
NEMA		
WRA		
Nile Bain		
Lake Basin Dev. Authority		
Other		

Section 4: 004: Evaluating the impacts of watershed governance structures on rural food security

401. What are the food security goals for the Lower Sio River Watershed?

1= Food Agricultural research Innovating to feed the county [ ]

2=Engaging and educating the farmers on sustainable food and agriculture [ ]

3=Improving rural livelihoods through food and agricultural systems [ ]

4=Advancing new food and agricultural product solutions [ ]

5=Encouraging a new generation of food and agricultural leaders [ ]

402. Are watershed management policies and programs contributing to shared food security goals and outcomes?
1=Yes [ ] 2=No [ ] if yes specify…………………………...

403. What are the drivers for food insecurity in the Lower Sio River Watershed?

1= Low farm yield [ ] *2= High prices of foods* [ ] *3= Low supply of food in the market* [ ] *4=Prolonged drought* [ ] *5= Land degradation* [ ] *6=Watershed resources degradation* [ ] *7=Low incomes* [ ] *8= Weak warning information systems* [ ] *9= Poor government policy* [ ] *7= Failure of traditional food systems* [ ] *8=Other Specify*…………………….

404. Has the county government impacted in any way on watershed management for food production and distribution in the Lower Sio River Watershed? *Reply per section of watershed*

	Section	***1=Yes***	***2=No***	***Specify***
A	*Hill tops*			
B	*Hill slopes*			
C	*Farm/ plain land*			
D	*Flood plain*			
E	*River stream*			
F	*Others*			

405. How does existing watershed governance structure impact on the following domains of food security in the Lower Sio River Watershed? **IMPACTS: (1= Positively, 2= No impact, 3= Negatively 4= Don't Know)**

Food security domain		**Level of impact**	**Give reasons for your answer**
a.	*Rural agriculture crop production*		
b.	*Rural agriculture livestock production*		
c.	*Rural food trade*		
d.	*Aquaculture activities*		
e.	*Ecosystems/Environmental activities*		
f.	*Development cooperation*		
g.	*Traditional production systems*		

406. Are the existing watershed governance structures contributing to the following factors of food security in the Lower Sio River watershed?

Factors of food security	**1=Yes 2= No**	**Give reason**

Foods are available			
a.	HHs willingness to change food production practices		
b.	HH farmers access to productive technologies and practices		
c.	HH farmers access to resources, labour, finance, agricultural inputs		
d.	HH farmers secure and timely access to fertile land, water and ecosystem services		
e.	HHs knowledge and skills to improve food production		
	Foods are accessed		
f.	Women have a strong say in HH economic decision making		
g.	Increased HH income		
h.	HH engage in secure income generating activities		
	Food stability		
i.	Farmers grow climate adapted crops		
j.	HH are energy efficient		
k.	Land restoration including soil and water conservation and management		
l.	HHs have and implement preparedness plans to protect lives and assets		
m.	HH have coping strategies		
n.	Resource assets, income exists which can be mobilized by HHs		
	Foods are utilized effectively		
o.	Access to clean water		
p.	HHs willingness to change diets		
q.	HHs skills and knowledge to ensure good nutrition, food safety and sanitation		

Section 5: 005: Determining actors perception to changes in rural watershed governance

501. To what extent do you agree with the following statements about changes in rural watershed governance? **5. Strongly Agree, 4. Agree, 3. Undecided, 2. Disagree, 1. Strongly Disagree**

	Statement	**Rank**
A	Watershed governance determine food security	
B	Current devolution system in Kenya has impacted watershed governance	
C	The county system has potential to promote watershed governance	
D	Current devolution system has potential to promote adaptive behavior through watershed governance	

E	Watershed management should be prioritized during county planning	
F	Accepted watershed governance will promote sustainable livelihoods.	
G	County government focus on watershed governance will increase budgetary allocations and human resources for sustainable food security.	

502. What is your level of satisfaction with the following domains of watershed governance in enhancing your involvement in food production and distribution in this watershed?

Levels: 1=Highly satisfied 2=Satisfied 3=Fairly Satisfied 4=Less Satisfied 5= Not satisfied

	Watershed governance domains	**Level of satisfaction**
a.	Creation of local social resilience to adapt to climate change	
b.	Enhancing water-use efficiency and conservation and improving management	
c.	Involving local expertise and resources	
d.	Clear roles and responsibilities of various actors	
e.	Protection of ecological health and functions including food production	
f.	Reducing or avoiding watershed related conflicts	
g.	Watershed management for food production decision making process	

503. In order of importance rank the watershed governance contextual factors that must be addressed by all actors for effective and sustained food production and distribution in the Lower Sio River Watershed. **RANKS 1= Most Important 2= Fairly Important 3= Important 4= Least Important 5= Not important**

Factor	**Rank**	**Give Reason for your ranking**
Geographical diversity		
Cultural diversity		
Land tenure system		
Legal rights to water and water resources		
Existing strategic land use plans and other watershed resources		
Lack of local government jurisdiction over upstream activities		
Emerging integrated single decision making for resource development in the county governments		
Limited or non-existence requirement to monitor and report actual water use		
The current lack of tools to assess cumulative watershed impacts		
Nature of potential changes to regulate groundwater extraction, monitoring, and assessment		

504. To what extend do you agree with the following as the main driver for a more collaborative watershed-focused model of management and governance in the Lower Sio River Watershed. **RANKS: 5. Strongly Agree, 4. Agree, 3. Undecided, 2. Disagree, 1. Strongly Disagree**

Driver	**Rank**	**Give reason for your ranking**
The demand for local domestic use water protection		
Water pollution control		
threat of increasing water use along River Sio		
Concerns of fish and other water habitant protection		
Recognition of increasing water scarcity		
Increasing uncertainty and conflicts among water users		
Growing demand for citizens to have a viable voice in watershed decision making		
Fiscal constraints on all levels of government		
Institutional barriers that results from fragmented decision-making		

505. Why do you think change is necessary in watershed governance systems at the local level in the Lower Sio River Watershed?

Reason	**1= Yes** **2= No**	**Give reason for your reason**
A commitment to more holistic watershed management approaches		
Ensuring water resource management are treated as a public trust		
New forms of governance that involve the sharing of power or rescaling of decision making		
Need for institutions that attempt to address the problem of fit between administrative and biophysical boundaries		
There is no need for change in watershed governance systems		

Thank you for participating in the study

APPENDIX VI: KEY INFORMANT INTERVIEW GUIDE

STUDY TITLE: WATERSHED GOVERNANCE AND FOOD SECURITY IN THE LOWER SIO WATERSHED, BUSIA COUNTY: ACTORS IN-DEPTH INTERVIEW GUIDE

This guide targeted the State and Non-State Actors

Instruction: Complete each section as indicated. This instrument will be used on conducting face to face interviews.

1. Name of the Organization _____________________Contact_____________________

2. Name of the Interviewee _____________________Designation_____________________

3. Which description best fits your organization?

1=National government dept [ ] 2=County government dept. [ ] 3=International NGO [ ] 4=Local NGO [ ] 5=Non-profit/community-based [ ] 6=Faith-based organization [ ] 7=Academic organization [ ] 8=*Private consulting/business* [ ] 9= *Other* ______________

4. Within which watershed/river basin(s) does your organization work? (*Please select all that apply*).

1=International [ ] 2= Sub Saharan Africa [ ] 3= Eastern Africa [ ] 4= Entire nation (Kenya) [ ] 5=Busia County [ ] 6= Lake Victoria Basin [ ] 7= Sio River [ ] 8= Western Kenya Region [ ] 9= Other specify ____

5. Which of the following priority topic areas fall under your organization's mission? (*Please check all that apply.)*

1=Watershed management [ ] 2=Forest resource management [ ] 3=Agricultural production [ ] 4= Land/habitat conservation [ ] 5= Food security [ ]6= Research/data collection [ ] 7= Grassroot institutions building [ ] 8= Education outreach & advocacy [ ]9= other (please list) ____

6. Approximately how many years has your organization been involved in watershed related efforts? *(Please only enter a number.)* _______________________________

7. What is the main priority watershed governance goals in the Lower Sio River Watershed?____

____

____

8. What are the domains/aims for watershed governance in the Lower Sio River Watershed?____

____

____

9. What are the watershed governance structures in the Lower Sio River Watershed?____

____

____

10. What are the drivers to watershed destruction in the Lower Sio River Watershed? Are they the same drivers for food insecurity in the watershed?____

____

____

11. What changes either social, economic and/ or environmental have you observed in watershed governance in the Lower Sio River Watershed since the year 2010 after devolution in Kenya?

12. Which watershed governance conditions are present that contributes to public adaptation to social, economic and environmental changes in the Lower Sio River Watershed?

13. How has your organization or institution adapted to the social, economic and environmental changes mentioned above?

14. How does your organization or institution contribute to the public watershed management activities for food security?

15. What watershed knowledge and resources does your organization offer that complement the efforts of other actors in watershed management in the Lower Sio River Watershed?

16. Does your organization have by-laws and plans that contribute to watershed activities in this watershed? Give examples.

17. Are these by-laws and plans consistent with the grassroots, county, national and international laws and plans? Give examples.

____

____

18. Is there public and political support for your programmers in watershed management in the Lower Sio River watershed?

____

____

19. Which departments or ministries have been created that coordinates and enhances watershed management and food security activities in the Sio Watershed?

____

____

20. What new social policy programs have been created to foster food security in the Lower Sio River Watershed?

____

____

____

21. Are there conflicts in the watershed governance systems in the Sio Watershed that may hinder food security goals? What are the causes of conflicts among actors and what mechanisms have been put in place to address such conflicts?

____

____

____

22. What are the main drivers for a more collaborative watershed-focused model of management and governance in the Lower Sio River Watershed?

____

____

23. Describe the working relationship between your organizations with the following institutions: *NEMA, WRUA, County Environment department, County Agriculture department, Faith Based organizations, CBOs, NGOs*.

____

____

____

24. Comment on the following sources of funds for local watershed management activities in the Lower Sio River watershed. *Individual income budgets*, *CDF, County Budgets, National government budgets, NGOs funds*

____

____

____

25. Describe how the existing watershed governance structures ensure the following values are observed in the Lower Sio River Watershed. I.e. ***Transparency, Accountability, inclusiveness and responsiveness.***

____

____

____

26. What are the domains or aims for food security in the Lower Sio River Watershed?____

____

____

____

27. How has the current watershed governance structures impacted on food security in the Lower Sio River Watershed? I.e. ***availability of food, access to food, food utilization and food stability.***

____

____

____

28. What are watershed governance structures in the Lower Sio Watershed that respond to food security crisis?

____

____

____

29. What are watershed governance structures in the Sio Watershed that hinder effective food security in the area?

____

____

____

30. Are you satisfied with watershed management and food security governance process in this Watershed? What changes do you proposed that will enhance watershed governance for food security in the Lower Sio River Watershed?

____

____

Thank you for participating in the study

APPENDIX VII: FOCUSED GROUP DISCUSSION GUIDE

STUDY TITLE: WATERSHED GOVERNANCE AND FOOD SECURITY IN THE LOWER SIO WATERSHED, BUSIA COUNTY: FOCUSED GROUP DISCUSSION GUIDE

Section 1: 001: General Information

FGD No:		**Name of Facilitator:**	
Name of the County:		**Sub county:**	
Ward:		**Village:**	
No of Males:		**No of Female:**	
Other information:			

Section 2: 002 Probing on Watershed Governance and Food Security

1. Which description best fits this group?

1= WRUA. [ ] 2= CFA. [ ] 3= Social Accountability [ ] 4= Faith based [ ] 5= Farmers group [ ] 6= Other ____________________

2. Within which watershed/river basin(s) does your group work? (*Please select all that apply*.)

*1=Village [ ] 2= Location [ ] 3= Sub-county [ ] 4= County [ ] 5= Other specify*_______

3. Which of the following priority topic areas fall under your group's mission? (*Please check all that apply.)*

1=Watershed management [ ] 2=Forest resource management [ ] 3=Agricultural production [ ] 4= Land/habitat conservation [ ] 5= Food security [ ]6= Research/data collection [ ] 7= Governance/ citizen engagement [ ] 8= Education outreach & advocacy [ ] 9= other (please list) ____

4. Approximately how many years has your group been involved in watershed related efforts? *(Please only enter a number.)* ____

5. What are the main priority watershed governance goals in the Lower Sio River Watershed?

Men	
Women	
General	

6. What are the domains/aims for watershed governance in the Lower Sio River Watershed?

Men	
Women	
General	

7. What are the watershed governance structures in the Lower Sio River Watershed?

Men	
Women	
General	

8. What are the drivers to watershed destruction in the Lower Sio River Watershed? Are they the same drivers for food insecurity in the watershed?

Men	
Women	
General	

9. What changes social, economic and/ or environmental have your group observed in watershed governance in the Lower Sio River Watershed since the year 2010 after devolution in Kenya

Men	
Women	
General	

10. Which watershed governance conditions are present that contributes to the members adaptation to social, economic and environmental changes in the Lower Sio River Watershed?

Men	
Women	
General	

11. How has your community adapted to the social, economic and environmental changes mentioned above?

Men	
Women	
General	

12. How does your group contribute to the watershed management activities?

Men	
Women	
General	

13. Does your group has by-laws, plans to regulate members watershed activities? Give examples.

Men	
Women	
General	

14. Are there any external assistance you received in making the by-laws and the plans to regulate members watershed activities?

Men	
Women	
General	

15. If yes are these by-laws and plans coherent with the county, national and international laws and plans?

Men	
Women	
General	

16. What watershed knowledge and resources does your group offer that complement the efforts of other actors in watershed management in the Lower Sio River Watershed?

Men	
Women	
General	

17. Do you and local political leadership support other actors' programmes in watershed management in the Lower Sio River watershed?

Men	
Women	
General	

18. Which departments or ministries have been created that coordinates and enhances watershed management and food security activities in the Sio Watershed?

Men	

Women	
General	

19. What new social policy programs have been created to foster food security in the Lower Sio River Watershed?

Men	
Women	
General	

20. Are there conflicts in the watershed governance systems in the Sio Watershed that may hinder food security goals? What are the causes of conflicts among actors and what mechanisms have been put in place to address such conflicts?

Men	
Women	
General	

21. What are the main drivers for a more collaborative watershed-focused model of management and governance in the Lower Sio River Watershed?

Men	
Women	
General	

22. Describe the working relationship between your groups with the following institutions: ***NEMA, WRUA, County Environment department, County Agriculture department, Faith Based organizations, CBOs, NGOs***.

Men	
Women	
General	

23. Comment on the following sources of funds for your participation in watershed management activities in the Lower Sio River watershed. *Individual income budgets, CDF, County Budgets, National government budgets, NGOs funds*

Men	
Women	
General	

24. Describe how the existing watershed governance structures ensure the following values in the Lower Sio River Watershed. I.e. ***Transparency, Accountability, inclusiveness and responsiveness.***

Men	
Women	
General	

25. What are the domains or aims for food security in the Lower Sio River Watershed?

Men	
Women	
General	

26. How has the current watershed governance structures impacted on food security in the Lower Sio River Watershed? i.e. ***availability of food, access to food, food utilization and food stability.***

Men	
Women	
General	

27. What are watershed governance structures in the Lower Sio Watershed that respond to food security crisis?

Men	
Women	
General	

28. What are watershed governance structures in the Sio Watershed that hinder effective food security in the area?

Men	
Women	

General	

29. Are you satisfied with watershed management and food security governance process in this Watershed? What changes do you proposed that will enhance watershed governance for food security in the Lower Sio River Watershed.

Men	
Women	
General	

Thank you for participating in the study

APPENDIX VIII: STAKEHOLDERS INVENTORY –BUSIA COUNTY

S/no	NAME OF STAKEHOLDER	TYPE OF ORGANIZATN	GEOGRAPHICAL AREA OF COVERAGE	SERVICES OFFERED / ACTIVITIES PROJECT TITLES
1	Family bank	Private Bag	County wide	Financial services
2	K-Rep Bank	Microfinance	County wide	Provision of credit
3	AFC	GoK microfinance	County wide	Provision of agricultural credit
4	KCB Limited	Private Bag	County wide	Kilimo biashara loans. Agricultural loans
5	KWFT	Private Bag	County wide	Provision of Microfinance to groups and individuals.
6	Equity bank	Private Bag	County wide	Kilimo biashara loans Agricultural loans
7	KARI	Research organization	Bungoma, Busia Siaya & Kisumu counties	**Research activities:** Maize, Grain legumes (Pulses), Horticulture, Sweet potatoes, Cassava, Oil crops, Sorghum and millet, KARI Seed Unit, Livestock, biotechnology & Fruit Nursery, Soil Fert & Water Management
8	PALWECO programme for agriculture and livelihoods in western communities	NGO	County wide	**C1-**Household economy, **C2-** Value chains approach in agriculture sub-sector, **C3-**Support functions that result into strengthened capacity of beneficiaries
9	ACCI-GIZ	NGO	Busia Bunyala Namable Butula	ACCI-Adaptation to climate change and insurance, Greenhouse gas sources and emissions and enhancing greenhouse gas sinks.
10	Fisheries Department	GOK	County wide	Farmed Tilapia, Farmed Catfish, Catfish fingerling production for bait and fish farming
11	Livestock	GOK	County	Indigenous poultry, honey value

	Department		wide	chain, dairy value chain, Small ruminants. Extension services
12	Cooperative Department	GOK	County wide	cooperatives development
13	ADS/WRCCS	NGO(ACK-Church organization)	County wide	Bee keeping, amaranth, oil palm, rice promotion
14	GAPP-Grass root poverty alleviation programme	NGO	Bunyala	Markets processed products from cassava, s/potatoes, sorghum and ground nuts.
15	NEMA	Parastatal	County wide	Environmental conservation
16	KAPAP	GOK programme	Busia, Bunyala, Namable, Butula.	Capacity building Input support to groups
17	ONE ACRE FUND	NGO	Countywide	Provision of input on credit
18	Agriculture department	GOK	County wide	Extension services
19	Forestry Department	GOK	County wide	Forestry extension, river bank rehabilitation
20	IPA(Integrated poverty action)	NGO	busia sub county	Spring protection, environmental conservation
21	KENFAP	Private farmers organization	County wide	Advocacy, lobbying ,biogas
22	Irrigation Department	GOK	Nambale, Busia, Butula.	Have 2 irrigation projects :mairo/Mukemo and Syekunya in namable on rice and local vegetables
23	BUSIA AGROVET	Private	Busia sub county	Agric inputs
24	REFSO(Rural energy and food security organization)	Private	County wide	**Cassava-** provision of clean planting Materials to groups and also does Bulking
25	Kenya Breweries	Private	County wide	**Sorghum-** engages farmers in contract farming
26	PAFID-CARP (Participatory	Private	Countywide	Conservation Agriculture-by use of Minimum tillage and herbicide

	Approaches in Integrated Development-CA regional program			control on weeds)
27	REEP(rural education and empowerment programme	Private	Busia, Butula, Namable	Sweet potatoes and tomatoes
28	ARDAP(appropriate rural development in agriculture programme)	Private	Busia, Butula, Namable	Sweet potatoes, Nerica rice, soya beans, g/nuts capacity building on production and value addition. Gives loan to groups
29	L3f Sacco (life long learning sacco)	Private	Busia, Butula, Namable	Sorghum- Collecting, storage and marketing of sorghum
30	ICS (International Child Support)	NGO	Busia, Butula, Namable	Cereal banking, Input credit
31	KENVEST	Financial Institution	Country wide	Provides financial credit
32	Lands Department	GOK	County wide	Land issues
33	Youth Department	GOK	County wide	Provides youth fund credit
34	Planning department	GOK	County wide	Provision of planning data
35	Veterinary Department	GOK	County wide	Veterinary services
36	Cooperative department	GOK	County wide	Marketing of agricultural products
37	Gender Department	GOK	County wide	Gives women enterprise fund credit
38	LBDA	NGO	Countywide	Fish, rice VCs
39	Farm concern international	NGO	Busia, Butula	Support horticulture and cassava production
40	Heifer international	NGO	County wide	Support dairy value chain-gives heifer grants to
41	KEBS	Parastatal	County wide	standardization of products
42	Public health department	GOK	County wide	Regulates products entry Controls quality of products Ensures food quality

43	KEPHIS	Parastatal	Countywide	Regulates products entry
44	Municipal council of Busia	GOK		
45	KICKSTART	Private	County wide	Demonstration on irrigation
46	Western seed company	Private	County wide	Provision of certified seed
47	Kirinyaga Millers	Private	Busia sub county	Buys orange freshed sweet potato flour
48	Faulu Kenya	Private	Countywide	Provision of microfinance to groups
49	GAPK-grow against poverty Kenya	Private	Busia sub county	Promotes cassava cottage Supports the vulnerable with dairy goats.
50	Cotton Development Authority(CODA)	Parastatal	Countywide	Promotion of cotton farming
51	Horticultural Crops Development Authority(HCDA)	Parastatal	Countywide	Facilitate development, promotion, coordination and regulation of the horticultural sub-sector
52	One World Development Foundation(OWDF)BUSIA	NGO	Countywide	Promotion of sorghum, soya beans, local poultry, local goats
53	KENYA SEED COMPANY	Parastatal	Countywide	Promotion of maize, beans, sorghum, finger millet. Coming up with Nerica rice 4
54	DEMAS BUSIA	NGO	Countywide	Promotes bee keeping
55	AGRICULTURAL CONSULTANT BUSIA	Private	Countywide	Consultancy on agriculture and livestock enterprises
56	KEPOFA/KDB NAMBALE	Private	Countywide	Service provider for poultry and dairy production
57	SEEDCO(K)	Private	Countywide	Deal with soya beans, sorghum & maize

58	Ministry of Veterinary Department	GOK	Countywide	Provision of veterinary services
59	LIFESTRAW	Private	Countywide	Water purification
60	AMUKURA CIVIC EDUCATOR	Private	Amukura	Civic Education
61	Human Support Organization (HUSO)	NGO	Countywide	Gender and civic education issues
62	Family Life Education Program(FLEP)	NGO	Countywide	Gender and civic education issues Adult education, agriculture
63	Kenya Woman and child Transformation Agenda (KEWAKTA)	NGO	Countywide	Gender and civic education issues
64	Budinet Bunyala	NGO	Countywide	Gender and civic education issues
65	Probios Technologies (Rabbit Marketing Linkages	NGO	Teso North (Malaba and Katakwa)	
66	JOSEPH WALUBENGO H	NGO	countywide	NRM
67	HAND IN HAND	NGO	COUNTY WIDE	Training Microfinance products and services Value addition and market linkage Focus on environment
68	ONE ACRE FUND	NGO	COUNTY WIDE	Provision of input on credit
69	WORLD VISION	NGO	ANGURAI-TESO NOTH CONSTITU ENCY	Involved in sponsorship project management, education, water, education, water and sanitation and HIV &AIDS projects
70	WINROCK INTERNATION AL (Yes youth can! Western	NGO	COUNTY WIDE	Youth issues

	program)			
71	FARM AFRICA	NGO	COUNTY WIDE	Aguashops
72	CATHOLIC RELIEF SERVICES	NGO	COUNTY WIDE	Farmer to farmer project
73	CABE(Centre for African Bio-Entrepreneurship)	NGO	COUNTY WIDE	
74	ICRISAT (International Crops Research Institute for Semi-Arid Tropics	Research organization	COUNTY WIDE	

APPENDIX IX: Simpact Kenya NGO; Farmer's Internal Regulations guideline

Simpact Kenya NGO; Farmer's Internal Regulations guideline (From English to Iteso language)

1. Farmers willing to join the organic sesame project will first receive training on organic sesame production.
   Lukakorwok lulokokina akoru nemam abosetaiti na agwelata ebaiti adumun akisisianakino naka akoru kikanyim itosomaete abosetait nakore.
2. New farmers joining the project or new fields being registered for organic production will take 2 years transition period unless exempted because of non-use disallowed input at least in at least three years before commencing organic production
   Lukakorwok lukitetiak kotani amaata nukiteteak lugirio akoru naemam ebosetait nagwelata eyangari ikaru iyare lukakilomo akoru nakakitsoma abosetaiti naka ore. Lu emamum kitosomato ikee kamaata kokaru kiuni nesiboni esikino.
3. Soil fertility shall be built using nutrient recycling, compositing, manures, improvement of soil organisms and control of soil erosion. Only allowed amendements/ natural inputs like phosphate rocks may be used.
   Abosetaiti kamana inyakakino kakitosoma abosetaiti nakore na ingarakiti bobo komam alelianar kalipo adepare iboro luechamakite (Natural inputs e.g Lime and Phosphate).
4. Tools and materials used for handling organic sesame shall be cleaned always before use.
   Iboro lutosomayo kakoru ikanyim lu ekorite kabosetaiti naka ore ilosio eroko kitosoma.
5. Farmers shall construct buffer zone to avoid contamination from neighbouring farms.
   Amaata kikanyim ejai atiakara kamaka kinyamata kaluche kanuka akirebokin akipwokun.
6. Crop production practices such as crop rotation shall be practiced. There shall be no burning of organic materials.
   Akoru naka akibelebele inyamata ejai itunga akisisia. Emamu akichwe abosetait.
7. Weeds, pests and diseases, shall only be managed through physical, biological and cultural methods. Only authorized and approved inputs may be used. Farmers shall not use synthetic materials at any one time on their farms.
   Inya, ikuru ka dekasinoi irebokino ka irotin lukasek (biological, physical and cultural). I boro luechamamakite boni esikite (inputs).
8. Farmers shall only use organic seeds provided by the cooperative or sourced from recommended source (own farm).
   Lukakorwok esikite boni adumun icoko luemamum ekeya kakatongotont bon.
9. Handling of organic sesame shall be done using clean materialand containers. Packing shall be done using labeled and designated bags.
   Akidara ikanyim luekorite emamum ekeya itosomayo iboro lu emam ekeya. Iboro lu igwaere paka kigirigiritete.
10. Sesame shall be stored in a designated clean store separated from possible source of contamination. No use of synthetic pesticides in the organic stores.
    Nama igwaere ikanyim ebait kolaye akirebokini ekipwokun. Mam ikitosoma ikee luka oduka.
11. Transport shall be done using the recommended and clean means. Vehicle transporting sesame shall be covered appropriately.
    Adakite ikanyim itosomayo iboro luelaete kicakitete. Amotoka karapitete tenan.
12. Farmers registered in the project shall only sell their sesame through the cooperative.
    Lukakorwok lu-igirakina egwelatere ikanyim kakatongongoto.
13. Processing shall be done by trained personnel using cleaning equipment.
    Akitene ikanyim esikite kwi lu-isisikite bon kiboro lu-elaete bon.
14. Farmers shall keep update records of their farms operations.
    Lukakorwok ebait ejautu kakigirigirisia ka koru kes.
15. Framers shall allow cooperative officials and inspectors to visit their farms.
    Lukakorwok ejai acamakin luka akatongotongot, kalu esikite anyanar amaata bon.

Source: Analysis from the interview with the Simpact Agronomist.

APPENDIX X: STATUS OF SMALL HOLDERS IRRIGATION SCHEMES IN BUSIA COUNTY AS AT OCTOBER 2017

Name of project	Size in HA	No of H/H	Location	Started	Type of scheme	Activities achievements	constraints	Remarks
Nandikinya	200	60	Bunyala sub county	1986	Pumping	Survey &Design canals laid Basic IWUA training	Lack of funds silted canals Flooding of pump house Lack of electricity Big changes in suction head	The has stalled for long and farmers are almost giving up Action on the intake system will ensure a quick result& Training of famers should be upscaled
Mudembi/Ruambwa	250	100	Bunyala sub county		Pumping	Incomplete Designs Basic IWUA training Laid canals installed intake system	Lack of funds Incomplete laying of canals Many farmers are not trained	The scheme is operating on phase 1 of 50 acres despite the challenges
Sisenye	200		Bunyala Sub County		Pumping	The intake construction &pump installation Canals are 50% done Basic IWUA training	Control flooding around the intake `Power supply not complete On farm distribution line	This project was taken up by NIB for up scaling
Samia Fruits	60	60	Samia Sub County	2010	Pumping&gravity	Installation of intake system Laying of rising main line	Flooding of the intake area Leaking	The intake must be protected from the rising levels of the

						Construction of storage tank Basic IWUA training	water tank Lack of funds Lack of distribution lines	lake and the tank repaired for objectives to be achieved
Neela irrigation project	120	80	Butula Sub county Esikoma ward	Gravity scheme	2008	2 springs protected Collection pan constructed Basic IWUA training	Not enough water Use of open canals Lack of funds Farmers on the steep slopes	Desilting of storage and change from open canals to pipes and drip system &storage tanks be combined to increase efficiency
Namusala	100	50	Butula Sub Cou Butula ward	Gravity scheme	2011	IWUA formed sensitization done Surveyed &designed	No funding Lack of cohesiveness among the farmers	The project did not start as it was not funded
Namalenga	50	45	Matayos Sub County	Gravity	2009	Laid open canals Basic IWUA training	Use of pipe instead of open canals for efficient conveyance	The project is viable with improvement of water conveyance &utilization on the farms
Akatagroit	40	100	Teso south	Gravity		Intake weir constructed main line 2220m installed	On farm distribution not done drip kits and storage	Intake works done by GOK Pipe works funded by WKCDD
Syekunya drainage site			Nambale Sub county	2009	Drainage	Drainage channels dug but incomplete Basic IWUA formation Survey and Design done	Late disbursement of funds Poor conflict resolution	There is need to capacity build the project committee members and the farmers

							among members	
Mayenje drainage project.	150	100	Matayos Sub County	1998	Drainage	Sensitization and mobilization Excavation of drainage canals	Low funding Incomplete designs	Need to complete the designs and Carryout EIA

APPENDIX XI: RESEARCH PERMIT FROM NACOSTI

THIS IS TO CERTIFY THAT:
MR. NAMENYA DANIEL NABURI
of MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY, 315-50300 MARAGOLI,has been permitted to conduct research in *Busia County*

on the topic: *WATERSHED GOVERNANCE AND FOOD SECURITY IN THE LOWER SIO RIVER WATERSHED, BUSIA COUNTY KENYA*

for the period ending:
9th October,2018

Permit No : NACOSTI/P/17/12713/19472
Date Of Issue : 9th October,2017
Fee Recieved :Ksh 2000

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Applicant's Signature

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Director General
National Commission for Science, Technology & Innovation