ASSESSMENT OF LOCAL GOVERNANCE STRUCTURES, ATTITUDES AND PERCEPTIONS INFLUENCING MANAGEMENT OF THE MANGROVE ECOSYSTEM IN VANGA, KENYA

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A Thesis submitted to the Graduate School in partial fulfillment of the requirements for the award of a Master of Science Degree in Natural Resource Management of Egerton University

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DECLARATION AND RECOMMENDATION

I hereby declare that this thesis is my original work and has never been presented for the fulfillment for the award of a degree in any other university and that all the sources I have used have been acknowledged.

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DEDICATION

I dedicate this work to my parents, Mr. George Omondi and Mrs. Margaret Mbira, my siblings Jane and Charles and to Almighty God, my source of constant support and encouragement throughout my academic journey.

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ABSTRACT

Mangroves throughout the world are a critical ecosystem facing numerous threats. In Kenya, losses of mangroves in the last two decades have been estimated to be at 20%. Continued destruction could result in more than 70% of mangrove cover loss in the next 50 years thus affecting biodiversity and livelihoods of many coastal communities. Overexploitation and conversion pressure are the main causes of loss and degradation. Incentive based mechanisms such as Payment for Ecosystem Services (PES) and Reduction of Emissions from Deforestation and Forest Degradation (REDD+) could significantly increase local community participation in mangrove conservation. Two important questions concerning the likely applicability of incentive based schemes to a given site are: what is the capacity of the local governance structures to manage these programs and what are the views of the local community regarding the state of the ecosystem? This study investigated the local governance structures that exist to support conservation and management of the mangrove ecosystem. Using Vanga mangrove ecosystem as a case study, the study further investigated attitudes and perceptions of local communities towards the status and condition of mangroves forests in their area. The data was collected through key informant interviews, focus group discussions, household surveys and participant observation. Data analysis was done using descriptive statistics, correlations, cross-tabulation, text analysis and data triangulation. The Forest Guard was recognized as the key decision maker in local mangrove governance by 78% of respondents while co-management by the Community Forest Association was only recognized by 32%. Poor monitoring strategies and lack of adequate community consultation were identified as major factors that led to continued destruction of the resource. More than half (62 %) of the respondents perceived the Vanga mangrove ecosystem as degraded to some extent; whereas 86% would be willing to participate in their conservation if incentives were provided. Local decision making on how to share benefits accrued was a significant motivation factor for participation in conservation as this allows for community priorities to be taken into consideration. It is highly likely that the attitude of the community towards the incentive based initiatives would be influenced by the perceived long-term benefits of conserving the mangrove ecosystem for carbon credits against the opportunity cost of short-term benefits of exploitation. Providing opportunities for community monitoring through creation of by-laws and local sanctions would promote better community support. Community training on incentive based schemes is necessary in order to provide a better understanding of the concept and thus foster long term community support in conservation.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

BMU	Beach Management Unit
CBNRM	Community Based Natural Resource Management
CCD	Climate Compatible Development
CDTF	Community Development Trust Fund
CESEA	Coastal Ecosystem Services for East Africa
CFA	Community Forest Association
COP	Conference Of Parties
EAWLS	East African Wildlife Society
INDC	Intended Nationally Determined Contribution
JEG	Jimbo Environmental Group
KFS	Kenya Forest Service
KMFRI	Kenya Marine and Fisheries Research Institute
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Service
MPA	Marine Protected Area
PES	Payment for Ecosystem Services
PFM	Participatory Forest Management
PIN	Project Idea Note
REDD	Reduction of Emissions from Deforestation and forest Degradation
SDF	State Department of Fisheries
SDG	Sustainable Development Goals
SES	Socio-Ecological Framework
VAJIKI	Vanga Jimbo Kiwegu

CHAPTER 1: INTRODUCTION

1.1 Background to the study

From global to local scales, mangroves are critical coastal ecosystems of immense significance both ecologically and economically. These ecosystems provide important goods and services which include provisioning such as charcoal, fuel wood and timber (FAO, 2007; Crona and Ronnback, 2005), regulating such as protection from floods, storms and erosion of soil, supporting services such as breeding and nursery sites for fish and crustaceans, and cultural which include recreation, religious and aesthetic values of the resource (Brander *et al.*, 2012; TEEB, 2010; UNEP, 2006; MEA, 2005). Mangroves also play an important role in carbon sequestration with their storage averaging 1023 Mg of carbon per hectare which is several times greater than the carbon density in terrestrial forest systems therefore having great implications for climate change mitigation (Donato *et al.*, 2011).

Mangroves are however, threatened ecosystems (Valiela *et al.*, 2001; Spalding *et al.*, 2012), with threats ranging from overexploitation, conversion of mangrove areas to other land uses (FAO 2007; Valiela *et al.*, 2001), pollution effects to climate change related factors (Adeel and Pomeroy, 2002; Alongi, 2002). The deteriorating status of mangroves has been extensively discussed in numerous studies and many possible solutions to address this issue suggested in various platforms (Giri *et al.*, 2011; Giri *et al*, 2008; Gilman *et al.*, 2008) but ironically, anthropogenic activities that accelerate mangrove degradation continue globally (Giri *et al.*, 2011) . This is due to the fact that human- induced destruction is driven by self-centered short term benefits (Hardin, 1968) against the long term ecosystem benefits. The situation has led to continuous efforts to engage the community living around the resource in management for effectiveness of conservation strategies (Walters, 2004).

Incentive based management through schemes such as Payment for Ecosystem Services (PES) provides a relatively new way of engaging communities in conservation and management of mangrove forest ecosystems. PES has been an effective venture in countries such as Costa Rica where there has been a well-developed PES scheme since 1997(Rosendal and Schei, 2014). Costa Rica was the first country to establish PES schemes and the progress and potential of the schemes there encouraged establishment of PES in countries like Ecuador (Cranford and Mourato, 2014; Wunder, 2005), Nicaragua (Pagiola *et al.*, 2007), Vietnam (To *et al*., 2012) and Bolivia (Wunder, 2005). Successes of PES principles have helped pave way

for introduction of Reduction of Emissions from Deforestation and forest Degradation (REDD+) schemes which provides financial incentives for reduced carbon emissions through compensation of countries that are willing to reduce carbon emissions from deforestation and forest degradation (UNFCCC, 2008). While the structure and modalities of REDD+ are still being debated (Larson, 2011), individual projects employing aspects of the scheme receive carbon offset payments from existing voluntary carbon markets such as the Kasigau Corridor Carbon project in Kenya. Whereas the contribution of mangroves to sequester carbon has been largely ignored in the past, their enormous potential creates the need to support the adjacent local communities in engaging in carbon offset projects and thus inclusion in REDD+ schemes (Locatelli *et al.,* 2014). The success of such projects will largely be dependent on effective management and governance systems particularly at the local level. Perceptions and attitudes of the local community also have a bearing on their ability to manage the forest resource. Those who deem conservation of the ecosystem for posterity as more important than short term economic or socio-cultural acquiring of benefits are more likely to be involved in conservation oriented projects.

Mangroves in Kenya continue to be degraded through overharvesting of wood products, particularly firewood and building poles (Dahdouh-Guebas *et al.,* 2000, Mohamed *et al.,* 2009)), conversion of mangrove areas to other land uses including urban development, pond aquaculture (Kairo *et al.,* 2001) and salt extraction (Abuodha and Kairo, 2001). Inadequate governance structures from national to grass-root level coupled with poor attitudes and perception of local communities toward mangrove conservation exacerbate the problem (Kirui *et al.,* 2013).

Mangroves in the Kenya have been formally protected since 1932 under Proclamation No. 44 and thereafter in 1964 by Legal Notice No. 174. Currently they are protected under the Forest Act of 2005. The Forest Act empowers the communities to manage gazetted forests including mangroves. Part IV Section 45 (1) of the Act allows for the communities to participate in co-management of forests by registering a Community Forest Association (CFA) under the Societies Act. The CFA must provide a clear management plan and subsequently sign a management agreement with the Kenya Forest Service (KFS) which is the government agency mandated by the Forest Act to protect all state forests. In mangrove areas, governance structures at the local level have also been inadequate to support co-management (Kirui *et al.,* 2013) thus resulting in communities largely being excluded. Major challenges also stem

from poor implementation and enforcement of the laws, inefficiency of surveillance and lack of economic incentives to local communities (Ongugo *et al.*, 2007).

1.2: Statement of the problem

The potential of obtaining payments to local communities for mangrove carbon credits has been proven to be great. This is owing to the successful implementation of Mikoko Pamoja in Gazi Bay, Kenya. Despite this success, there is still limited understanding of local governance structures and community support for the establishment of a sustainable mangrove carbon offset project. This study sought to understand the local mangrove governance structures and community mental models of the mangrove resource through a case study in Vanga, Kenya, a site being considered for the upscaling of Mikoko Pamoja project.

1.3: Research Objectives

1.3.1: Broad objective

To support existing governance systems, national bodies and international protocols in promoting development of local incentive-based schemes that incorporate multiple mangrove ecosystem services.

1.3.2: Specific objectives

1. To characterize the major goods and services extracted from mangroves in Vanga area.
2. To characterize local governance systems, their roles and acceptance amongst the local community in the Vanga area.
3. To evaluate the local perceptions and attitudes on the state of the mangrove ecosystem in Vanga area.
4. To assess the potential for community involvement in incentive based management through a mangrove carbon offset project.

1.3.3: Research questions

1. What are the mangrove goods and services that the Vanga community depend on?
2. What local governance systems exist in Vanga and what are their roles and level of acceptance in the community?
3. How does the local community perceive the state of mangroves in Vanga and what are their attitudes towards it?

4. Does the local community have the capacity to participate in conservation of Vanga mangrove ecosystem through an incentive-based mangrove carbon offset project?

1.4: Justification

The global importance of carbon sequestration by mangroves opens the possibility of payments from a global carbon market for this service under REDD+ policies (Locatelli *et al.*, 2014). However, REDD+ discussions mainly focused on terrestrial forests, largely ignoring the contribution of mangroves to carbon storage. Kenya is already involved in REDD preparedness and submitted its Intended Nationally Determined Contribution (INDC) in July 2015 indicating a target of 30% reduction in greenhouse gas (GHG) emission by 2030. The mitigation activities proposed to meet the target are afforestation and reforestation. Avoided deforestation could help meet the target through enhancing carbon storage. This is in line with Kenya's Sustainable Development Goal (SDG) number 7 which promotes environmental sustainability and could be accomplished through mangrove conservation for carbon sequestration. The first successful attempt in the world to include mangroves in the carbon market was at Gazi Bay, Kenya where a small scale mangrove carbon feasibility project was launched in 2012 ("Mikoko Pamoja": see www.eafpes.org). The success of this project opens up the possibility of upscaling it to a larger mangrove area such as Vanga mangrove ecosystem which is an important fishing area and is the largest mangrove area in south coast Kenya.

However, a larger area presents more governance and social dynamic challenges. It is therefore important to understand the local mangrove governance and community perspectives and their implications on sustainability of a mangrove carbon offset project. Poor governance structures and negative attitudes and perceptions of the local community towards mangrove conservation has contributed to loss of mangroves in Kenya. Also, information on local governance of mangrove ecosystem in Kenya is scarce, with greater emphasis given to terrestrial forests. Incentive based mechanisms such REDD+ have also largely concentrated on terrestrial forest with little attention given to mangroves despite their important role in carbon sequestration.

Mangroves in Vanga are faced by continued destruction mainly through overharvesting. This contributes to loss of livelihood for the largely fishing community that is dependent on mangroves as fish habitat (Fulanda *et al.*, 2009). The formation of the Community Forest

Association (CFA) by Vanga community is an important milestone in co-management and also provides the local community with a direct economic stake in protection and sustainable use of the mangroves (Badola *et al.,* 2012). Much as the recently enacted resource utilization legislation (GoK, 2005; GoK,2012) advocate for co- management of coastal resources, little is known on how these co-management structures function in mangrove areas of Kenya and how communities support them. The findings of this study will contribute to better understanding of local governance structures in mangrove areas, their interactions as well as their likely outcomes and how the local knowledge and perceptions may influence the success of incentive based mechanisms for conservation.

1.5: Scope and limitations

The study focused on villages within and adjacent to the mangroves of Vanga, Jimbo and Kiwegu herein referred to as 'Vanga mangroves'. The key informants in the study were selected purposively in order to obtain in-depth data on mangrove governance systems and livelihood. The limitations of the study were:

- Household surveys captured the information from the household head as the representative of the household.

1.6: Definition of terms

In this study, the working definition for terms was as follows:

Governance: These are " the rules of collective decision making in settings where there are plurality of actors or organizations and where no formal control system can dictate the terms of the relationship between these actors and organizations" (Chhotray and Stocker, 2009).

Payment for Ecosystem Services: This is an approach to conservation based on market systems in which local forest communities receive monetary or non-monetary compensation as an incentive to conserve their immediate ecosystem for its services (Milder *et al.,* 2010) which could be purification of water, mitigation of floods, biodiversity conservation and sequestration of carbon (Jack *et al,* 2008).

Forest Governance: Involves 'new modes of regulation in the forestry sector, such as decentralized, community based and market-oriented policy instruments and management approaches.' (Arts *et al.,* 2014).

Institutions: These are 'humanly devised constraints that structure human interaction. They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions and self-imposed codes of conduct), and their enforcement characteristics.' (North, 1994).

Social-Ecological Systems: These are 'complex adaptive systems where social and biophysical agents are interacting as multiple temporal and partial scales.' (Janssen and Ostrom, 2006).

Conservation: The protection, preservation, restoration and rational use of all resources in the total environment.

Management: This involves the application social, administrative, legal and economic aspects to technical forestry principles and practices in order to achieve the desired objective.

Attitudes: This is the tendency of an individual to act in a particular manner based on their experiences, beliefs, values, motivations and habits with regards to a particular situation.

Perceptions: This involves the comprehension and understanding of a person's surrounding and phenomena based on their own interpretations of meaning from the particular surrounding or phenomena.

CHAPTER 2: LITERATURE REVIEW

2.1: Mangrove goods and services

Mangroves are trees and shrubs found growing along the intertidal areas of tropical or sub-tropical coasts. They are tolerant of high levels of salt and have an elaborate aerial root structure to provide gaseous exchange and support functions (Kathiresan and Bingham, 2001). Functions performed by mangroves are of great significance to communities living adjacent to the ecosystem. These comprise provisioning services (water, fuel wood, timber and food provision), regulating services (flood regulation, erosion control and shoreline protection), supporting services (cycling of nutrient and formation of soils, fish breeding sites) and cultural services (religious, spiritual and recreational service) as shown in Figure 1(MEA, 2005; Brander *et al.*, 2012, Spaninks and Beukering, 1997, UNEP, 2006 and TEEB, 2010). Another significant function of mangroves is their potential to mitigate climate change through carbon capture and storage. The captured carbon could also be traded in regulated and voluntary markets through incentive schemes such as PES and REDD+. Mangrove carbon storage had largely been ignored in REDD+ negotiations which are international policies by parties to Kyoto protocol to reward forest owners for carbon storage of their land (Irving *et al.*, 2011). This is despite mangroves and associated species (collectively referred to as 'blue carbon') containing greater carbon density than terrestrial forests. (Locatelli *et al.*, 2014; Donato *et al.*, 2011).

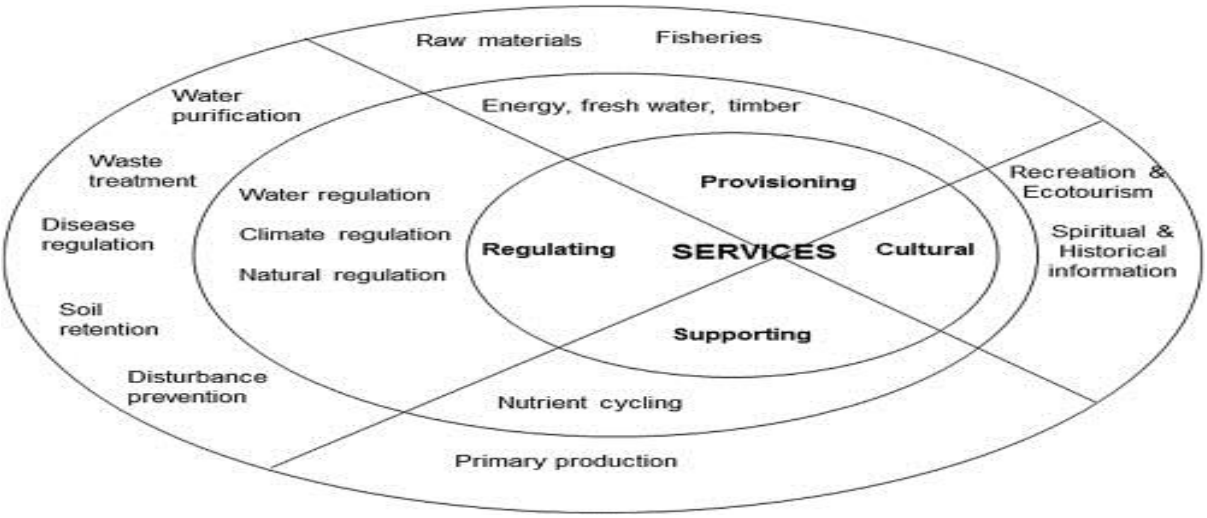

Figure 1: Ecosystem services and functions of mangroves (Source: Vo Quoc *et al.*, 2012)

2.2: Global status of mangroves

Mangroves were once estimated to cover 75% of the tropic coast (McGill, 1959). Total mangrove area was estimated at 170,000 km². The last two decades have seen significant decrease in the global cover of the mangrove forest with losses ranging between 25% and 35% (Valiela *et al.,* 2001). More recent studies by Giri *et al* 2011 place the approximate mangrove cover at 138,000 square kilometers. According to Valiela *et al.,* 2001 the rate of loss of mangroves stands at 2.1%, which is higher than those of terrestrial rainforests and coral reefs that are also ecosystems under threat. Causes of mangrove losses and degradation have been identified as overexploitation of resources, conversion of mangroves land to other land uses such as aquaculture, urban development and pollution effects (FAO, 2007; Valiela *et al.,* 2001; Adeel and Pomeroy, 2002; Alongi, 2002; Primavera, 2005). While anthropogenic threats have caused widespread reduction of mangroves, natural climatic factors such as sea level rise further compound threats to mangroves (Gilman *et al*., 2008; Alongi, 2008). These threats have resulted in loss of livelihood for many fishing communities since mangroves directly or indirectly account for approximately 70-80% of fish catches globally (Sandilyan and Kathiresan, 2012; Babier *et al.,* 2011).

2.3: Conservation of mangroves

The rate of mangrove loss has been escalating and without proper conservation measures in place, the functional capacity of mangroves would be lost in approximately 100 years or less (Duke *et al.,* 2007; Ellison, 2002). Global concerns over disappearance of mangroves have been raised by numerous researchers (Ellison, 2002). This has led conservation measures such as large scale mangrove restoration in countries like Indonesia (Ibrahim *et al.,* 2015), Malaysia (Hashim *et al.,* 2010), and Vietnam (Cuong *et al.,* 2015). The recent climate change effects have given mangrove conservation a greater global platform especially after the Tsunami in 2004 where the value of mangrove in shoreline protection was appreciated by coastal communities that were sheltered from the strong waves by the mangroves (Spalding *et al.,* 2010). Also, the ability of mangrove forest soils to sequester upto six times more carbon that their terrestrial counterparts (Donato *et al.,* 2011) has rendered mangrove as a "must watch" ecosystem for carbon storage.

2.3.1: Local governance and conservation of mangroves.

Like most common pool resources, integrated management of mangrove resources is required to achieve sustainable coastal development leading to economic and ecological benefits from the ecosystem, and equity in resource benefit distribution (Agrawal, 2014, Agrawal *et al.,*

2013). Due to their proximity to mangrove ecosystems, local community have the most significant influence on sustainability (Manéz *et al.,* 2014). Community Based Natural Resource Management (CBNRM) has been widely applied as a management strategy to achieve conservation and local development goals in mangrove areas (Walters, 2004). CBNRM provides a bottom-up management approach where communities are actively engaged in decision making, administration of sanctions and providing community-led solutions to issues to motivate their cooperation in conservation, rather than rules imposed on the community by higher level institutions (Andersson *et al.,* 2014; Nunan *et al.,* 2012; Hartter and Ryan, 2010; Ostrom and Nagendra, 2006).While CBNRM may structurally differ from country to country, the most common approach is resource co-management agreements between government agencies and the local community (Saunders *et al.,* 2008) .Government support to local governance structures is necessary for the success of co-management and improvement of their adaptive capacity (Saunders *et al.,* 2010). Understanding the multiplicity of interests and actors within the community their influence on decision making is key to promoting effective communication and feedback mechanisms at all management levels (Crona and Bodin, 2006; Agrawal and Gibson, 1999). Also, community engagement in joint management ventures should include some form of economic or social benefit in order for the community to be motivated to participate in the long term (Agrawal and Gupta, 2005).

2.3.2: Theoretical framework for natural resource governance

The definition and assessment of good governance is not an easy process (Secco *et al.,* 2014) and therefore, appropriate indicators must be developed. Proxies for good governance are dynamic therefore no framework is ideally suited for all scenarios under study. Researchers may often have to modify or improvise or merge frameworks so as to make them suitable to their work. This study employed the Socio-Ecological Systems (SES) framework (Ostrom, 2005; Ostrom, 2007) as in figure 2.

The SES framework developed by Ostrom (2005) considers eight attributes that contribute to effective governance of common pool resources: identifiable boundaries, capacity for monitoring, means of resolving conflicts, level of sanctions, balance between costs and benefits, stakeholder rights to decision making on governance mechanisms, level of participation and development of a large system or network. The framework is characterized by multiple tiers or level of attributes (Basurto *et al.,* 2013). The first level or primary variables include: Resource systems (RS), Governance Systems (GS), Resource Units (RU)

and Actors (A) (Ostrom, 2007). Each primary variable is subdivided into several second level or secondary, tertiary and other variables. The framework is applied for analytical purposes by selecting a proportion of variables that are relevant to the topic of study and making inferences with regards to relationships between these variables (Ostrom, 2005; Ostrom 2007; Ostrom 2009).

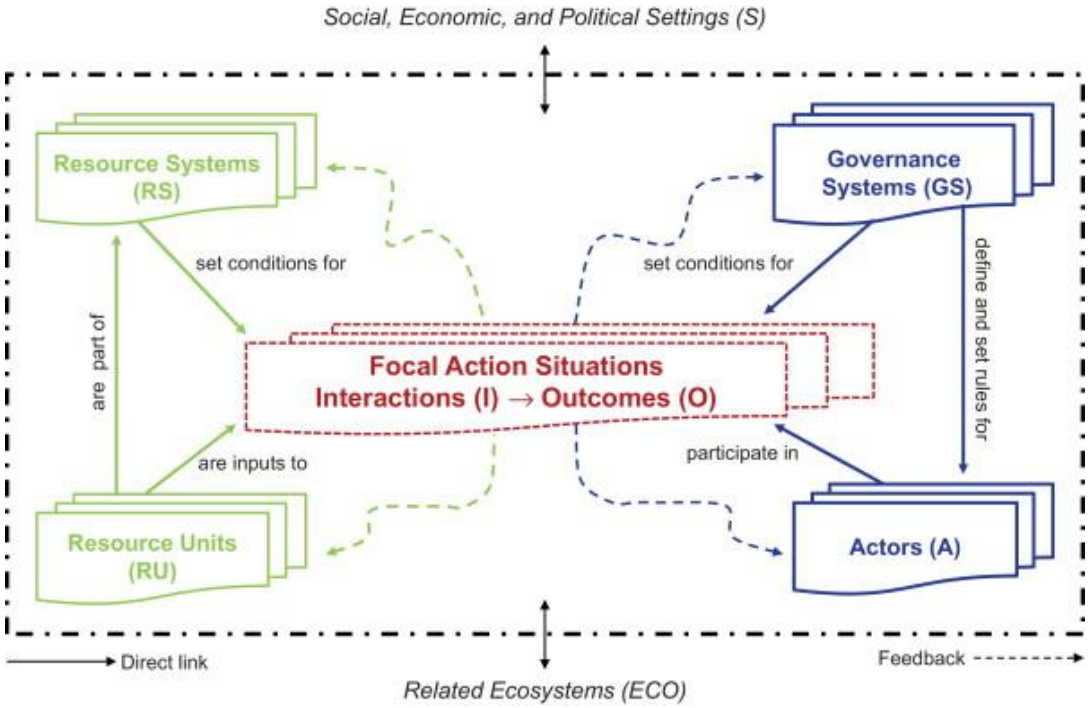

Figure 2: Diagrammatic representation of the SES framework (Ostrom, 2007)

For the purposes of this study, the SES framework by Ostrom (2007) that served was applied as an organizational tool. The 1st tier variables were adopted and the framework modified and expanded to form more specific focus on mangrove governance aspects So as to make the framework suitable to this study. The 2nd, 3rd, 4th and 5th variables were as shown in Table 1. The modified SES framework together with a similar approach in Lockwood *et al*., 2010 all focusing on resource governance served as a kind of checklist to ensure that critical value aspects of governance were covered by the study. Most emphasis was placed on the governance systems and actor elements of the framework. Part of the influences that were exogenic in nature such as Social, Economic and Political setting and related ecosystems were considered in the classification of mangrove governance.

Table 1: Modified SES framework for mangrove governance

Social, Economic and Political Settings (S)
S1 – Economic development
S2 – Demographic trends
S3 – Political stability
S4 – Other governance systems
Governance systems
GS1 – Policy area
GS2 – Geographic scale of governance system
GS3 – Population
GS4 – Regime type
GS4.1 Democratic
GS4.2 Autocratic
GS5 – Organizations
GS5.1 Government organizations
GS5.1.1 Support enforcement
GS5.1.2 Support funding
GS5.1.3 Restoration efforts
GS5.2 Non-government organizations
GS5.2.1 Capacity building
GS5.2.2 Linking
GS5.2.3 Bridging
GS5.2.3.1 Cooperatives
GS5.3 Community-based collaborative structures
GS5.3.1 Legal mandate
GS5.3.2 Representative of resource users
GS5.3.3 Accountable to resource users
GS5.3.4 Space for effective participation of resource users
GS5.4 Skills and capacity of organizations
GS5.4.1 Training and mentoring
GS6 – Rules-in-use
GS6.1 Property-rights
GS6.1.1 Open access
GS6.1.2 Permits and licenses
GS6.2 Operational rules
GS6.3 Collective-choice rules
GS6.4 Constitutional rules
GS7 – Repertoire of norms and strategies
GS7.1 Gender norms and relations
GS8 – Coordination and integration
GS8.1 Coordination
GS8.2 Flow of information
GS8.3 Fit
GS9 – Adaptability
GS9.1 New knowledge
GS9.2 Uncertainty
GS9.3 Anticipating problems and issues
GS9.4 Learning
GS9 – Monitoring
GS9.1 Social
GS9.2 Bio-physical
GS10 – Sanctions
GS11 – Fairness
Resource systems
RS1– Clarity of system boundaries
RS2– Size of resource system
Resource units
RU1– Interaction among resource units
RU2– Economic value
Actors
A1– Number of relevant actors
A1.1 Number of resource users
A2– Socioeconomic attributes
A2.1 Wealth status of types of users.
A3– History or past experiences
A3.1 Collaborative management duration
A4– Location
A5– Leadership/entrepreneurship
A5.1 Leadership skills
A5.2 Trust in leaders
A6–Social capital
A6.1 Trust and reciprocity
A7– Knowledge of social-ecological systems
A8– Importance of resource (dependence)
A8.1 Occupational diversity
A8.2 Primary dependence on mangrove forests and fisheries
A9– Technologies available

Action situations
I1– Harvesting
I2– Information sharing
I3– Deliberation processes
I4– Conflicts
I5– Investment activities
I6– Lobbying activities
I7– Self-organizing activities
I8– Networking activities
I9– Monitoring activities
I10– Evaluative activities

Outcomes
O1– Social performance measures
(e.g., efficiency, equity, accountability, sustainability)

2.4: PES and REDD+

PES is a new approach to conservation based on the market systems where communities receive monetary or non-monetary compensation as an incentive to conserve their immediate ecosystem for its services such as purification of water, mitigation of floods and sequestration of carbon (Milder *et al.,* 2010: Jack *et al.,* 2008). PES is voluntary and requires a properly defined and specified ecosystem service (Farley and Constanza, 2010). It is also conditional in that the service providers only benefit from the buyers if they maintain the service at a stipulated level or improve it (Wunder, 2005). In recent years, PES has grown in popularity due to its potential to meet both conservation and development goals (Van Hecken and Bastiaensen, 2010). PES schemes were first implemented in Costa Rica in 1997 and have been replicated in a number of countries particularly in South America (Rosendal and Schei, 2014). There have been mixed results with the implementation of PES indicating both great successes and failures (Mahanty *et al.,* 2013). Some of the failures have been attributed to complexity of valuation of ecosystem services for which payments are quantified and some services being overrated while others are underrated (Redford and Adam, 2009), and lack of proper governance structures particularly at the local level (Farley and Constanza, 2010).

PES schemes helped pave the way for REDD at COP 11 when Costa Rica which had a long history with PES and Papua New Guinea forwarded reduction of emissions from deforestation as an agenda. At COP 13 in Bali the acronym REDD was coined to refer to Reduction of Emissions from Deforestation and Forest Degradation. The acronym was later modified to REDD+ at Poznan in 2008 to incorporate conservation, sustainable management for forests and enhancement of carbon stocks into the former definition (UNFCCC, 2008). REDD+ was adopted in 2010 at COP 16 in Cancun. PES generally encompasses a much broader perspective of payment including other ecosystem services beyond carbon storage (Jack, *et al.,* 2008). PES bear similarities to the REDD+ policies and also to objectives of the Kyoto protocol thus it would be useful for informing REDD+ implementation mechanisms post-2015 (Pagiola, 2011). Mechanisms for the implementation of REDD+ are still under negotiation with various issues coming into play such as financing, political influences and ethics (Larson, 2011), even in the recent COP 21 held in Paris in 2015. Meanwhile countries continue to lay structures to support REDD+ through the REDD+ preparedness program, particularly in developing countries that hope to receive carbon credits from their forest carbon stocks. However, individual project across the globe that are employing REDD+ strategies receive payments for carbon credits from voluntary carbon markets.

2.4.1: PES, REDD+ and mangroves

Mangroves have an enormous potential of acting as carbon sinks. Recent studies indicate that mangroves are the largest carbon banks among the tropical forests and can store several times more carbon than their productive terrestrial counterparts (Donato *et al.,* 2011). This makes mangrove forests well suited for carbon credit benefits through REDD+ projects (Locatelli *et al.,* 2014). Despite their significant contribution to carbon storage, mangroves have been neglected in REDD+ discussions and much focus has been given to terrestrial forests. Many mangrove ecosystems are plagued by poor governance and instability both at local and national level which renders REDD+ schemes unsustainable in such areas (Locatelli *et al.,* 2014). Efforts to provide adequate policies to govern mangroves and other 'blue carbon' habitats should be intensified to make them viable for carbon markets (Ullman *et al.,* 2013).

2.5: Mangroves in Kenya

All the nine mangrove species that have been described in the Western Indian Ocean region occur in Kenya (Macnae, 1968; Kokwaro, 1985). *Rhizophora mucronata Lam., Ceriops taga Perr l* and *Avicennia marina Forrsk.* constitute more than 70% of the forest formation (GoK, 2015). Other species *Sonneratia alba Sm., Bruguiera gymnorrhizha Lam. ,Lumnitzera racemosa Willd., Heritiera littoralis Aiton. , Xylocarpus moluccensis Lam. and Xylocarpus granatum Koen.* (Tomlinson, 1986; Kirui, 2013).The total area covered by mangroves in Kenya is estimated at 55,000 hectares (GoK, 2015). The total mangrove cover loss represented is 18% since 1985 while the average loss is 0.7% yr^{-h} (Kirui *et al.,* 2013). Temporal and spatial variations in the rates of mangrove cover loss are evident and this may be as a result of differences in governance structures and resource use patterns (Kirui *et al.,* 2013). If the factors resulting in degradation continue unabated, most mangroves in the south coast will be lost in the next fifty years, thus the need for effective mechanisms of managing these resources sustainably.

2.5.1: Utilization of mangroves in Kenya

Mangroves in Kenya provide a wide array of functions to the local community both directly and indirectly. Direct uses include firewood, building poles, making boat ribs, medicines and tannins (Kairo *et al.,* 2001; Kairo, 2001). Utilization differs from species to species (see Table 2) depending on wood size and quality. Shoreline protection and provision of fish habitat are among the major indirect uses (Kairo *et al.,* 2001; Dahdouh-Guebas *et al,* 2000). The local communities are likely to place value on the mangrove ecosystem based on their

utilization patterns since their aim is to obtain maximum benefit from the resource (Dahdouh-Guebas *et al,* 2000).

Table 2: Mangrove species and their uses (Source: Kairo, 2001)

Species	**Local name**	**Main use**
Rhizophora mucronata Lam.	Mkoko	Pole, dye, firewood, fencing, charcoal
Bruguiera gymnorrhiza Lam.	Muia	Poles, firewood, charcoal
Ceriops tagal Perr.	Mkandaa	Poles, firewood, charcoal
Sonneratia alba Sm.	Mlilana	Boat ribs, poles, firewood
Avicennia marina Forrsk.	Mchu	Firewood, poles
Lumnitzera racemosa Willd.	Kikandaa	Fencing poles, firewood
Xylocarpus granatum Koen.	Mkomafi	Funiture, poles, firewood
Xylocarpus moluccensis Lam.	Mkomafi dume	Fencing poles, firewood
Heritiera littoralis Aiton	Msikundazi	Timber, poles, boat mast

2.5.2: Threats to mangroves in Kenya

In Kenya, indiscriminate and poorly regulated harvesting of mangroves especially for fuel wood and timber are the main drivers of degradation (Abuodha and Kairo, 2001). Increased losses have implications of reducing the amount of carbon stored by the mangroves in the long term (Pendleton *et al.,* 2012). Mangroves at the Kenyan coast are of great value. The mangroves in the south coast alone have an estimated economic valuation of US$ 6.5 million (Huxham *et al*., 2015) of which a significant proportion (approximately 59%) is contributed by regulating services. This indicates the immense value of the ecosystem services offered by the mangroves and provides further argument for the need to conserve them. There has been extensive mangrove restoration in Gazi Bay since 1991 (Kairo *et al.,* 2001; Kairo *et al.,* 2009) with more than 10 hectares restored thus contributing to improved ecological functions of mangroves in the area thus serving as a model restoration site for other mangrove areas in Kenya.

2.5.3: Mangrove forest governance in Kenya

Mangrove forests in Kenya are currently managed under the National Forest Act of 2005 by Kenya Forest Service (KFS), the government agency mandated to protect all forest on public land (GoK, 2005; GoK, 2014). The Forest Act promotes Participatory Forest Management (PFM) through the establishment of Community Forest Associations (CFAs) which work in co-management with Kenya Forest Service (KFS). CFAs are allowed to protect, conserve and manage the forest, formulate and implement forest programmes, assist in enforcing provisions of the Act and monitor any developments, changes or occurrences within the forest. While Participatory Forest Management (PFM) has been widely embraced in the country since its inception in 1997 (Ongugo *et al.,* 2008), it's effectiveness in management of forest resources has been largely hampered by lack of local capacity (Ongugo *et al.,* 2008) for example in the development of suitable management plans. This demotivates communities from actively participating in management and decision making. Despite mention in policy documents such as Proclamation No. 44 in 1932, Legal Notice No. 174 in 1964 and the current Forest Act of 2005, mangroves have had little regard compared to the terrestrial forests due to lack of specific policies that relate to them. Recently, the National Mangrove Management Plan has been developed and plans for its implementation are underway. The Fisheries Act Cap 378 provides subsidiary regulations for the protection of fish breeding areas including mangroves thereby supporting the management of mangroves.

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2.5.4. Incentive based mangrove conservation in Kenya

The Forest Act (GoK, 2005) recognizes the potential significance of carbon credit schemes in providing economic benefits to the local community through incentives and promoting conservation. It is estimated that the adoption of Climate Compatible Development (CCD) such as through PES and REDD+ schemes could yield approximately upto 3 times the present net value of the ecosystem in the south coast of Kenya (Huxham *et al.,* 2015). Initiating of a mangrove carbon offset project in Kenya requires the presence of a CFA duly registered and having a co-management agreement with KFS as a prerequisite. The community can only be involved in the mangrove governance and exercise their user rights through the CFA. The CFA must provide a clear definition of the mangrove area they wish to conserve including baseline bio-physical and socio-economic characteristics of the area as well as a detailed management plan. These parameters are used to develop a Project Idea Note (PIN) and Project Design Document (PDD) which are used to obtain certification for trade in the carbon market.

A small scale REDD+ based project for mangrove conservation already exists and is earning benefits to the local community in Gazi Bay, Kenya through sale of carbon credits in the voluntary carbon market ("MikokoPamoja": see www.eafpes.org). The project dubbed 'Mikoko Pamoja' is a pioneer in the sale of mangrove carbon credits worldwide. Through the project, the community have participated in the replanting of more than 7000 seedlings since its inception in 2012. The community has also earned US$ 25,000 from the sale of carbon credits since 2014 which has been utilized for different development projects such as education and water projects in Gazi bay. This success indicates promising outcomes for the upscaling of the carbon offset project to other mangrove areas in Kenya such as in Vanga which is the largest mangrove expanse in the south coast region of Kenya.

2.6: Conceptual framework for the study

The conceptual framework (Figure 3) represents the independent variables (mangrove goods and services valued by the community, local mangrove governance systems, community perceptions and attitudes toward the mangrove resource and incentive based mechanisms) and how these influence the current status of the mangrove ecosystem and community adoption of incentive based conservation. The intervening variables of socio-economic status, policy, legal frameworks, mangrove dependence and cultural background influence outcomes of the dependent variables.

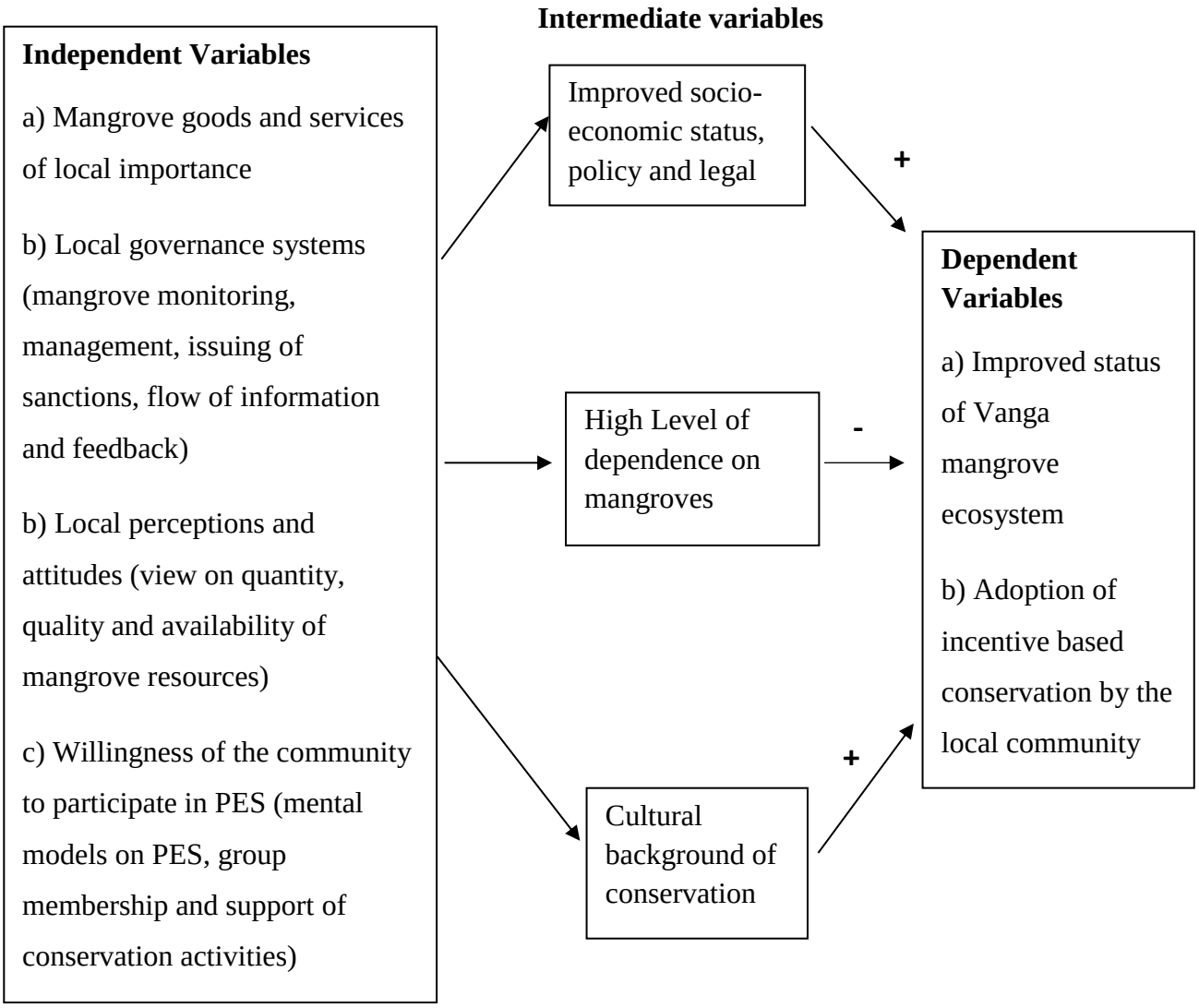

Figure 3: Conceptual framework for the study

CHAPTER 3: METHODOLOGY

3.1: Description of the study site

3.1.1: Location and Size

The Vanga mangrove ecosystem is located in Kwale County in the south coast of Kenya near the Kenya-Tanzanian border. It is located at 4.663˚S and 39.215˚E. This mangrove complex is the largest in the south coast of Kenya covering an estimated 3440 hectares (Rideout *et al.*, 2013).

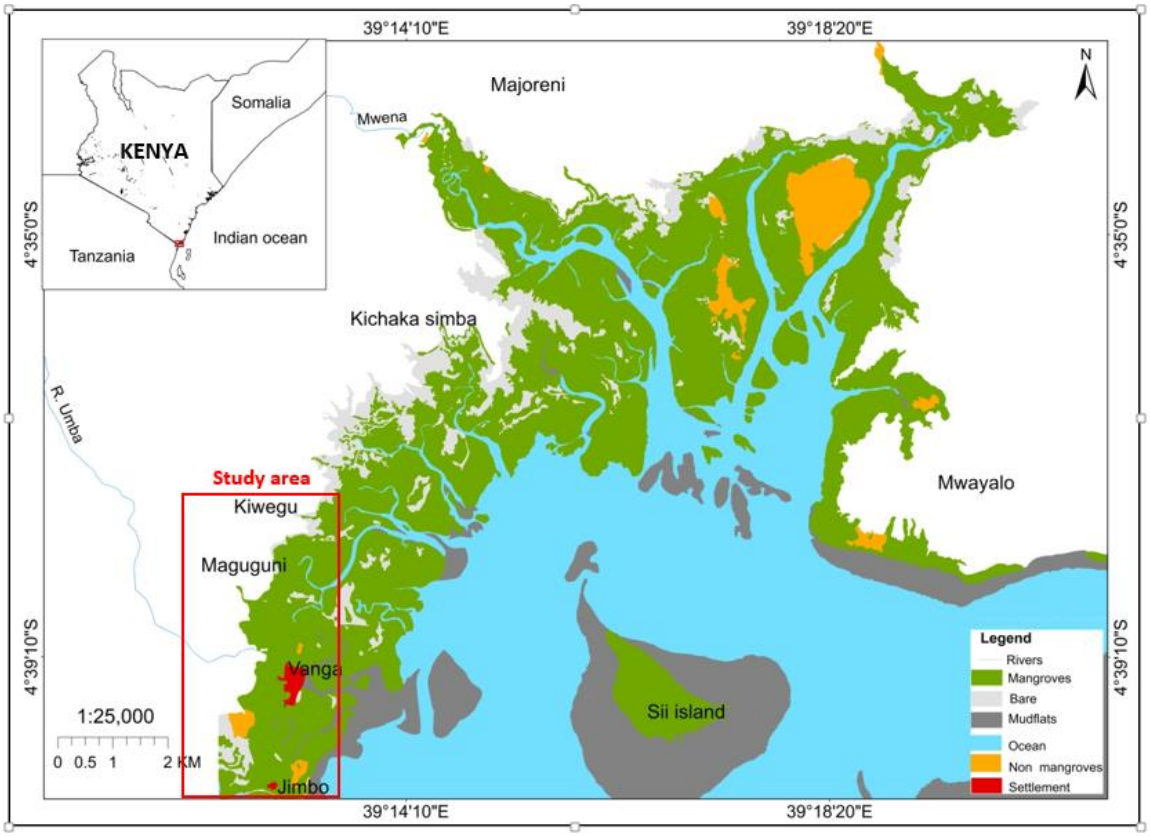

Figure 4: Map showing study site (Source: Stella Choge)

3.1.2: Climatic conditions

Vanga area is influenced by the monsoon winds which are common to the Kenyan south coast. The total annual precipitation ranges from 1000mm to 1600 mm and has a bimodal distribution. Long rains occur between April and August while the short rains occur between October and November. The temperature varies between 24˚C and 39˚C and the relative humidity is about 95% due to its location adjacent to the sea.

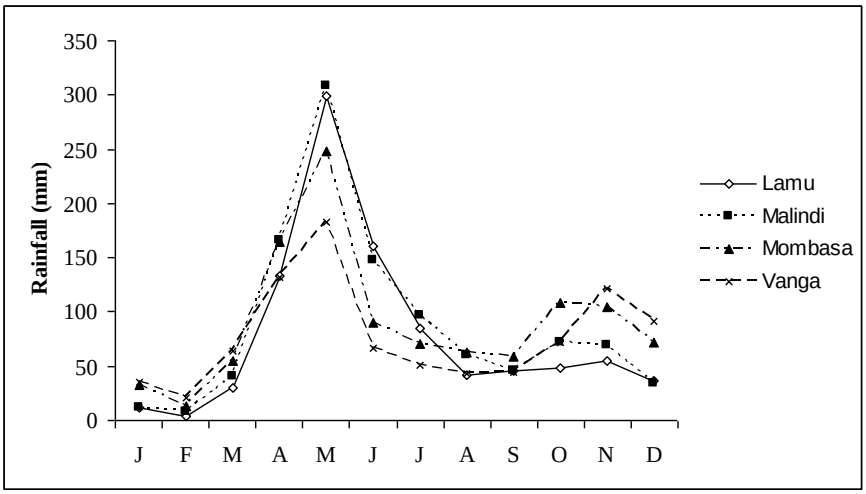

Figure 5: Average annual precipitation in coastal Kenya

3.1.3: Socio-economic status

Vanga area encompassing Vanga, Jimbo and Kiwegu villages is estimated to have a population of 13,546 and a total of 2,418 households (KNBS, 2010). There are approximately 6,519 males and 7, 027 females in the area representing a ratio of 1:1.07. The Digo ethnic group accounts for about 72% (Omwenga 2009). Islam is the dominant religion in the area accounting for approximately 97% of the population. The major economic activity in the area is artisanal fishing contributing to more than 80% of the local economy inclusive of other fishing related activities such as boat making and fish vending (Omwenga, 2009; Ochiewo, 2004). Other income generating activities include crop farming (mainly rice), small business enterprises and casual labour in house construction.

The total dependence ratio in Vanga is among the highest in Kwale County (KNBS, 2013) with fewer people contributing to the household income compared to the number of dependents per household. Most of the houses in the area are semi-permanent and about 86.8% of the households use firewood as the main fuel for cooking. (KNBS, 2013). Sanitation level is relatively poor in the area with 87.15% still using unimproved sanitation methods such as uncovered pit latrines, bucket, and use of bushes. There is a lack of adequate waste disposal facilities such as landfills. Only 24.5% have access to portable water (KNBS, 2013).Generally the level of education is low with 40.5% of the population having attained no formal education.

3.1.4: Management status of Vanga mangrove area.

The Vanga mangrove ecosystem is gazetted as a forest reserve conservation area and is managed by the Kenya Forest Service under Buda Forest station. There is one forest guard in

charge of the area extending from Jimbo to Kiwegu area. Community participation in management is through the VAJIKI Community Forest Association which is yet to sign a co-management agreement with the Kenya Forest Service.

3.2: Research Design

3.2.1: Sampling of key informants and FGD respondents

20 key informants and participant's in the 6 focus group discussions held were selected through non-probability sampling techniques which included purposive sampling where by the respondents were selected based on their respective roles in local mangrove governance which were determined in a stakeholders workshop held for the community and also through participant observation during community meetings.

3.2.2: Sample size for household surveys

The respondents in the household survey (n=151) were selected based on a simple random sample using a modified Fisher's equation (Fisher *et al*, 2004):

$$\mathbf{n} = \frac{t^2 \times p\,(1-p)}{m^2}$$

Where : n = Required sample size

t = Confidence interval at 95% (of which a standard z-value is 1.96)

p = The % households that lie within 5 km of the mangrove system

m = Margin error at 5% (with a standard value of 0.05)

$n = \{1.96^2 \text{ X } 0.11(1-0.11)\} / 0.05^2$

$n = 150.437056$

3.3: Data collection

3.3.1: Characterizing the major goods and services from mangroves of Vanga

Identification and ranking of major goods and services was carried out through the stakeholders' workshop where 30 stakeholders from Vanga were asked to list the major goods and services obtained from the mangroves. The goods and services were then ranked through a tallying process starting with the highest tallied to the lowest tallied. The rankings were compared to the economic valuation obtained by Huxham *et al.,* 2015 for Vanga.

3.3.2: Characterizing local governance systems, roles and acceptance

Survey questionnaires were administered to 151 households in Vanga, Jimbo and Kiwegu villages with a range of Likert scale type of questions and some open ended questions on the local governance in relation to the mangrove ecosystem. A stakeholders' workshop was conducted and from this, 20 key informants were selected purposively based on their involvement in local mangrove governance in Vanga. The key informants were later interviewed using semi-structured interview schedules and 6 focus group discussions were also conducted for other stakeholders. The interviews were recorded using a dictaphone and later transcribed for purposes of analysis on the NVIVO software. Participant observation was also used to collect information during stakeholder workshop and village meetings and mangrove related activities.

3.3.3: Local perceptions and potential to participate in incentive-based projects

Data was collected through the household survey questionnaires to the 151 households in Vanga, Jimbo and Kiwegu villages. The questions addressing local perceptions, attitudes and potential to participate in PES were in Likert scale format. The 20 key informant interviews and the 6 focus group discussions conducted for local leaders, community forest association members, and separate discussions for women and men also featured questions on local attitudes and perceptions on the state of the mangroves. There were a series of questions on demographics of the respondents for purposes of profiling.

3.4: Data Analysis

3.4.1: Characterizing the major goods and services of Vanga mangroves

Data was analyzed using descriptive statistics where the goods and services were arranged based on their ranking which represented their importance to the community. The data was then presented in form of a table.

3.4.2: Characterizing local governance systems, roles and acceptance

The qualitative data obtained from key informant interviews, focus group discussions and participant observation were used to build themes based on the modified Social-Ecological Systems (SES) framework (Ostrom 2005: Ostrom, 2007, Ostrom and Mcginnis, 2014). The framework was used as an organizational framework in which selected variables from the framework were used to develop a coding form. The variables selected served as indices for characterizing governance and the indices were considered as significant for each interview based on the frequency of their appearance. This text analysis was carried out on the NVIVO program for qualitative data analysis. The data obtained was used to develop an institutional

map for local governance representing all stakeholders, their interactions and linkages with each other. The data obtained was used to create links between the various actors and develop a network constituting the local mangrove governance structure. Responses from key informants and focus group discussions were used for data triangulation in order to provide more meaning and insight to the results obtained. Likert scale questions relating to acceptance of governance by the community were tested for reliability and inherent consistency among the questions using the Cronbach alpha coefficient and then used to compute a composite variable. Graphs were drawn to represent community perceptions on the governance.

3.4.3: Local perceptions and attitudes toward the state of mangroves

Descriptive statistics were used to assess socio-demographic characteristics of the population. The Likert scale data was tested for reliability and inherent consistency among the questions using the Cronbach alpha coefficient. According to Nunnally and Bernstein1994), a Cronbach alpha coefficient from 0.60 and 0.70 is acceptable but higher coefficients of 0.80 or 0.90 (George and Mallery, 2003) are desirable. Questions that resulted in lower coefficients were deleted from the scale. The data from the scale that was within the recommended range of the coefficient was then reduced by computing a composite variable based on the median of responses for each respondent and from this graphs were drawn. Kendall tau b statistic and squared multiple correlations were used to test for correlations among the variables and cross-tabulations were used to describe interactions of variables. The data from key informant interviews and focus group discussions were transcribed, coded thematically using the SES framework as an organizational framework and used for data triangulation.

3.4.4: Potential to participate in incentive-based mangrove projects

The potential to participate in incentive-based mangrove projects was determined based on six variables derived from the SES framework: sense of responsibility towards the mangrove resource, membership in local conservation groups, readiness to cooperate with the local mangrove governance in conservation of the mangrove resource, support to prohibition of harvest of mangroves for purposes of conservation, willingness to participate in replanting and acceptance of compensation for avoided harvesting. For the first three variables, responses to each variable was scored based on an arbitrary scale of +1, to -1 and the cumulative score for all respondents were used to determine their potential to participate in mangrove PES projects without consideration of incentives. The cumulative scores were also

determined for the last 3 variables and these represented responses in which incentives for conservation were considered. Data from the two sets of variables was compared to represent responses with incentives and responses without incentives.

CHAPTER 4: RESULTS

4.1: Socio-economic characteristics of the respondents

40% of the respondents were household heads while 60 % responded on behalf of the household heads who were away at work. The average household monthly income in the area is estimated to be between US $20-156. This is low to moderate compared to the poverty line which is estimated at US $1.25 a day (Rufino *et al.,* 2013). Out of the 151 households surveyed, 32% of the respondents were not able to estimate their monthly income due to the lack of regular income sources. This indicates that income by itself was a poor descriptor of poverty in the area. Therefore, we can speculate that the income earned may seem adequate but the high level of dependence significantly reduces the impact the income would have on improving the living standards in the community. The average number of individuals per household was 6 persons. 86.8% of household heads were between 35-60 years. 47% of the households were dependent on fishing and fishing related activities as a primary source of income. This was the major income earner followed by crop farming (particularly rice and cassava) and operation of small business enterprises. Most of the respondents had lived in Vanga for a substantial period of time with only few (below 5 %) having lived in the area for less than 5 years. 60.3% of the households interviewed used mangrove products particularly firewood as a source of cooking fuel and most households either purchased or collected firewood weekly.

4.2: Major goods and services from mangroves of Vanga

Importance of mangroves for fish habitats was the highest ranking value of mangroves (see Table 3) since the community of Vanga is dependent on fishing as a major income earner.

Mangrove Goods and Services	Rank by Community	Rank based on Economic valuation by Huxham *et al.*, 2015
Fish habitat, nursery and breeding site	1	3
Timber/Building poles	2	4
Firewood	3	4
Source of clean air	4	Not ranked
Shoreline protection	5	1
Eco-tourism	6	5
Source of bait for fish	7	Not ranked
Herbal medicine	8	Not ranked
Aesthetic value	9	5
Sediment trapping	10	1*
Dyes	11	Not ranked

Key: * refers to indirect benefit

Table 3: Ranking of mangrove goods and services by Vanga community

The second and third ranking uses of mangroves were as a source of timber/building poles and source of firewood respectively. Source of clean air and shoreline protection were considered significant particularly after the effects of Tsunami which affected the area in 2004. Ecotourism was important to the community since they recognize it potential in generating income through the mangrove boardwalk. Lower ranking mangrove values were considered as beneficial to only a small subset of the community. Carbon sequestration which is ranked as 2nd in economic value by Huxham *et al.*, 2015 was conspicuously missing from community rankings due to the fact that the community had limited knowledge of this ecosystem function.

4.3: Local mangrove governance structure

At the national level, the KFS board is at the top of the hierarchy followed by the director and assistant directors. The national level management are primarily responsible for policy making. At the regional level, there is the head of conservancy, followed in command by the ecosystem conservator who is in charge at the county level. According to the respondents, the regional and local governance receives support from other government parastatals such as Kenya Wildlife Services (KWS), Kenya Marine and Fisheries Research Institute (KMFRI) and the State Department of Fisheries (SDF) which have complimentary roles in mangrove areas particularly related to protection of the mangrove ecosystem since it provides a habitat for a variety of fish, crustaceans and other associated flora and fauna. The forest manager serves as the head of a forest station which in this research is the Buda Forest station. Flow of

information between the national and regional governance systems is mostly down the hierarchy as described in Figure 6

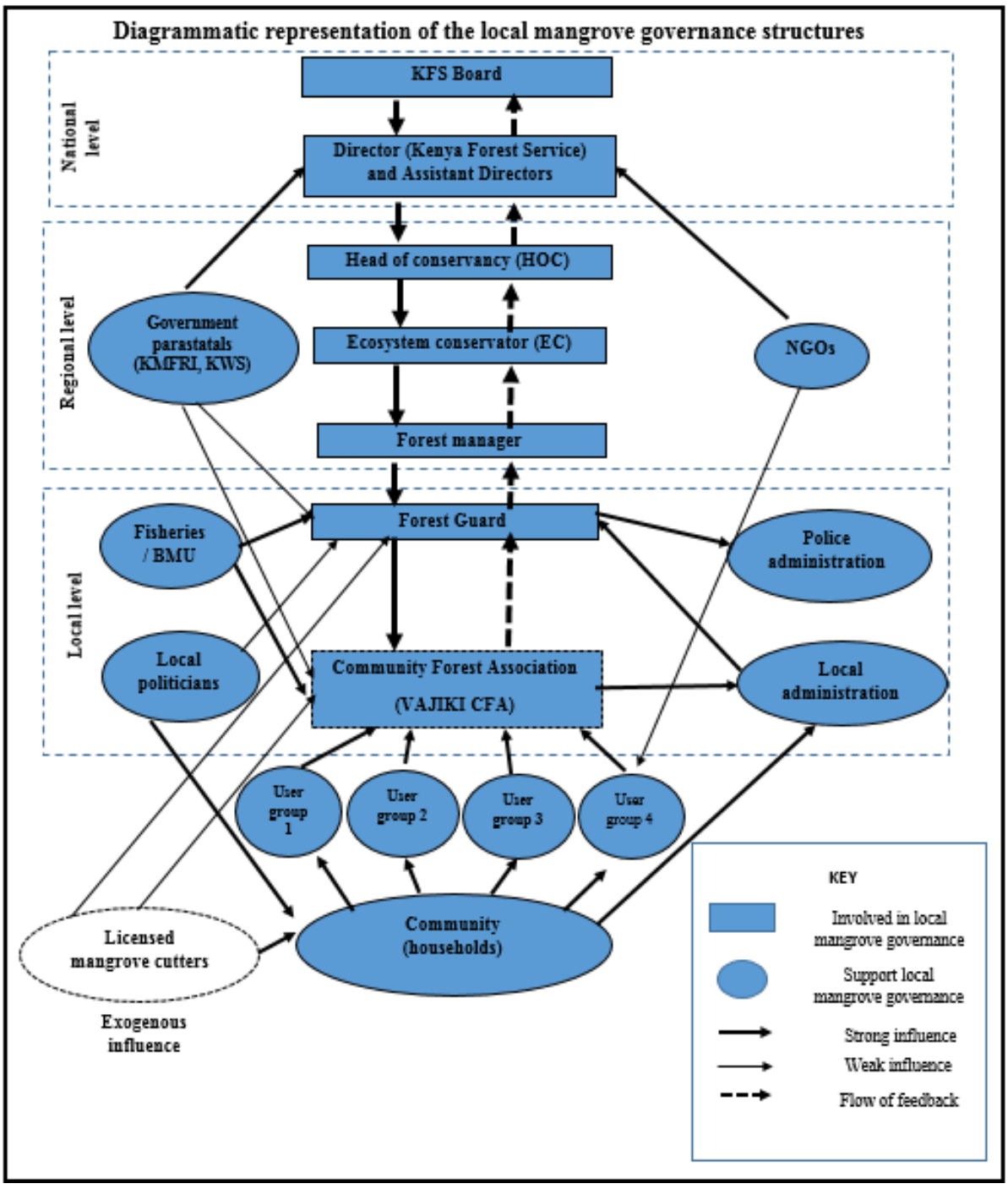

Figure 6: Mangrove governance structure in Vanga area

At the local level, there were more complex interactions with more actors influencing mangrove governance in one capacity or another. The forest guard was recognized as the key decision maker in terms of local mangrove governance by 78% of the respondents. He was

the local representative of KFS, under the authority of the forest manager and was in charge of a section called a bit which in this research was Vanga bit extending from Kiwegu village to Jimbo village. VAJIKI CFA was the entity in co-management with KFS and worked semi-formally with the forest guard since the co-management agreement is still in the process of being finalized. The CFA was registered in 2009 and consisted of 4 conservation groups namely Mwambiweje women group, Mwagugu mariculture which are in Vanga village, Jimbo Environmental Group in Jimbo village and Vumilia nguvu kazi group in Kiwegu village. However, the CFA was not recognized by 68.9% of the respondents probably because it had not received full recognition from KFS through signing of a management agreement. This has resulted in the CFA having little mandate to act in the community as it is not fully recognized as "a source of power" in local mangrove governance. Delays in signing of the agreement were due to lack of adequate funds.

The local administration consisting of the chief and assistant chiefs of the location and the village chairpersons were considered important in supporting the forest guard. The chief's office was the most recognized authority by 98% of the respondents therefore the forest guard was expected to liaise with the chief in enforcement of rules, conflict management, issuing sanctions in order to attain community cooperation. The community respected the authority of the forest guard but nevertheless considered him somewhat unsympathetic to their needs because he was not a local from the area. The local leaders were seen to identify more with the community's needs since they were natives and particularly the village chairpersons who were elected by the community.

The police administration was involved in supporting the forest guard through law enforcement and carrying out sanctions like arresting of illegal harvesters. The fisheries office also provided support to the forest guard through disseminating information on mangrove conservation and also in conflict resolution. This was due to importance of mangroves for the fisheries resource (Babier *et al.*, 2011) which was also recognized by the fishermen who form the Beach Management Units (BMU) in Vanga, Jimbo and Kiwegu. The BMUs support the forest guard and the CFA in law enforcement and monitoring illegal harvesting in the mangrove areas particularly those areas that are inaccessible on foot. The role of the county government in mangrove governance was not clearly defined. The ward administrator who worked closely with the chief and village chairpersons was the only county government official mentioned as one rather indirectly involved in local mangrove governance. Power dynamics at the local community were mentioned as having some

influence on mangrove governance particularly from some of the political leaders. The respondents mentioned instances when some political leaders would seek to overrule the forest guard by granting permission to community members to go and cut mangroves without permits so as to gain favour with the community for their political ambitions. Some of the politicians were also seen to be quick to defend those caught harvesting illegally and thus undermining the work of the forest guard.

The licensed mangrove cutters were seen to have some exogenous influence in the local governance of mangrove because of their destructive potential through indiscriminate harvesting. The mangrove cutters applied for an annual license from KFS which allowed them to cut mangroves in defined locations as their source of livelihood. The cutters were expected to pay revenue to KFS depending on the number of poles they cut. The community would then purchase mangrove wood from the licensed cutters. The community could also get informal permits to harvest dry fallen mangroves for subsistence particularly by women who were mentioned to be the main collectors of firewood. In Vanga however, some of the licensed mangrove cutters harvested indiscriminately and others allegedly used licenses issued in other counties to harvest in the Vanga mangrove ecosystem. At the moment, there was only one mangrove cutter licensed to harvest in the Vanga mangrove ecosystem. There was also low monitoring of the harvesting activities of mangrove cutters once they are issued with the license. This led to conflict with the community because the community viewed the activities of the mangrove cutters as destructive yet the mangrove cutters were protected by the licenses they hold which they could misuse without proper monitoring. For instance, the community in Vanga village took collective action and dismissed a mangrove cutter who was allegedly practicing clear felling of the trees and confiscated the poles he had harvested. The CFA reported the matter directly to the forest officer, by-passing the forest guard who was considered as being partial since he took little action to prohibit the cutter. The community had no stake in recruiting the cutters but was forced to deal with the consequences of mangrove destruction from their activities caused by poor monitoring strategies.

Contribution of majority of stakeholders to the roles and responsibilities in local mangrove governance in Vanga was viewed as quite limited. In 6 out of the 10 roles mentioned, more than 70% of the respondents viewed these roles as the responsibility of the forest guard (see Figure 7). The local conservation groups were seen to be at the forefront in replanting of mangroves in the degraded areas as mentioned by 64% of the respondents. Between 20-40 % of the respondents were not aware of who was responsible for creating awareness,

community involvement in mangrove conservation activities and organizing meetings where the community would be engaged in mangrove related activities. The respondents attributed this to scarcity of such activities taking place in the area. 73.5% of the respondents were aware of the harvesting rules by KFS and 88.2% of those aware found them satisfactory. There was no mention of any local rules that had been established to protect the mangroves. Currently, the operational rules in mangrove governance were those from KFS management plan as guided by the Forest Act of 2005.

Demographic factors seen to influence governance in the area was the increasing local population. There was an influx of people from neighboring areas coming to settle in the area due to presence of the basic products obtained from mangroves such as firewood and building poles. This was cited as a major issue contributing to illegal harvesting besides the destructive harvesting done by licensed mangrove cutters. There was little mention of gender issues influencing governance. The respondents mentioned that participation of women in governance was encouraged. This was shown by the fact that one of the groups in the CFA was a women's group and had greatly participated in mangrove restoration activities. The community generally promoted participation of women as evidenced by the fact that the village chairperson in Jimbo village was a woman and had served in the elected post for 11 years and also the ward administrator of the area was a woman.

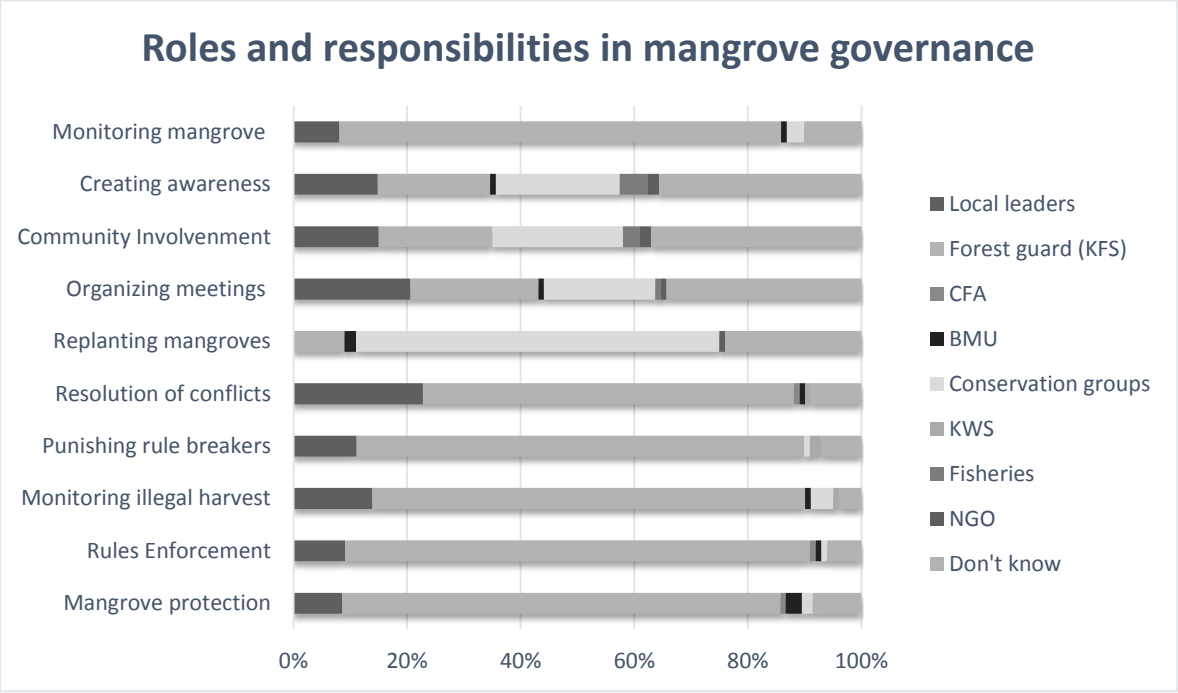

Figure 7: Division of roles and responsibilities in mangrove governance

Community perceptions on various aspects of governance in relation to mangroves was generally good. The responses had a Cronbach-Alpha statistic of 0.819 based on 13 aspects of governance considered: Organization structure and coordination, recognition and respect by the local community, interaction with other stakeholders (CFA, BMU, NGO and local conservation groups), conflict resolution, transparency and accountability, fairness and equity and involvement of local community in decision making. Based on these attributes, governance was perceived as good by 78 % of the respondents. This provides an indication of acceptance of the mangrove governance by the community. The highest ranking attribute was respect to the leadership involved in mangrove management by the community.

Consultation by local leaders was considered to be moderate while consultation by KFS through the forest guard considered lowest ranking since most of the respondents said that the community was rarely consulted in matters regarding mangrove management (See Figure 8)

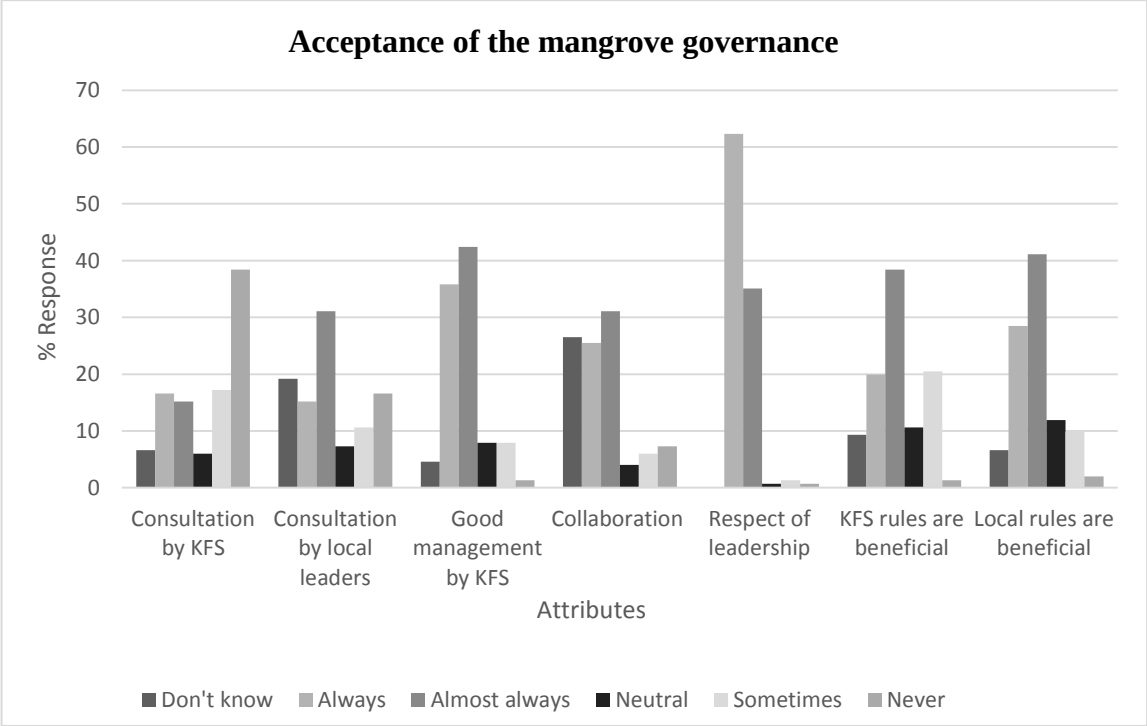

Figure 8: Acceptance of the current mangrove governance structure

4.3: Local attitudes and perceptions on the status of mangroves.

The Cronbach-Alpha statistic for the variables was 0.885 which is above the recommended minimum of 0.7. The increase in the statistic if any of the variables is deleted was considered negligible as shown in Table 4 therefore all the variables were included in computing a composite variable representing mental models of the respondents on the status of mangroves. 27.3 % saw almost no change in the condition of the mangrove. 7.3 % viewed the

mangroves as slightly degraded, 53.0% viewed it as severely degraded and 2.0% viewed it as very severely degraded. 9.9 % of the respondents did not know how to rate the condition of the mangroves. Therefore, a total of 62.3% of the respondents viewed the condition of the mangroves to be degraded to some extent (See Figure 9).

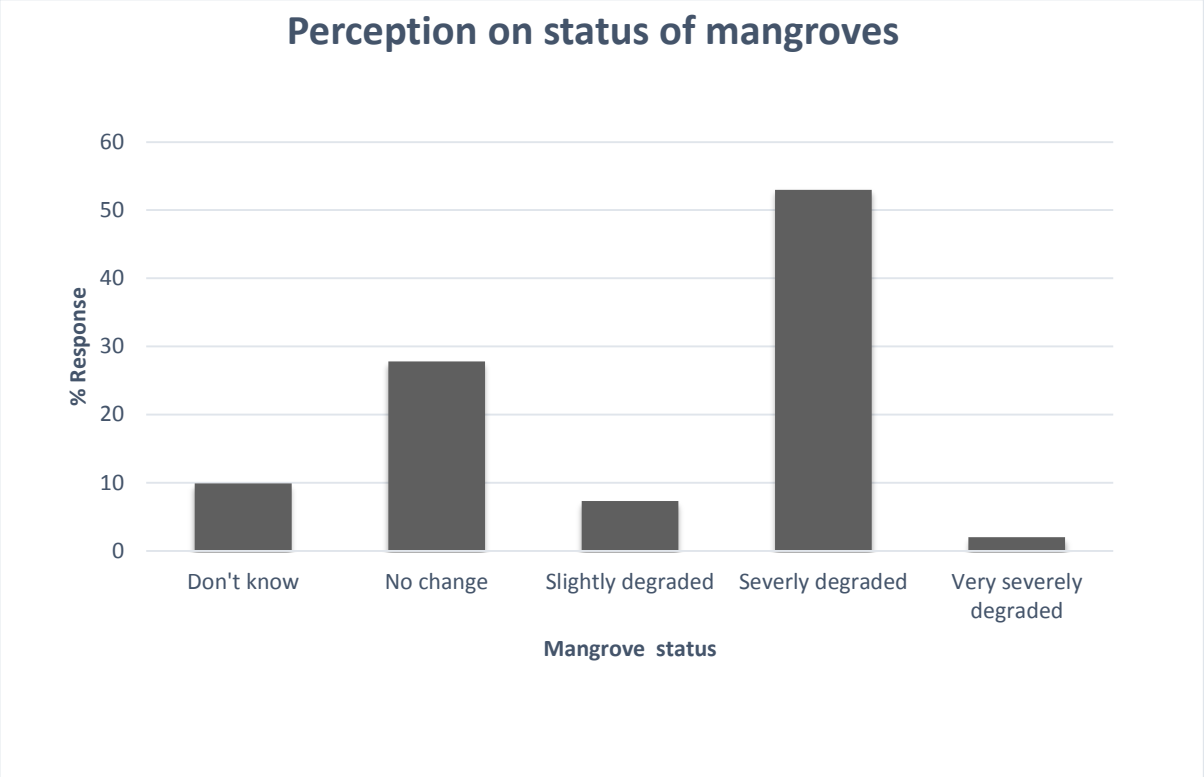

Figure 9: Perceptions on the state of mangroves in Vanga

Based on the ranking of products obtained or associated with the mangrove area, a squared multiple correlation (R^2) of the items was carried out to evaluate the correlation in responses for each item. As shown in table 3 below, 6 of the components had 85-90% of their variation explained by the consequent regression of the each individual component with the other components. However, for the forest cover component, only 21.8% of the variation could be explained by the regression of the other variables. This could be due to the fact that the forest cover was seen to have increased by most respondents as a result of the replanting efforts by the conservation groups that are taking place in the area.

Table 4: Cronbach alpha and squared multiple correlation of the variables

Component of mangrove	**Squared Multiple Correlation statistic (R^2)**	**Cronbach's Alpha if item is deleted**
Forest cover	0.218	0.896
Availability of preferred species	0.609	0.865
Quantity of building poles	0.891	0.860
Quality of building poles	0.893	0.863
Quantity of firewood	0.870	0.857
Quality of firewood	0.885	0.855
Fish availability around the mangrove areas	0.915	0.884
Invertebrate availability (e.g. crabs) in the mangrove areas	0.913	0.882

There were no significant correlations between perceptions on the condition of mangroves and demographic characteristics of the community such as use of mangroves, highest level of education and number of years spent in Vanga.

Table 5: Cross-tabulation of perceptions on status of mangroves against use of mangrove products

		Use of mangrove products		
		Yes	**No**	**Total**
Perceptions on state of mangroves.	Don't know	7	8	15
	No change	26	16	42
	Slightly degraded	6	5	11
	Severely degraded	51	29	80
	Very severely degraded	1	2	3
Total (N)		91	60	**151**

From the cross-tabulation, most of the most of the respondents who viewed the mangrove resource as degraded were users of the resources. 60.3% of the respondents use mangrove products. The main products used were firewood and building poles. However, there was no significant correlation between use of mangroves and perception on the state of mangroves ($p>0.05$) indicating that perception on the status of mangroves in Vanga could be randomly distributed among both users and non-users of the mangrove products.

In a situation where harvesting of mangroves from the forest was prohibited, 59.6% would seek alternative products such as paraffin, terrestrial firewood and charcoal, and coconut husks as fuels instead of firewood and use bricks and building stones instead of building poles. Out of the respondents who would seek available alternatives, charcoal was mentioned as the most preferred by 45.36% of the respondents.

Table 6: Response to prohibition of mangrove harvest

Alternative to prohibition of mangrove harvest	% respondents	Description
Move to a different area	0.7	-
Carry out illegal harvesting	3.3	-
Seek available substitutes	59.6	Alternatives sought: Charcoal **(45.36%);** Terrestrial firewood **(22.68%);** Paraffin **(2.06%);** Coconut husks **(29.90%)**
Other	36.4	Not affected because they do not use mangroves **(80.39%)**; Seek government assistance through intervention **(7.84%)**; Don't know what to do **(11.76)**

4.4: Potential community involvement in incentive based mechanisms

Based on the first set of attributes tested 58.93% (which represents the percentage of respondents with positive scores), were more likely to participate in conservation in the absence of incentives. For second set attributes 86.09% were more likely to participate in incentive based conservation. This represents a 27.16% increase in positive response therefore indicating that more people would be willing to be involved if some form of incentive would be provided.

80.1% of the respondents were ready to cooperate with the KFS in conservation of the Vanga mangrove forest. There were diverse reasons for cooperation as shown in the pie chart below. The three major reasons for cooperation that is: importance of mangroves to the livelihoods of the community members, a sense of responsibility for the environment and the need for community development could be linked to collective action benefit. The 19.9% who were not willing to participate were mostly those who regarded mangrove management as the responsibility of the forest guard and KFS in general.

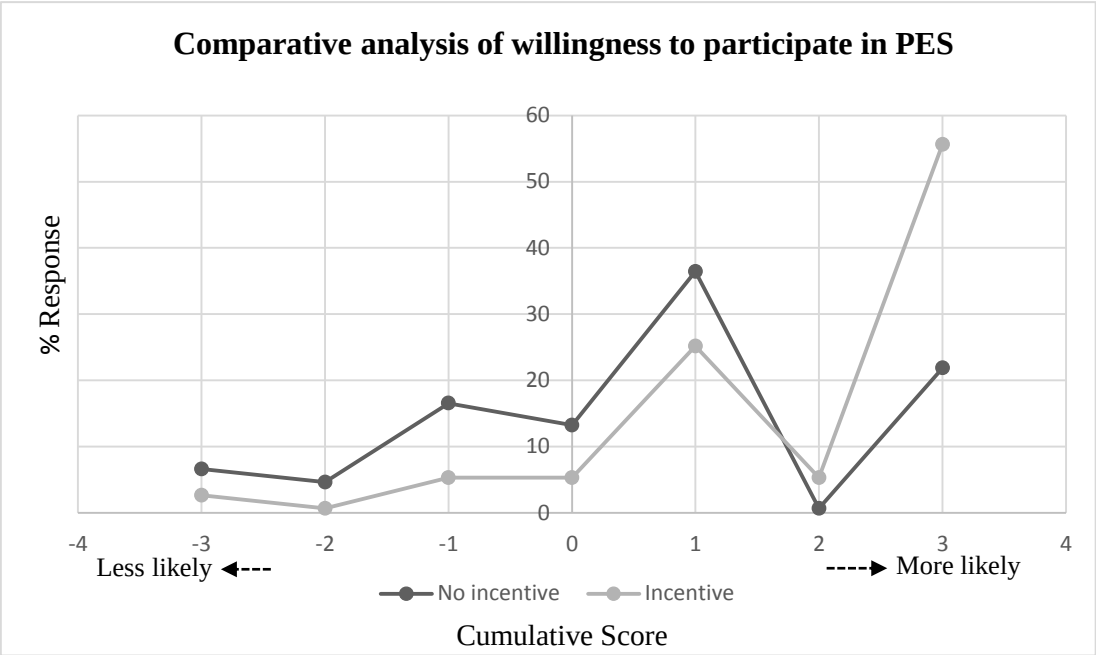

Figure 10: Percentage responses based on availability of incentives

80% of the respondents had limited or no understanding of incentive based mechanisms. Out of the 20 key informants interviewed, only 12 had a fairly accurate understanding of what incentive based mechanisms were which in this case focused on mangrove carbon offset project. The concept of a virtual carbon market was quite foreign to the community who have always dealt with physical tradeable goods and services. The idea of selling carbon credits is not quite clear to the community which mostly equated carbon to a mineral resource which will be mined and sold.

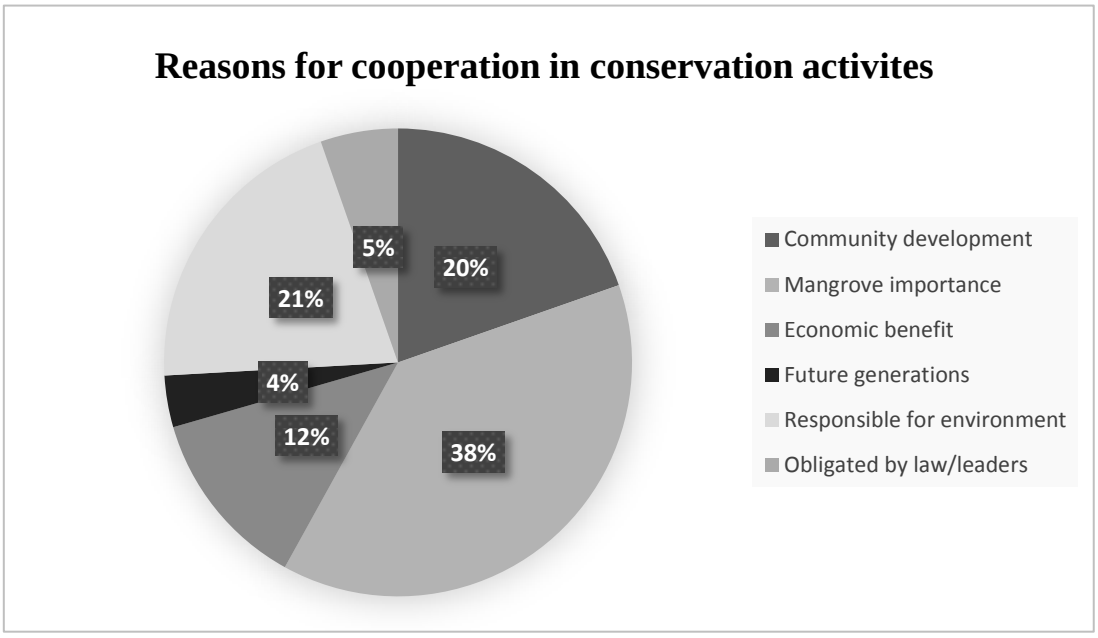

Figure 11: Percentage response on reasons for cooperation

The major challenges to community participation in mangrove conservation were highlighted as lack of awareness, lack of economic gain, poor coordination and transparency among community groups, discrimination in participation within community groups, lack of interest and lack of time due to other commitments. The highest ranking was lack of awareness

Table 7: Ranking challenges of community participation in mangrove conservation

Challenges highlighted	**Rank**	**% Mention by respondents**
Lack of awareness	1	25.21%
Lack of economic gain	2	18.80%
Lack of interest	3	16.66%
Lack of time	4	16.23%
Poor coordination and transparency in community groups	5	12.39%
Discrimination in participation within local groups	6	10.68%

CHAPTER 5: DISCUSSION

5.1: Major goods and services from mangroves of Vanga

The importance of mangroves for fish habitats was of highest importance to the community in Vanga based on community ranking while based on economic valuation (Huxham et al., 2015) shoreline protection was of highest importance. There rankings between the community and economic valuation differ since the community values are based on perceived economic gain for households and development of the community. Being a predominantly fishing community (Ochiewo, 2004) there is greater regard for the value of mangroves in fisheries because of its direct benefits as compared to shoreline protection which is considered an indirect benefit.

5.2: Local mangrove governance structure in Vanga

The current mangrove governance structure in Vanga at the national and regional levels was similar to most of the forests in Kenya since they are all under the management of KFS. However, there were differences at the local level due to the uniquely complex interactions that differ from one locality to another and were designed to be peculiar to the needs of the particular region (Saunders *et al.,* 2008). Mangrove governance in Vanga has been undergoing a transition from sole state management to a co-management agreement. The commencing of this transition was with the signing of the management plan with KFS. Once a management agreement has been signed, the CFA would be officially engaged in co-management of the forest. The process of formation of the CFA in Vanga area was initiated by East African Wildlife Society (EAWLS) through funding and providing technical support in the preparation of a management plan which was signed in 2009. The subsequent signing of the management agreement seems to have encountered delays due to lack of adequate funds to see the process through. There was high donor dependency for most community initiatives in the area. This is similar to findings by Cinner *et al.,* (2012) who researched on co-management agreements for fisheries in Kenya, Zanzibar and Madagascar and found that donors were the major drivers of decentralization through funding. The influence of the VAJIKI CFA was still regulated by KFS but it was presumed that with the signing of a management agreement, more power shall be allocated to the CFA for a level of autonomy in decision making, monitoring and issuing of sanctions at the local level. With the recognition of the CFA, all community groups that would want to carry out activities in the mangrove forest would have to register with the CFA in order to gain access to the resource.

Most of the responsibilities with regards to Vanga mangrove ecosystem were handled by the KFS forest guard who was recognized as the authority in mangrove governance at the community level. However, there were still numerous and complex interactions of the stake holders who have a multiplicity of interests (Rönnback *et al.,* 2007) with regards to the mangrove forest for example the State department of Fisheries and the BMUs seek to enhance the fisheries resource in the mangroves and NGOs mostly seek to provide alternative livelihood sources such as apiculture in mangrove areas. The roles of these actors were considered supportive because they complemented work done by the forest guard. Other stakeholders such as the local administration, NGOs, and other government departments also had some influence particularly in resource use conflict resolution and fostering local cooperation in conservation (Cinner *et al.,* 2012). These local interrelationships provided a robust network that strengthened the capacity of the local co-management beyond the support offered by the state and were beneficial to the overall condition of the resource (Saunders *et al.,* 2008; Agrawal and Gibson, 1999).

Partial decentralization of power to the local actors is a factor that influences co-management agreements in Kenya (Cinner *et al.,* 2012; Roy, 2014). This could result in minimized collective action by the community since it promotes top-down decision making and neglects community contribution to governance of their resource (Hartter and Ryan, 2010). Interactions of the local community and the natural resources could be substantially influenced by the design of the rules of governance, how they are implemented and how they are enforced in the area. Effectiveness of co-management is most strongly dependent on the local institutional factors at the community level (Saunders *et al.,* 2008; Gutiérrez *et al.,* 2011). Co-management of mangroves in Vanga is still in the formative stages but it is important to note that the CFA would only provide meaningful benefit to governance if it would be allowed to create and enforce local rules particularly pertaining to harvesting and monitoring as seen that there are currently no local rules for governing mangroves. Otherwise, if the CFA has very limited power to act such that the community cannot recognize it as an authority in local mangrove governance, as is the case at present, then the devolution would have no effect in engaging the community. Effective conservation of mangroves in Vanga would most certainly require the strengthening of the CFA to take up more definitive roles in mangrove governance.

The presence of well-defined boundaries in natural and social terms that complement each other, a reconciliation between governing rules and prevailing local situation, mechanisms for

conflict resolution, monitoring strategies, presence of graduated sanctions, collective-choice rules and regulation of local institutions by the overseeing government entity are critical for management of natural resources such as mangroves (Ostrom, 1990). In the case of Vanga the natural resource boundaries were much broader compared to the social boundaries established by the local community. While the Vanga mangrove ecosystem extends from Jimbo, Vanga, Kiwegu to Majoreni village, the social boundaries established by the local community extended only to Jimbo, Vanga and Kiwegu villages. This was due to the fact that Majoreni lies in a different local administrative boundary from the other three villages yet falls under the same mangrove ecosystem. While there had been efforts to include Majoreni in the VAJIKI CFA by KFS, the CFA members seem to be opposed to the move because of the difference in local administrative boundaries which might bring confusion and conflict in terms of the co-management. They proposed that Majoreni village should establish their own CFA since the mangrove forest in that area is managed by a different forest guard.

In the light of this situation, there was need for further consultation with the community in order to harmonize the ecosystem and administrative boundary differences and ensure sustainable management of the mangrove ecosystem. Without clear definition of boundaries, "free riders" would be introduced and they would receive benefits of the resource without taking any responsibility for conservation and management (Saunders *et al.*, 2008). In the case of Vanga, the community view the licensed mangrove cutters and immigrants into the area as such individuals. Streamlining co-management with institutional arrangements within the existing geographically oriented social structures at the local level in Vanga would allow for more effective governance and minimize management conflicts (Cinner *et al.*, 2012).

Mangrove destruction in Vanga could be greatly attributed to poor monitoring arrangements resulting in unregulated harvesting even by duly permitted individuals such as the licensed mangrove cutters. Although illegal harvesting was prohibited, there was still destruction of mangroves largely because those who had permits and licenses had generally poorly defined and consequently unregulated access to the resource. There seemed to be no clear harvest limits placed for both the licensed mangrove cutters and the community. Even if the limits were available, they were not properly monitored and enforced. The situation was worsened by the fact that there was lack of adequate monitoring personnel and equipment such as boats. This contributed to the indiscriminate harvesting practices particularly by those who harvested in areas that were only accessible by boat and thus out of the reach of the forest guard who was in-charge of monitoring. A study of the south coast of Kenya by Huxham *et*

al., (2015) indicates that poor enforcement of regulations as well as lack of alternatives to mangrove products drive the current trends in forest degradation in the area.

According to Gibson *et al*., 2005, the functionality of monitoring and enforcement mechanisms for rules established are pivotal to the protection of indigenous natural resources in the long term and also determining the ecological fate of the resources. Until the management agreement for Vanga mangroves is signed, the responsibility of monitoring and enforcement of rules lies squarely on the shoulders of the forest guard who was overwhelmed due to the vast expanse of the mangrove area and lack of adequate resources. Formalizing of the co-management agreement by the state government would certainly provide legal backing for the CFA to be more fully engaged such that it can formulate local by-laws that incorporate collective action decisions and intensify monitoring and enforcement. This would be more effective in regulating access and use of the resource (Saunders *et al.,* 2008; Lindsay, 1998; Ostrom, 1990).

The lack of consultation of the local community in decision making was highlighted as a major challenge. This could be as a result of accountability and feedback largely being directed up the hierarchy of mangrove governance with very little accountability downward to the community. This was similar to the case in West Africa where Béné *et al.,* 2009 found that there was more accountability to the top authorities and almost none to the local community. Cinner *et al.,* (2012) suggest that co-management would provide a level of downward accountability since the community would be directly involved in selecting leaders to represent their interests in mangrove governance and thus could hold these leaders accountable. This would serve to limit access and place effective controls on harvesting (Saunders *et al.,* 2008).

The local community generally has a positive attitude towards the current mangrove governance in Vanga. This could probably be due to the fact that the local community perceives the rules and regulations as being adequate and thus limiting illegal harvesting particularly from non-members of the community who were considered a threat to the resource. A significant proportion of the respondents were aware of some of the rules in place, particularly harvest regulations enforced by the KFS. There was generally great satisfaction with the rules largely because it restricted harvesting by ‘outsiders’ who were seen to be the main propagators of destruction. Even though the current governance of mangroves in Vanga was perceived as good by the community, the lack of consultation of the

local community could present a major challenge in cooperation of the local community. Proper communication of verifiable information is considered a sure demonstration of power (Krott *et al.*, 2014) and in the scenario in Vanga, it was the forest guard and to some small extent, external actors (other government parastatals and NGOs) who were exercising this power at the time. The consideration of community views is important for their cooperation in conservation (Agrawal and Ribot, 1999).

Local conservation groups were seen to be at the forefront of replanting mangroves as a result of funded projects in the area. For example, Jimbo Environmental Group received funds from Community Development Trust Fund (CDTF), a government initiative, and had replanted over 15,000 seedlings in the last two years. Replanting efforts were also largely dependent on donor funding available and some instance where donor funding stopped, there has been little replanting efforts thereafter. The VAJIKI CFA had limited sources of funding. The main source of funds for the majority of CFAs in Kenya was the membership fee and monthly or yearly subscription fees paid by the members of the CFA (Ongugo *et al.,* 2008). Such was the case for VAJIKI CFA and these funds were often inadequate for carrying out activities thus the need for support from donors. Benefit sharing between KFS and the CFA was mentioned as a point of concern for the CFA considering the fact that the CFA had inadequate funding. Revenue from fines and local permits issued were expected to be shared in the co-management agreement in order to support the running of the CFA. With the potential establishment of an incentive based project the CFA would have a source of funds to support its engagement in local mangrove governance.

According to some respondents, there seemed to be some political influence at play particularly when it came to issuing of sanctions. Some politicians were seen to be interfering with the course of justice particularly when an illegal harvester affiliated to them was arrested. The influence of some local politicians in derailing the work of the forest guard demonstrated power dynamics in which the community may likely side with the politicians because the politicians are community members duly elected to represent the community rather than the forest guard who was appointed to represent the state at the local level. The use or abuse of power by an actor of great influence in the community for self-interest could be a great hindrance to successful decentralization of forest governance to the community (Krott et al., 2014). While this issue was not widespread in the Vanga, Jimbo and Kiwegu villages, it was a matter of concern highlighted by the respondents (particularly those involved in mangrove conservation in the area) as one that would rapidly spread if an

incentive based initiative would be established in the area. They would seek to influence decisions particularly on projects undertaken by the community so that they could gain local approval for their political agendas. Empowerment of the community mainly focusing on their areas of priority would limit such political influences.

5.3: Community attitudes and perceptions towards the state of mangroves

The 62.3 % who viewed the mangroves as degraded was due to the fact that they perceived marked reductions in the products of mangroves that are most sought by the community that is firewood, building poles and associated resources such as fish and other crustaceans. Community attitudes toward the state of the resource could be influenced by the perceived benefits that were closest to the community in meeting their immediate needs (Badola *et al.*, 2012: Badola and Hussain, 2005). The 9.9% of respondents who gave no opinion on perception on the state of the mangrove were either those who did not go to the mangrove areas and only bought the products from vendors or those who did not use the mangrove products. Those who saw no change in mangroves mostly based their opinions on their individual household benefits from the mangrove resource, both directly and indirectly. As long as they were able to obtain the products they required for subsistence regardless of how difficult it was to obtain, they did not see any change in the resources.

While 62. 3% viewed the state of the mangroves as degraded 78.8% responded that the local governance was generally good with the exception of inadequate community consultation and involvement. This shows that a significant proportion viewed the mangroves governance as good yet still perceived the resource as degraded. The disparity between the two views could be explained by the fact that there could be other external underlying factors affecting the state of the resource other than governance. The factors mentioned by the respondents were the vastness of the area compared to the personnel available to monitor, intrusion by licensed mangrove cutters and immigrants from other area who harvested illegally and had little regard for community policing efforts, and inadequate consultation of the local community in mangrove governance.

It is however difficult to ascertain the level of destruction associated to the licensed mangrove cutters and the immigrants apart from destruction caused by local residents who also harvest illegally (Saunders *et al.*, 2008). Harvesting by locals in Vanga was mostly regulated semi-formally by issuance of permits by the forest guard yet the permit indicated no limit for harvest as it was considered that the local community would only harvest for

subsistence purposes such as obtaining firewood for cooking and the target would be dry fallen wood requiring no felling. The cutting of mangroves for purposes beyond subsistence was only allowed for licensed mangrove cutters who harvest and sell to the local community and beyond, once they had paid revenue to the government. This situation bore similarities to that found in Kisakasaka, (Saunders *et al.,* 2008) where local harvesting is similarly insufficiently regulated and degradation has been on the increase.

While all other resources considered as important to the community (firewood, building poles, availability of preferred tree species, fin fish and other crustaceans) were seen to have decreased, the mangrove cover was seen to have improved in the past five years by most respondents. This could be explained by the fact that there are conservation efforts through the replanting of mangroves particularly in Jimbo village. While most of the planted trees were still young, the general perception was that the trees would contribute to future wellbeing of the forest.

Most of the respondents were willing to seek alternatives to mangroves in the case that mangrove harvesting was prohibited. Most claimed that they would not resort to pilfering from the forest because of the serious penalties they would face. A common concern among the respondents was the cost of the alternatives. These were considered quite high for most of the community members who would normally spend much less in obtaining mangrove products for example, a bundle of wood costing 50 Kenya shillings would cook 3 meals while paraffin costing 50 shillings would cook 2 meals at most. Also, the availability of the alternatives was limited (Huxham *et al.,* 2015) since there was lack of market and also because some of the alternatives such as use of coconut husks instead of cooking fuel instead of mangrove products were unreliable. More than half of the respondents would resort to using products from the terrestrial forests including firewood and charcoal due to the fact that these products were the next cheapest option after mangroves. While this would reduce pressure on the mangrove forest, it would transfer pressure to the near-by terrestrial forests resulting in some sort of "leakage" situation where the community conserve their own forest resource but contribute directly or indirectly to the overexploitation of the neighboring terrestrial forest. This could be remedied by encouraging the establishment of woodlots in the area so as to meet the wood demand by the community particularly of fast growing species such as Casuarina which were well suited to the climatic characteristics of the Kenyan coast (Kitha and Lyth, 2011).

The use or non-use of mangroves products, education level and years lived in Vanga area had no significant relationship to the perception on the state of mangroves. This could be explained by the fact that perception seemed to be based more on individual household experiences with the resource rather than by demographic characteristics. Badola *et al.*, 2012 observe that values and thoughts can be influenced by individual experiences. Those who perceived the resource as degraded could have been directly or indirectly affected by the decrease in products demand. Even those who did not use the mangrove products could have experienced the indirect effects of the decrease in mangroves such as decreased fish availability from the mangrove areas and the reduced ecosystem services such as shoreline protection.

5.4: Willingness to participate in incentive based conservation

The results of this study indicate that availability of incentives was a major motivation factor in participation of the local community in conservation initiatives at the local level. Community acceptance of such projects hinged on perceived incentives and benefits likely to be accrued at individual household level as well as community level (Travers *et al.,* 2011). A few of the respondents were willing to participate in such an incentive based scheme because of having some information about the carbon-offset project in Gazi bay and the benefits obtained by the community there. Also, the fact that such a project would be managed at community level with decision making on how to share benefits left to the community appealed to the local community. Opportunities for local decision making were therefore considered fundamental to the success of conservation initiatives (Ostrom 1990, Clements *et al.,* 2010). Previous projects in the area were donor driven with little consultation with the community on the implementation of activities therefore, there was lack of community ownership and initiative in maintaining the projects once the donors left. It would be crucial therefore, that the local communities be included in management in order to improve the ecosystem and the benefits it provides (Jack *et al.,* 2008: Badola *et al.,* 2012).

The community in Vanga seemingly favoured collective action benefits as indicated by their reasons for cooperation in conservation. Mangrove importance to the wellbeing of the people was ranked highest by the respondents probably because they perceived a direct linkage between mangroves and their survival (Badola *et al.,* 2012) thus the need for conservation. Others would cooperate simply because they perceived it as their responsibility since they live next to the mangrove resource. 5% of the respondents would only cooperate because they were forced to by the law or by the leaders representing a lack of intrinsic motivation

probably due to the fact that there had been limited community consultation in the past and thus the community was mostly obliged to follow the rules set from higher management levels.

Knowledge of incentive based conservation strategies was very minimal with almost 80% of the respondents having no knowledge about such projects. Those who were aware particularly of the mangrove carbon offset project in Gazi Bay were mostly the key informants and still had very limited understanding of the nature of these schemes since it is a virtual market concept that is complex and not so easily conceived by the local community considering that 40.5% of the community had little to no education. Therefore, their likelihood to accept and support the establishment of incentive-based schemes in the long-term was dependent on their perception of how fairly and equitably costs and benefits will be distributed in the community. This was a major determinant of community acceptance (Sommerville *et al.,* 2010) and thus should be adequately considered in all its dimensions in the process of designing an incentive-based scheme. The respondent's perspectives were largely dependent on the kind of benefits that would be accrued, whether they were individual benefits, or communal benefits and also on what the cost would be in terms of time and manpower. While conservation was seen as a beneficial activity particularly with the presence of incentives, the contribution to household income was also a factor of consideration (Walton et al., 2006) since some of the respondents were unwilling to forgo their daily activities for conservation activities if it yielded insignificant benefit to the household income either directly or indirectly.

While the community was positive towards mangrove conservation and more so with the presence of incentives, caution would need to be undertaken to ensure that the community have a correct understanding of the nature of the benefits there-in so as to avoid introducing a sort of 'no pay, no care' ethic of ecosystem management (Fisher, 2011) where the community would only support conservation initiatives if they received incentives. Such an instance could be largely avoided by creating more rights and responsibilities for the community in mangrove governance such that they have a sense of ownership of the resource and they can manage it in the presence or absence of incentives. If the community perceives the mangrove ecosystem as state owned, then they would feel that they have the right to get payment for protecting state property. The potential benefits of a mangrove incentive-based schemes provide development funds for the community which would be managed by the CFA for the benefit of the villages involved. These funds were of great significance to the community

since their use is directly controlled at the local level (Clements *et al*., 2010) unlike funds received from government and non-governmental donors in which the community has very little say with regards to the appropriation of the funds. Indigenous establishment of rules promotes more community acceptance (Ostrom, 1990) in comparison to the ones imposed by external forces (Cardenas *et al.,* 2000). Bennett and Dearden, 2014 observe that successful conservation strategies at local level are built on the support of the community. This support is greatly dependent on the perspectives of the community with regards to the resource and its governance. Positive attitude towards the local mangrove governance and the understanding that the mangrove resource in Vanga was being degraded and the values currently derived could be lost provided proper foundation for the establishment of a sustainable incentive-based project in the area. Clear understanding by the local community of the goals of conservation through incentives would be key and must be adequately communicated to avoid conflicts (Rönnback *et al.,* 2007).

Future environmental, socio-economic and political dynamics should be taken into consideration since they may influence future circumstances of implementing incentive-based projects such as PES and REDD+ (Jack *et al.,* 2008). While the situation in Vanga was likely to be conducive for such a scheme, future influences especially from political authority particularly with the devolution of administrative power should be taken into consideration. Sustainability of these schemes could be improved if they work to promote the empowerment of local institutions and support the inherent motivations for conservation in the area (Clements *et al.,* 2010).

Establishment of community incentive-based initiative requires proper recognition and understanding of the differences and processes at the local level, influences of external actors and institutions (Agrawal and Gibson, 1999). In Vanga, the CFA would be the main proprietor of such a scheme without exclusion of the KFS which was the government link to the resource. It would be through the CFA that the financial benefits accrued would be channeled and decision making on spending put forward to the community through a voting process to ensure that the highest ranking developmental endeavor selected by the community is implemented without imposition from external forces. This had contributed to the success of the Mikoko Pamoja carbon offset project and promoted its acceptability in the community since the community is directly involved in suggesting the projects to be undertaken for the good of all the residents. Local management of the funds creates greater local support and accountability as well as more effective institutions (Clements *et al.*, 2010).

Poor local collaboration within and between the community conservation groups and lack of opportunities for equal participation in the groups were highlighted as challenges to cooperation in conservation initiatives. This was probably due the fact that some of the respondents perceived the groups as exclusive and only those with a certain level of education or knowledge could participate and benefit from the groups. Only few of the group members were knowledgeable on aspects of conservation and thus seemed to control the groups and were given more opportunities for training while the rest of the members were supposedly neglected. A lack of information sharing within the community groups could create mistrust and conflicts and thus affect the overall coordination of conservation initiatives. Providing more localized trainings in order to reach more community members and the sharing of perspectives particularly of the different users groups within the CFA as well as other stakeholders would provide better understanding of each actor's intentions (Steins and Edwards, 1999) and ensure more collaboration in management of the mangrove resource.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

Community ranking and valuation of mangrove goods and services was based on direct benefits to the economic development of households and the community as a whole rather than on the indirect benefits that the community could not be able to quantify in terms of its contribution to their immediate income. Community priorities should be taken into account in decision making with regards to mangrove management to encourage their participation in sustainable management of the resource.

Partial devolution of co-management has resulted in limited participation for the community in mangrove management decision making processes. While the governance seemed promising with the future institution of local management through the CFA, the main challenge in the area was lack of adequate monitoring capacity and strategies, lack of adequate community consultation in mangrove decision making, as well as lack of clear definition of boundaries could curtail sustainable management of the mangrove resource. The mental models of the community towards the current mangrove governance seemed to be influenced by the effectiveness of the current regulations in limiting use of the resource by outsiders who were deemed to be a threat to the sustainability of the resource.

Active decision-making by the local community in management of resources would likely be the most effective way of ensuring long term cooperation in the sustainable management of resources by the local community (Travers *et al.,* 2011). Devolution of roles and responsibilities to the CFA would provide greater accountability to the community and possibly contribute to their recognition and support of the local mangrove governance arrangements. Also, mechanisms for benefit sharing should be clearly defined to the local community for PES projects to work.

By-laws should be in place to enhance community monitoring to augment the current monitoring efforts of the forest guard thus ensuring more effective management of the resource. The recent National Mangrove Management Plan is expected to provide guidance for more effective governance of mangroves at the local level as well as the regional level. Access to the resources by those duly allowed to harvest through issuance of permits and licenses should be more clearly defined and regulated. There should be clear alignment of boundaries such that the administrative and social boundaries coincide with the natural

resource boundaries in order to minimize confusion, resource use conflicts and create harmony in management of the resource.

The attitude towards the condition of the Vanga mangrove ecosystem was as a result of the decrease in the benefits accrued from the resource in the past 5 years. The product from the mangroves and those products associated with mangroves were seen to have decreased and the cost of the available products had increased. The view of decreasing benefits from the resource would most likely provide suitable motivation for conservation of the resource through initiatives such as PES.

While PES could be a potentially effective incentive based mechanism for promoting sustainable mangrove conservation in Vanga, longer term measures such as promoting alternative livelihoods and promoting use of substitutes to mangrove products such as building blocks which are more durable instead of mangrove poles and establishment of woodlots reduce mangrove firewood requirement since these are the top products obtained from mangroves. The community would require proper training on PES projects particularly for mangrove areas and should work closely with Mikoko Pamoja which is a model mangrove carbon offset project that has been successful in providing benefits to the Gazi bay community. This project would provide a demonstration site for the community in Vanga to emulate. There was however need for further research to assess the contribution of external actors to over-exploitation of mangroves in the area.

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APPENDICES

Appendix 1: Key Informant Interviews

My name is Marlyn Omondi and I am a Masters student at Egerton University. I am carrying out research on local perceptions, attitudes and governance structures that support mangrove conservation and management in Vanga area. I am working in collaboration with the Kenya Marine and Fisheries Research Institute (KMFRI) in a research project named Coastal Ecosystem Services in East Africa (CESEA) working in selected coastal communities dependent on mangroves and seagrass resources in Kenya. One of the key research aims in this project is to generate understanding of determinants and nature of effective, pro-poor and resilient local governance, knowledge exchange and identification of potentially best sites for new integrated payment for ecosystem services (PES) scheme. The information you provide will be very useful to this study. This interview is confidential and will be used for research purposes only.

(Target Key Informants: Village chairpersons, Local chief, BMU leader, CFA leader, Fisheries Officer, Forest guard)

1. Do you feel responsible for the protection of the mangrove ecosystem?
2. How are the products from the mangrove ecosystem utilized in the community (Wood, Timber, Fish)?
3. Are there alternative resources that can be used to supplement or substitute mangrove products and services that the community demands? Are these alternatives affordable?
4. Would you like to cooperate with the forest department for mangrove conservation and restoration?
5. What is your understanding of the mangrove governance structure in Vanga? Who are the main stakeholders and the key decision makers?
6. In your opinion, would you term the current local governance structure and the KFS as effective in the conservation and management of the mangrove ecosystem?
7. What destructive practices take place in the mangrove ecosystem? What actions have been taken to curb these practices and by whom? Which are these actions?
8. What income generating activities are you involved in that relates to the mangrove ecosystem?
9. What challenges do you face in the management and conservation of the mangrove ecosystem?
10. Are there any resource use conflicts that exist in Vanga area? Which ones are they? How are they resolved or how have they been resolved in the past?
11. Are there conflicts with regards to the governance structures in your community? How are they resolved and who is involved in resolving them?In case of conflict in the utilization of the mangrove ecosystem, whom do you report to? How do they handle the situation?
12. What groups are involved in the governance of mangrove ecosystems? What are the roles and responsibilities of each group in governance?

13. How do the different conservation groups (BMUs, CFAs, and Turtle Conservation etc.)Interact with each other? Do they work in collaboration or separately? How do they relate with the KFS officials?
14. Are you a member of any mangrove-related conservation group (CFAs, BMUs, Turtle Conservation etc.)? Which one/ones? If yes, why did you join the group? Are you an active or passive member? Are you a leader or an ordinary member of the group? What benefits do you obtain from the group?
15. Do you attend community meetings? How are they conducted? Who is in charge? Do you participate in the meetings?
16. Have you heard of Payment for Ecosystem Services (PES) projects? In your understanding, can you explain what you know of PES?
17. How do the key decision makers relate with the ordinary community members and with the KFS?
18. How do you view the state of Mangroves Vanga comparing the current state with 5 years ago? Is it improving or deteriorating? Do you still obtain as much value from it as you did 5 years ago or has it increased or decreased?
19. What factors do you think have led to the current state in the mangrove ecosystem?
20. What is the contribution of the non-local resource users to the state of the mangrove ecosystem?
21. What measures do you think should be taken to improve the current state of mangroves in Vanga.
22. Does politics influence mangrove ecosystem governance structures in your area? If yes, in what way?
23. Would you consider your community as poor? If yes, why? What are the indicators of poverty in your community?

Thank you for your time and cooperation

Appendix 2: Focus Group Discussion (Community)

My name is Marlyn Omondi and I am a Masters student at Egerton University. I am carrying out research on Local perceptions, attitudes and governance structures that support mangrove conservation and management in Vanga area. I am working in collaboration with the Kenya Marine and Fisheries Research Institute (KMFRI) in a research project named Coastal Ecosystem Services in East Africa (CESEA) working in selected coastal communities dependent on mangroves and seagrass resources in Kenya. One of the key research aims in this project is to generate understanding of determinants and nature of effective, pro-poor and resilient local governance, knowledge exchange and identification of potentially best sites for new integrated payment for ecosystem services (PES) scheme. The information you provide will be very useful to this study. This discussion is confidential and will be used for research purposes only.

1. Do you feel responsible for the protection of the mangrove ecosystem?
2. How are the products from the mangrove ecosystem utilized in the community (Wood, Timber, Fish)?
3. Are there alternative resources that can be used to supplement or substitute mangrove products and services that the community demands? Are these alternatives affordable?
4. What is your understanding of the mangrove governance structure in Vanga? Who are the main stakeholders and the key decision makers?
5. List all stakeholders and key decision makers who are involved in governance of the mangrove ecosystem.
6. In your opinion, would you term the current local governance structure and the KFS as effective in the conservation and management of the mangrove ecosystem?
7. What destructive practices take place in the mangrove ecosystem? What actions have been taken to curb these practices and by whom? Which are these actions?
8. What income generating activities are you involved in that relates to the mangrove ecosystem?
9. What income generating activities are you involved in that relates to the mangrove ecosystem?
10. Are there any resource use conflicts that exist in Vanga area? Which ones are they? How are they resolved or how have they been resolved in the past?
11. In your opinion, what actions should be taken by the local governance system and KFS in order to improve the protection and conservation of the mangrove ecosystem?
12. What is your understanding of Payment for Ecosystem Services (PES)?
13. What benefits do you think PES can provide to your community?

Thank you for your time and cooperation

Appendix 3: Focus Group Discussion (Local Conservation Groups)

My name is Marlyn Omondi and I am a Masters student at Egerton University. I am carrying out research on Local resource values and governance structures that support mangrove conservation and management in Vanga area. I am working in collaboration with the Kenya Marine and Fisheries Research Institute (KMFRI) in a research project named Coastal Ecosystem Services in East Africa (CESEA) working in selected coastal communities dependent on mangroves and seagrass resources in Kenya. One of the key research aims in this project is to generate understanding of determinants and nature of effective, pro-poor and resilient local governance, knowledge exchange and identification of potentially best sites for new integrated payment for ecosystem services (PES) scheme. The information you provide will be very useful to this study. This discussion is confidential and will be used for research purposes only.

1. What was the motivation behind establishment of this group?
2. How many members are present?
3. What are the major threats to mangroves does the group address?
4. What part does your conservation group play in conservation of mangroves and the associated products it provides?
5. What activities in the recent past has the group been involved in that relate to conservation of mangroves? Are the activities donor sponsored?
6. What local initiative has the group undertaken to support the protection and conservation of mangroves
7. Does the group collaborate with other conservation groups in your area to promote conservation of mangroves? If yes, which groups?
8. In what activities does the group work collaborate with other conservation groups?
9. Does the group work in collaboration with the Kenya Forest Service? If yes, in what ways/ activities?
10. In your opinion, what actions should be taken to improve collaboration with KFS and other conservation groups in the protection of the mangrove ecosystem?
11. What is your understanding of Payment for Ecosystem services?
12. List all stakeholders and key decision makers who are involved in governance of the mangrove ecosystem.

Thank you for your time and cooperation.

Appendix 4: Household Survey Questionnaire

My name is …….. I am carrying out research on local governance structures, attitudes and perceptions that support mangrove conservation and management in Vanga area. I am working in collaboration with the Kenya Marine and Fisheries Research Institute (KMFRI) in a research project named Coastal Ecosystem Services in East Africa (CESEA) working in selected coastal communities dependent on mangroves and seagrass resources in Kenya. One of the key research aims in this project is to generate understanding of determinants and nature of effective, pro-poor and resilient local governance, knowledge exchange and identification of potentially best sites for new integrated payment for ecosystem services (PES) scheme. The information you provide will be very useful to this study. This interview is confidential and will be used for research purposes only.

1. General Information

1.1: Household No.	Household GPS Coordinates		Northings : Eastings:
1.2: Name of Respondent			
1.3: Sex of Respondent	1= Male ( ) 2= Female ( )		
1.4: Are you the household head	1= Yes ( ) 2= No ( )		
1.5: If No, what is the Sex of Household head?			1= Male ( ) 2= Female ( )
1.6: Age of the Household head			
1.7: Marital Status of Household head	1= Married ( ) 2= Single ( )	3= Widowed ( ) 4= Divorced ( )	5= Separated ( ) 6= Other (specify) ( )……
1.8: How many years has the household head lived in the area?			
1.9: Household Gender distribution	1= Male …….. 2= Female …….		
1.10: Household Age Distribution	1= < 5 …….. 2= 5-18 ……...		3= 19 -60 …….. 4= >60 ……..
1.11: Highest Education level of the Household head.	1= No Education ( ) 2= Incomplete Primary ( ) 3= Completed Primary ( ) 4= Incomplete Secondary ( )		5 = Completed Secondary ( ) 6 = Tertiary (College) ( ) 7= Islam Schooling ( ) 8 = Adult Schooling ( )
1.12: Average Household Income per month			
1.13: Household head Occupation	1= Primary Occupation …… 2= Secondary Occupation ……		

List of Occupations		
1= Fishing	2= Crop farming	3= Livestock keeping
4= Seaweed farming	5= Fish vending (fresh,fried)	6= Food Vending
7 = Firewood	8= Charcoal	9= Small business(Kiosk)
10 = Craftsman (carpenter)	11= Lumbering (Timber, Poles)	12= Tailoring
13 = Thatching (makuti weaving)	14= Casual Labour	15= Employment
16= Retired (Pension)	17= Others (Specify)	

2. Utilization of Mangroves

2.1: Does your household extract products from the mangrove forest?
Yes ( ) No ( )
2.2: Which products do you harvest from the mangrove forest and how often do you harvest them?

Product	**Frequency of harvest** **1= Daily 2 = Weekly** **3= Bi-weekly 4= Monthly**	**Alternative sources**	**1= Purchased** **2= Obtained at no cost**
1=Firewood			
2=Building poles			
3=Boat making materials			
4=Furniture making			
5=Fishing stakes			
6=Fence construction materials			
7=Traditional medicine			
8=Other (Specify) ……..			

3. Local Governance Structures Characterization, Roles and Acceptance

3.1: Do you know who is in-charge of managing the mangrove forest?
Yes ( ) No ( )
3.2: If yes, mention the specific individuals and their position:
……..3.3: Are there community groups involved in the management of mangrove forests in Vanga?
Yes ( ) No ( )
3.4: If yes, which groups?
…….
3.5: Are the local community leaders involved in conservation and management of mangroves?
Yes ( ) No ( )
3.6: Which key stakeholders are responsible for the following functions? (*Tick all that apply*)
(1= Local Leaders, 2= KFS, 3= CFAs, 4=BMUs, 5= Local conservation groups, 6= Other government institution: *Specify* …., 7= Other local institution: *Specify* …8=NGOs: *Specify*….)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
3.6a: Protection of the mangrove ecosystem								
3.6b: Enforcement of rules and norms regarding harvesting from the mangrove forest								
3.6c: Monitoring of illegal harvesting activities								
3.6d: Punishment of those who break rules and laws regarding mangroves								

3.6e: Resolution of conflicts arising from mangrove resource utilization								
3.6f: Replanting of mangroves in degraded sites								
3.6g: Organizing community meetings for mangrove management								
3.6h: Involvement of the local community in conservation of the mangrove ecosystem.								
3.6i: Creating awareness on conservation of the mangrove ecosystem								
3.6j: Monitoring of the condition of the mangrove ecosystem								

3.7: Are you aware of any rules and regulations governing the management of mangroves?

1= Yes ( ) 2 = No ( )

3.8: If yes, which ones? (*If no, skip to 3.10*)

1 = Forest Act of 2005 ( )	4 = Traditional Rules and Customs ( )
2 = National Forest Policy ( )	5= Others: Specify…… ( )
3 = KFS Management Plan ( )	

3.9: To what extent are you satisfied with the rules and regulations? (*Circle one*)

(1= Very Satisfactory, 2= Satisfactory, 3= Neutral, 4= Unsatisfactory, 5= Very Unsatisfactory)

3.10: To what extent do you agree with the following?

(1=Always, 2= Almost Always, 3=Neutral, 4= Sometimes, 5= Never)

	1	**2**	**3**	**4**	**5**
3.10a: KFS consult the local community in the conservation and management of the mangrove ecosystem?					
3.10b: You agree with the way KFS manages the mangrove forest.					
3.10c: The local leaders consult the local community in the conservation and management of the mangrove ecosystem?					
3.10d: The local leaders work in collaboration with KFS in management of the mangrove ecosystem?					
3.10e: The local leaders are respected by the community.					
3.10f: The rules established by KFS are acceptable to the community and are beneficial conservation of the mangrove ecosystem					
3.10g: The rules established by the local leaders are acceptable to the community and are beneficial to conservation of the mangrove ecosystem					

3.11: How would you rate the local governance structure based on the following attributes?

(1= Very Good, 2= Good, 3=Neutral, 4=Poor, 5= Very Poor, 6= Don't know)

	1	**2**	**3**	**4**	**5**	**6**
3.11a: Organization structure and coordination among the local leaders						
3.11b: Recognition and respect by the local community						
3.11c: Interaction and working with KFS						
3.11d: Interaction and working with CFAs						

3.11e: Interaction and working with BMUs						
3.11f: Interaction and working with other conservation groups (NGOs)						
3.11g: Interaction and working with local conservation groups						
3.11h: Ability to resolve resource use conflicts in the community						
3.11i: Transparency and accountability of the local leaders.						
3.11j: Fairness and equity in distribution of resources.						
3.11k: Involvement of the local community in decision making						
3.11l: Accessibility of the leaders by the local community (availability and approachability)						
3.11m: Providing feedback to the local community on decisions made.						

4. Local Attitudes and Perceptions on the State of the Mangrove Ecosystem

4.1: How do you view the condition of the mangrove forest for the past 5 years based on the following characteristics?

(1=Largely increased, 2=Increased, 3= No change, 4= Decreased, 5= Largely decreased)

	1	**2**	**3**	**4**	**5**
4.1a: Forest Cover/Size					
4.1b: Availability of preferred tree species					
4.1c: Quantity of Timber					
4.1d: Quality of Timber					
4.1e: Quantity of Firewood					
4.1f: Quality of Firewood					
4.1g: Availability of Fish					
4.1h: Availability of invertebrates (Crabs, Prawns, Sea cucumber etc.)					

4.2: What is your view on the overall condition of the mangrove ecosystem in the past 5 years?

Not Degraded ( ) slightly degraded ( ) Unchanged ( ) Severely Degraded ( )

Very Severely Degraded ( )

4.2: Do you feel responsible for the conservation and management of the mangrove forest?

Yes ( ) Somewhat ( ) No ( )

4.3: In the case that harvesting of mangrove trees from the forest was prohibited, what action would you take?

1= Move to a different area ( )

2= Carry out illegal harvesting ( )

3= Seek available substitutes to mangrove products ( ) *Specify which substitute* ……

4= Other ( ) *Specify* ……

5. Potential for participation in conservation measures such as PES

5.1: Do you know of any conservation activities taking place in your area?

Yes ( ) No ( )

5.2: If yes, specify

…….5.3: Are you a member of any conservation group?

1= Yes ( ) 2= No ( )

5.4: If yes, which one/ ones?

…….5.5: What activities has your group carried out in the past 5 years?

…….5.6: Would you be willing to cooperate with the KFS and local leaders in the protection of the Vanga mangrove forest? Yes ( ) No ( )

5.7: *Respondent to give reason why or why not*

……

5.8: What is your opinion with on management of the mangrove resource with regards to the following:

(1= Strongly Agree, 2= Agree, 3= Neutral, 4= Disagree, 5=Strongly Disagree)

	1	**2**	**3**	**4**	**5**
5.8a: Making decisions on use of mangrove resources is open to community members					
5.8b: Community members have equal access to management information concerning the mangrove resource.					
5.8c: Dispute handling mechanisms by KFS are effective					
5.8d: Dispute handling mechanisms by local leaders are effective					
5.8e: Would you support if the community was prohibited from harvesting mangroves from the forest for at least 10 years to promote conservation of the forest?					
5.8f: Would you participate in replanting of mangroves for purposed of restoring the mangrove forest?					
5.8g: Would you accept compensation (monetary or non-monetary) for avoiding harvest of mangrove trees from the forest?					

5.9: In your opinion, what 3 main challenges prevent local participation in mangrove conservation in Vanga?

……

Thank you for your participation