ASSESSMENT OF WOODY RESOURCE AND MANAGEMENT POTENTIALS FOR IMPROVED LIVELIHOOD IN KITUMBI VILLAGE LANDS FOREST RESOURCE, TANGA, TANZANIA

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ABSTRACT

This study aimed at assessing the contribution of woody resource and its management in improving the livelihood of community surrounding Kitumbi VLFR in Tanga, Tanzania. Specifically, the study aimed at assessing the woody resources available in Kitumbi VLFR; the effectiveness of the governance structure in managing Kitumbi VLFR and contribution of wood lands in improving livelihood of the surrounding communities of Kitumbi VLFR. Forest inventory was done to collect data on forest stock while data related to socio-economics and forest governance were obtained through household survey and key informant interviews. The results showed the stand parameters in terms of the number of stems per ha (N), basal area per ha (G) and tree volume per ha (V) of woody resource available in Kitumbi VLFR were 395±88, 5.11 ± 0.65 m^2/ha and 45.14 ± 7.04 m^3/ha respectively of 54 tree species belonging to 20 plant families. The forest was typical miombo but unhealthy. In 10 years, Kitumbi VLFR has contributed revenue estimated to amount to TZS 5 782 407 from 1140 pcs equivalent to 55.03 m^3 of timber of various species. The study established further that there are large woodland areas within the village, which are used as agricultural expansion areas, these woodlands within agricultural land contributed 27 percent to the total household income in the study area. Also, the result revealed the existence of ineffective forest governance with governance.

DECLARATION

I, Anthony Bonifasi Mwilenga, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

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This work is dedicated to my beloved father, late Boniface Bulangi Mwilenga, who built the foundation stone for my education. Father, I'm proud of your contribution.

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LIST OF ACRONYMS AND ABBREVIATION

CITES	Convention on International Trade in Endangered Species of wild Fauna and flora
CPU	Cost Per Unit
Dbh	Diameter at Breast Height
DFC	District Forest Conservator
DFO	District Forest Officers
EAMCEF	Eastern Arc Management and Conservation Endowment Fund
EMA	Environmental Management Act
FORVAC	Forestry and Value Chains Development programme
FR	Forest Reserve
G	Basal area per hectare
GIS	Geographical Information System
GPS	Global Positioning System
HDC	Handeni District Council
KDC	Kilindi District council
MNRT	Ministry of Natural Resources and Tourism
m^3	Metre cubic
TFS	Tanzania Forest Service
TZS	Tanzania Shillings
NHIF	National Health Insurance Fund
NTFPs	Non Timber Forest Products
NAFORMA	National Forest Resource Monitoring and Assessment
URT	United Republic of Tanzania
V	Volume per hectare

VEO	Village Executive Officer
VLFR	Village Land Forest Reserve
VNRC	Village Natural Resource Committee

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Miombo is a vernacular word in Bemba language, which the ecologists now use to describe the woodlands largely populated by trees in genera *Brachystergia, Julbernardia*, and *Isoberlinia* (Gumbo *et al.,* 2018). In mainland Tanzania, miombo occupies approximately 93 percent of the forested area (URT, 2015). Such a huge forest resource requires sustainable management plans so that ecosystem services continue to flow and livelihood of surrounding community is improved. Unfortunately, the societies dependent on those woodlands are still poor and their livelihood always uncertain. If well managed woodlands can play a big role in mitigation, alleviation and elimination of poverty and improved livelihood of resource owners (Gumbo *et al.,* 2018).Recently miombo woodlands sustain the livelihoods of more than 100 million rural poor and 50 million urban people. The charcoal sector alone employs vast numbers of rural people and offers additional income to many poor rural families. However deforestation and degradation of miombo woodlands is a common challenge the resource encounters. In response to this, Tanzania governments began to shift toward decentralized forest management through participatory forest management (PFM) by introducing the national forest policy of 1998. PFM intended to improve local livelihoods, to conserve and regenerate forests and forest resources, and to promote good governance (URT, 2013).

The quality of forest governance structure can determine whether forest resources are used and managed according to institutions at hand. Weak forest governance structure has negative impacts on the livelihood of the community that depends on the forest resources.

We can diagnose problems and advance reforms only when we can measure effectiveness of forest governance structures in particular forest management (FAO, 2011).

Kitumbi village land is rich in miombo woodland ecosystem covering reserved and unreserved woodland. The reserved woodland, which is estimated to be 7 705.3 ha stands for the name of Kitumbi VLFR. The VLFR is owned and managed by Kitumbi village community of in Handeni district. Its establishment is in line with the national forest policy of 1998 and Forest Act number 14 of 2002. Unreserved woodlands serve as a production forests within agricultural land (HDC, 2019).

1.2 Problem statement

In Tanzania, deforestation is estimated to be 469 420 ha annually (URT, 2017). This necessitates proper management, which starts with having a proper forest management plan that considers the improvement of livelihood of the surrounding communities and sustainability of forest resource. The degradation of forests and deforestation may be mitigated when the livelihood of forest-dependent people is improved through participatory forest management. However, the communities owning and managing these woodlands are still poor and with always uncertain livelihood (Gumbo *et al.*, 2018). Kitumbi village is abundantly covered with miombo woodlands in both reserved and unreserved forested land. The report from Kitumbi village land use plan in year 2019 suggested the unreserved forest land, which is within agriculture expansion area and reserved forest land to be 5 453.7 ha and 7 705.3 ha respectively; the latter being Kitumbi VLFR. Unreserved forested land is part of the agricultural land for expansion. The area serves as a production forest when the land is prepared for farming purposes. It is where poles, timbers, firewood, charcoal and other forest produces originate. Both unreserved forested land and Kitumbi VLFR are one of the potential

woodlands whose degradation and deforestation are high with the livelihood of the community surrounding them remaining unsupported by the resource (HDC, 2019). Thus, the study aimed at assessing woody resource in Kitumbi VLFR and its contribution and contribution of woody resources within the agricultural expansion area in improving the livelihood of the community surrounding these resources. The study further assessed, the effectiveness of the existing forest governance structure in managing the Kitumbi VLFR in attaining the improved livelihood of the community owning and managing this forest.

1.3 Study justification

The study reveals the contribution of management and effectiveness of forest governance structure in managing Kitumbi VLFR in order to attain improved livelihood of the community. Also, the study documents the woody resources available in Kitumbi VLFR and contribution of the forests to the improved livelihood of the village community. Also the study contributes to knowledge or better ways of managing community forests for improved livelihood. This contributes to the community participation in management of forest resources as opposed to centralized approach.

1.4 Objectives

1.4.1 Main objective

The main objective of this study was to assess the contribution of woody resource and its management in improving the livelihood of community surrounding Kitumbi VLFR in Tanga, Tanzania.

1.4.2 Specific objectives

i. To assess the woody resources available in Kitumbi VLFR
ii. To assess the contribution of woodlands to the livelihood of surrounding communities of Kitumbi village
iii. To assess the effectiveness of the governance structure in managing Kitumbi VLFR

1.4.3 Research questions

i. How much woody resource is available in Kitumbi Village Land Forest Reserve?
ii. How much do the woodlands contribute to the livelihood of surrounding communities of Kitumbi village?
iii. How much effective is the governance structure in the management of Kitumbi VLFR?

1.5 Conceptual framework

The model of the Conceptual Framework is adapted from Carney (1998) and Scoones (1998), with inputs from this study. This study focused on showing how miombo woodland resources contribute to improved livelihood through activities facilitated by policies and institutions. The study stratified income sources into four categories: woodland, Agriculture, livestock and fishing.

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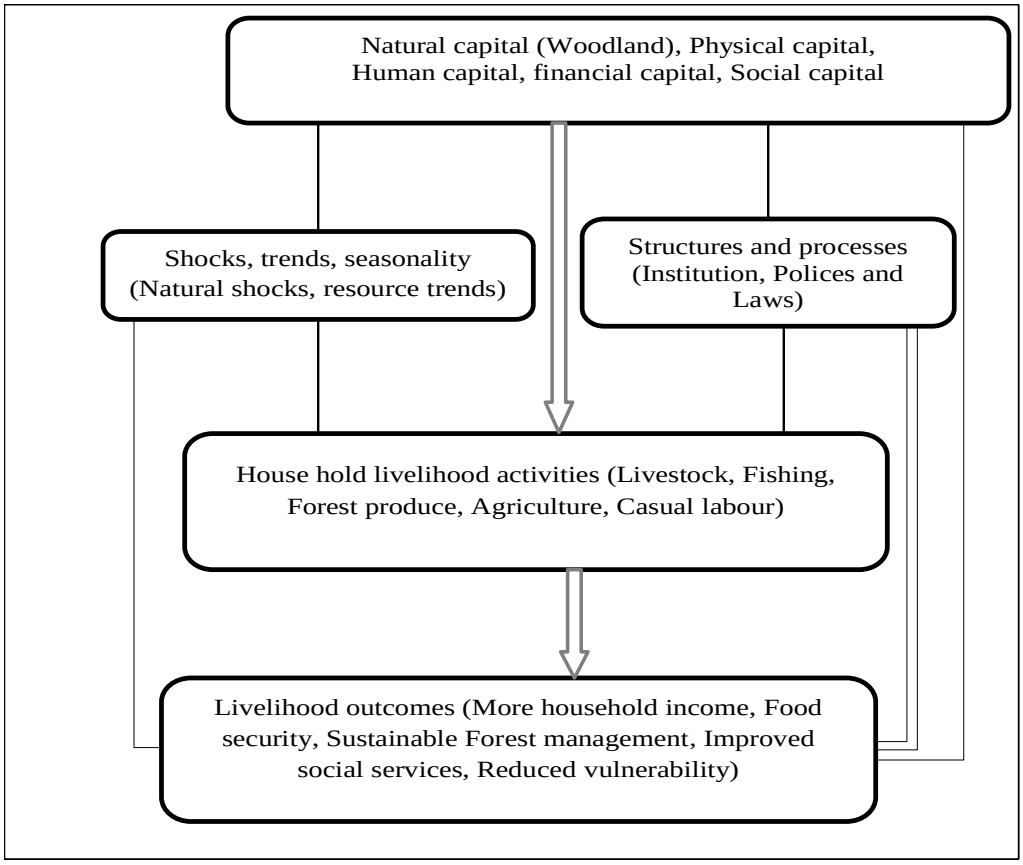

gure 1: Represents the sustainable livelihood conceptual framework

Source: Model modified from Carney and Scoones in (1998).

1.6 Study limitations

The major limitation during biophysical data collection was insecurity. People with farms or grazing lands within the forest reserve resisted inventory team from reaching their sites. This made it difficult for some sample plots to be reached and assessed. About five (5) sample plots from two (2) clusters could not be accessed and hence were not assessed.

During socio-economic survey, the first limitation was the long distance between households for interviews and the second major limitation was availability of the respondents. In cases where the interviewee was available, he or she was busy with land preparation for the new agricultural season. This led to long waiting time hence adding some extra costs beyond the estimated budget.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Woody resource in miombo woodlands

In miombo woodlands, parameters such as woody species composition, diversity, basal area, volume and number of woody stems per specified size of an area are very crucial. All these are useful in forest resource management because they are used in the analysis and determination of forest growth and yield prediction. Thus, these parameters are very important to the foresters in making recommendations and decisions on forest management (Njepang, 2015). However, these parameters are not constant in miombo woodlands. For example, Lyimo and Shaban (2015) in a study conducted at Kitulangalo FR reported 71 different woody species with 995±256stems/ha, basal area of 7.961±0.8m^2/ha and standing volume of 54.72±11.3m^3/ha. Also, NAFORMA reported the national wise growing stocks of 1053 stems/ha, 8.3m^2/ha and 55.1m^3/ha for the number of stems, basal area and volume respectively (URT, 2015). Again, Mwakaluka *et al.* (2014) reported that Gangalamtumba VLFR, Iringa town, had a volume, basal area, and number of stems of 92.17±39.0m3/ha, 13.55±5.52m2/ha and 1521±594stems/ha respectively. The study by Isango (2007) at Nyang'oro forest reserve reported basal area 15.63 m/ha, number of stems 700/ha and tree volume 65.7m3/ha. The same study by Isango (2007) at Kitonga forest reserves documented that 15.4m2/ha, 1038stems/ha and 64.9m3/ha of tree basal area, number of stem and volume respectively. In both studies by Isango (2007) the woody species richness recorded were 47 and 57 for Nyang'oro and Kitonga respectively. Again, Malimbwi (2007) reported that the study conducted at Kitulangalo FR in Morogoro had a volume, basal area, and number of stems of 352±52 stems/ha, 8.3±1 m2/ha and 64.7±9.4 m3/ha respectively. From Kilindi district, Tanga, Mnkonde village reported that at Mbwego VLFR there were 80 different woody species with

number of stems, basal area and volume of 237.2±24 stems/ha, 9.6±1 m2/ha and 97.34±12.45 m3/ha respectively. From Songea district, Ruvuma, Liweta village reported that at Lupagalo-Liweta VLFR there were 71 different woody species with number of stems, basal area and volume of 243.7±28 stems/ha, 8.66±0.9 m2/ha and 81.58±9.7 m3/ha respectively. Thus, these records show the necessity of conducting an inventory in Kitumbi VLFR, which will provide data for various purposes.

2.2 Miombo woodlands and livelihood

A livelihood entails the capabilities, assets, resources and activities required to make a living. It is the ability of paying for the necessities of life such as food, shelter, education, healthcare, and water and creating assets. Woodlands can be utilized to improve livelihoods and enhance sustainable management. Generally, livelihoods require natural capital (natural resources), physical capital (basic infrastructure), human capital (health, knowledge, skills), social capital (relationship of trust, membership of groups, networks), financial capital (pensions, incomes, savings, supplies of credit) as well as political capital to make it get improved (Chambers and Conway., 1991).

The study shows that woodlands provide abundant benefits on human capital. The surgery patients who could see deciduous trees require less pain killing drug than similar patients who view only brick walls. Prisoners surrounded by trees and woodlands had fallen sick less than those used to see concrete walls.

The study by Ryan *et al.,* 2016 suggested that worldwide more than 100 million dwellers from rural and 50 million dwellers from urban depend on miombo woodlands for their lives and livelihoods. Miombo woodland resource may contribute in an effort for mitigation and elimination of poverty, climate change impacts and improving livelihood.

Studies in Zambia show that 43.9 percent of the total income was contributed by miombo woodland resources in rural areas (Kalaba *et al.*, 2013). Mulenga *et al*. (2011) in Zambia recorded that forest produce contributed 34% to total gross income to households. The study conducted in Urumwa forest reserve showed that the miombo woodlands contribute 42 percent of the total household income (Njana *et al*., 2013). Woodland resources contribute to household income through different livelihood activities. Woody resources contribute up to 76% of total energy used in sub-Saharan region (southern Africa) in the form of renewable biomass. The trade in wood fuels sector in southern Africa is proving employment between 1.4 and 2.5 M people with a total value of $780 M per year. In southern Africa woodfuel used in rural areas in most case is in the form of wood. The 50 million urban populations in the region are using traded woodfuels by 70–90%. The study by Ngaga *et al.*, 2006 suggested that the miombo woodlands can act as a cushion to famine by providing famine foods; thus, it may serve as a safety net.

2.3 Forest governance structure for improved livelihood

It is now undoubtedly clear that governance is always a weak link in describing the reason(s) behind unsustainable use of forests and trees. We can identify problems and advance reforms only when we can measure effectiveness of forest governance structures in particular forest management area (FAO, 2011). No natural forest management or plantation project will succeed if the resources are poorly governed. Generally, successful forest management should not only rely on technical knowledge alone.

The meaning of the term governance is debatable. However, there are some points of agreement as to its basic ingredients (Makaramba, 2003), and these include, participation, equity, accountability, effectiveness, political stability, voice, absence of violence, control of corruption and rule of law. According to OECD (2002), effective forest governance

structure can be defined as a system that brings about, or are designed to bring about a desired outcome.

Forest governance structure originates from three main pillars, National Forest Policy (URT, 1998), National Forest Act Number 14 of 2002, and guidelines for the management of community-based forest resources. To attain both improved livelihood and sustainable forest resource management require effective forest governance structure. Governance determines who can do what to whom, and on whose authority.

The highest governance structure in the village is the elected village council. The council guides village assembly to compose Village Natural Resource Committee (VNRC), which is the manager of VLFR (URT, 2007). The effectiveness of any institute or VLFR governance structure depends to the adequacy of the number of members constructing the organ and their capabilities in terms of skills and expertise, motivation, willingness to act, and availability of incentives and resources (such as transport, fuel) necessary to enable them carry out their responsibilities ((FAO., 2011).

2.5 Data capture techniques

The essential components described in the foregoing sections are useful in the development of a forest management plan. The techniques of data capture are targeted to collect data relevant in describing biophysical, socio-economic and governance aspects of the forest.

2.5.1 Biophysical data capture

Forest biophysical data were collected through sampling process in the forest inventory. Total forest area was a sampling frame in which sampling units were randomly selected

to obtain the required sample size. For example, in 2020, Mnkonde village in Kilindi, Tanga, conducted a similar study at Mbwego VLFR. A grid of 76 sample plots was systematically laid out in 19 clusters to cover 1095 ha of the VLFR. Each cluster had four circular plots of 15 m radius laid out at the corners of a square measuring 100 x 100 m (MVC, 2020).

2.5.2 Socio-economic and governance data

Socio-economic and governance data were obtained mainly through interviews to the households and key informants. A similar study by Bwoyo (2008) conducted socio-economic survey through interviews with households adjacent to the forest and to village leaders using structured questionnaires. Based on Boyd *et al.* (1981 cited in Njana, 1998), 105 households were randomly selected and checklists were used to guide discussions with key informants.

CHAPTER THREE

3.0 METHODOLOY

3.1 Description of study area

3.1.1 Location and size

Kitumbi village is in Handeni District in Tanzania, and located in between 426 000 and 456 000 East and between 9 362 000 and 9 374 000 North. The village covers 27 214.50 hectares and comprises nine sub-villages namely, Lugala, Malumbi, Tewe, Komsanga, Tibili, Kwedilima, Chofo, Mkuyuni, and Kwagosi. On the North, the village shares borders with Kwangahu and Chogo villages. Furthermore, the village borders Kwedihwahwala village on the East, Kwamsisi village on the South East, Pozo na Mkata East villages on the South, Kwenkale village on the West and with Luiye village on the North west. The village is about 100 kms from Tanga region headquarters. It is 69 kms from the district administrative headquarter; Handeni town and 10 kms from headquarter of Handeni District Council, Mkata and it is along the Dar es Salaam and Tanga highway.

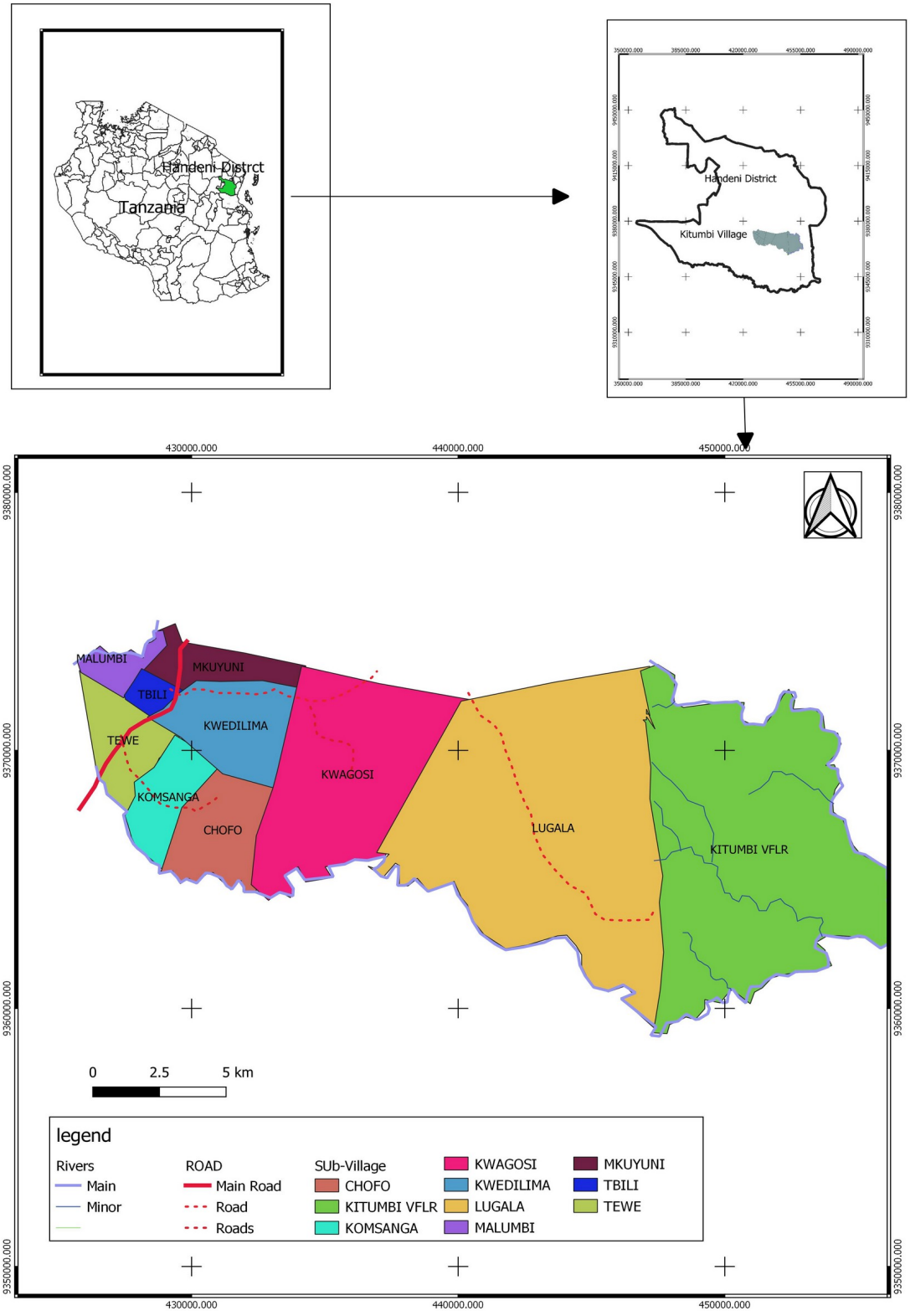

Figure 2: Map of Kitumbi village with respect to Handeni district and Tanzania

3.1.2 Climate, topography, geology, hydrology and soils condition

The study area receives annual rainfall ranging from 800 to 1600 mm per year (HDC 2019). Normally, there are two rainy seasons, long rainy season in March and May and short rainy season in October and December. The average annual temperature in this area is 22 $^{0}_{C}$ (HDC, 2019). Kitumbi VLFR is situated at an altitude of between 143 and 234 metres above the sea level. The village is relatively flat terrain with an elevation of between 143 and 518 metres from the sea level. The study area is surrounded by four seasonal rivers namely Kwale, Wimba, Msangazi and Lukula (Mkula). Collectively, the rivers pour their waters into the Indian Ocean. The rivers are the major sources of water at Kitumbi village. The river water is mainly used for domestic purposes and irrigation by small scale farmers. The village has three major mountains namely Kwakobo, Mwega and Kubi. The village soils are a mixture of loam, clay and sand. Loamy soil is predominant followed by sandy soil dominating a large part of the village land. A small part of the village land is occupied by gravels, rocky and clay soils, which are unsuitable for agriculture. However, these areas are rich in minerals, including graphite, feldspar, quarts, iron, and gold.

3.1.3 Population and ethnicity

According to the Population 2012 census, the human population in Kitumbi village is around 11 902 people and 2160 households. In the study area, Zigua are the major ethnic group while Shambaa, Digo and Arusha are minority ethnic groups. Nguu hunters moved into the area from Kilindi neighbouring district during colonial times searching for Nkale area. During this movement, they reached a site with a big cave where they settled and hid their properties in the cave. They termed the cave as Kwechitumbi referring to it as a store. The site was used to store hunting tools. The population around the cave grew and

the cave was not enough to offer storage space for all the people any more. In 1971, the Kitumbi village was officially registered as number KIJ 386 in 1978.

3.1.4 Vegetation and Land use

The study area has vast riches of miombo forest categorized into unprotected and protected woodlands. The protected woodlands include Kitumbi VLFR (7 705.3 ha), reserved mountainous land (931.1 ha), water catchment areas (231.2 ha) and grazing land (2 914.8 ha) (HDC, 2019). The unprotected woodlands are abundantly found in the agricultural land (14 278.2 ha) which is estimated to be 4 735.2 ha. The area (4 735.2 ha) is inhabited by farmers for settlement purposes. The Kitumbi village community relies on poles production, firewood, timber, charcoal and wild vegetables as economic and livelihood activities

3.1.5 Kitumbi Village in Handeni District as a study area

Kitumbi village was chosen as study area due to the presence of Kitumbi VLFR which has 7 705.3 ha and about 4 735.2 ha of unreserved woodlands within the agricultural expansion area. As per village community this valuable woody resource was contributing nothing to their livelihood while the resource is highly depleted and converted into other land uses such as farming, mining, grazing and settlements.

3.2 Research design

The study used cross-sectional research design. The approach was beneficial because it was inexpensive and enables the collection of data and information at a single point in a time (Setia, 2016).

3.3 Sampling design and data collection

In this study, there were three sources of data to be collected, socio-economic, biophysical, and secondary data.

3.3.1 Socio-economic data

Based on Boyd *et al.* (1981), 5 percent of sampling frame of households were chosen. The sampling frame was divided into nine strata based on sub-villages, and 108 households were selected systematically from 2160 households in the village. The sub village households were selected based on population size (Table 1).

Table 1: Sub villages in Kitumbi village showing the number of households and respondents

List of respondents and location			Sex of respondents	
Name of sub-village	**Total number households**	**Number of households interviewed**	**Female**	**Male**
Lugala	196	10	0	13.5
Malumbi	175	9	14.7	4.1
Tewe	367	18	0	6.8
Komsanga	134	7	11.8	18.9
Tibili	380	19	26.5	12.2
Kwedilima	363	18	0	6.8
Chofo	99	5	5.9	6.8
Mkuyuni	340	17	8.8	21.6
Kwagosi	106	5	32.4	9.5
Total	**2160**	**108**	34	74

Interviews guided by questionnaires were administered to the households to obtain the opinions on effectiveness of forest governance structures and main source of household income (Agriculture, woodland, livestock, and wage), energy and building materials in the household (Appendix 4). Also, purposive sampling was used to select key informants who were to provide information to assist in the assessment of contribution of Kitumbi VLFR to improved livelihoods and effectiveness of forest governance structure

(Appendices 5, and 6). Key informants responded to questions about law enforcement, surveillance tools, motivations and incentives to VNRC and patrol team. Also key informants responded to questions about impacts of governance to livelihood and management, fire management tools and teams and capacity of forest owners and managers in forest management. The latter was focused in terms of the number of staffs/members in a patrol team and VNRC and their respective skills and expertise. These were governance indicators for determining whether forest governance structure for Kitumbi VLFR was effective. Questions about effectiveness of governance structure featured in both questionnaires to households and to key informant's interviews (FAO, 2011; Angelsen *et al.,* 2011). Both households and key informants responded to questions by voting to one choice among seven choice (Most effective, very effective, effective, somehow effective, ineffective, very ineffective and most ineffective. The responses to questionnaires from households and Key informants were determined in per cent. Therefore response from key informants were analysed separately from household response. The results from both groups were compared to see similarities and variations.

3.3.2 Biophysical data

Due to resource constraints (time and funds) a SI of 0.1 percent was used in assessing biophysical data in Kitumbi VLFR. This is equivalent to 112 sample plots of 0.07 ha using the formula below;

$N = (TA * Si)/(Ps * 100)$……...……Equation 1

Where TA = total forest area, Si = sampling intensity, Ps = plot size and n = sampling units/sample plots. Three circular and concentric plots were allocated in each cluster in order to minimize inventory costs but improve accuracy of measurements.

3.4 Layout of clusters and plots in the forest

A clustered systematic sampling design was used. The cluster of four plots was laid out in transect as shown in Figure 3 and plots laid out in Figure 4. The four plots were laid out at the corners of a square measuring 100 x 100 m. The total numbers of clusters laid out were 28 and the distance between clusters was 1600 m (Figure 5).

The measurements for tree diameter at breast height (Dbh) was recorded as follows: in a radius of 5 m: Dbh of all trees ≥1cm, In a radius of 10 m: Dbh of all trees ≥ 10 cm, in a radius of 15 m: Dbh of all trees ≥ 20 cm. Tree heights of dominant diameter, mid diameter and smallest diameter in the plot were measured in meters using sunto hypsometer (URT, 2015).

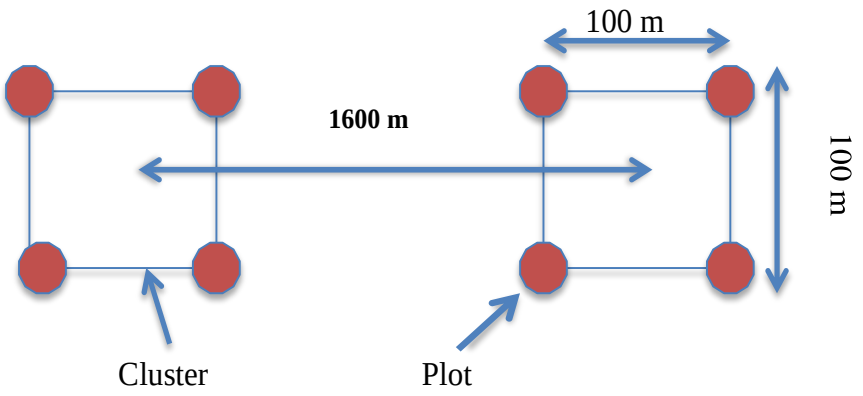

Figure 3: Cluster layout

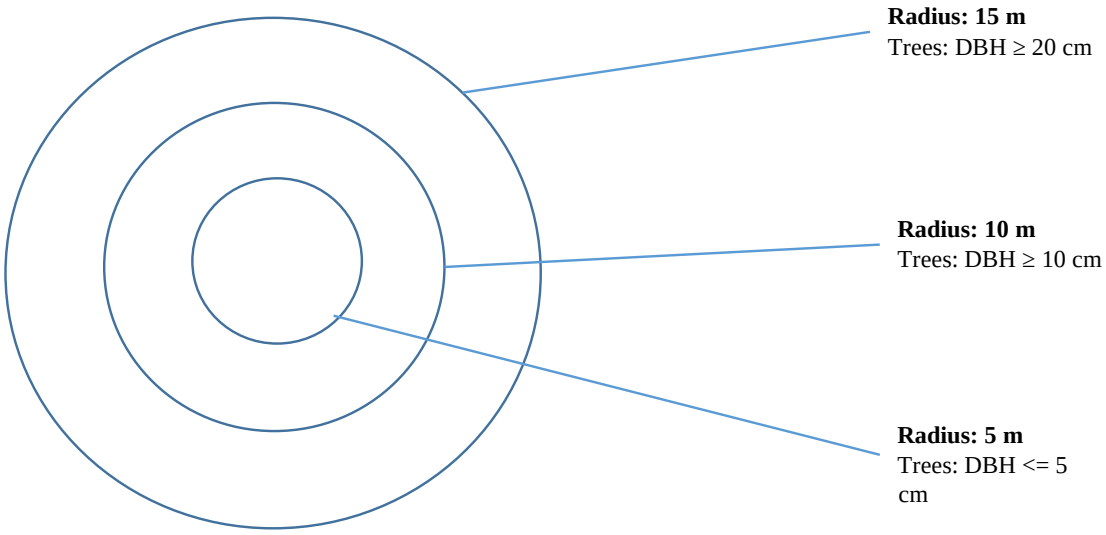

Figure 4: Plot layout

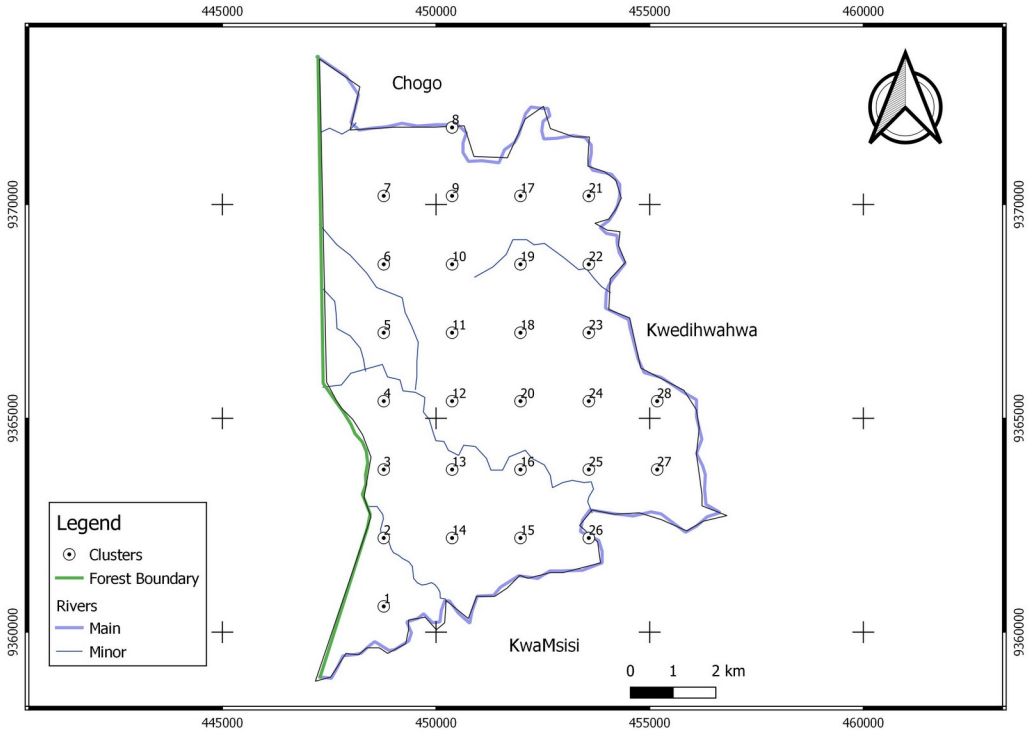

Figure 5: The map of Kitumbi VLFR showing layout of clusters

3.4.1 Secondary data collection

Secondary data were obtained from previous studies and also different literatures such as books, journals, government record and websites to supplement the information.

3.5 Data analysis

3.5.1 Socio-economic data analysis

The qualitative and quantitative analysis techniques were used to process and analyse data. The content-structural analysis was used for qualitative data from verbal discussions with key informants. This approach assisted in ascertaining values and attitudes of the respondents (Kajembe, 1994). Both key informants and households were supposed to choose one from the list of seven (7) choices (Most effective, very effective, effective somehow effective, ineffective, very ineffective and most ineffective governance structure) for objective three (3). For objective two (2) the key informants and households responded to the questions towards contribution of woodlands to the households and the community surrounding them. There were six key informants (village chairperson, Village Executive Officer, Ward Executive Officer, VNRC chairperson, Ward Councillor, and District Forest Officer). The results were summarized in table forms suitable for discussion. The quantitative data were processed to get descriptive statistics (frequency, means, standard error and standard deviations). The technique was facilitated by statistical package for social science (SPSS) software. Measures of central tendency such as mean, standard deviation, median and mode were computed in order to be able to explain the sample characteristic to analyse data on objectives two and three. Results from both households and key informants were computed separately and compared.

3.5.2 Biophysical data analysis

Data were analysed using Microsoft excel. First, a checklist of all tree species recorded in the whole Kitumbi VLFR was prepared. The checklist included the matching of local and botanical names. To estimate the heights of trees, which those were measured for dbh only the Height-Diameter allometry equation for woodland tree species developed by Mugasha et al. was used i.e. $1.3 + 24.3701 \times (1 - \exp(-0.0405 \times D0.8070))$ where D is tree diameter recorded in the forest. The determination of the basic stand parameters, that is, the number of stems per ha (N), basal area (G) and volume (V) was done using the equations by Malimbwi *et al*. (2018) outlined below with aid of Microsoft excel spread sheet software.

$N = \Sigma(i/A*n)$……..…….……..……..Equation 2

$g = pi*Dbh^2/4*10000$ …….Equation 3

$G=\Sigma (gi/A*n)$……..…….Equation 4

Malimbwi *et al* (2018)

$V = 0.00011* ((Dbh^2) * H)^{0.5758}$ …….. ..……Equation 5

Where; N = Stem density, i = Stem count per plot, A= Plot area (ha), n = Number of plots, G =basal Area (m^2 per hectare), Dbh = Diameter at breast height (cm); pi (= 3.14159265). gi = Basal area of a tree (m^2). Where; V, volume (m^3) and H, total tree height (m).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

This chapter presents the research findings, discussion and implications. It is divided into three (3) sections; Section 4.1 presents woody resources available in Kitumbi VLFR. Section 4.2 presents the contribution of woodlands to the livelihood of Kitumbi village community. Section 4.3 discusses effectiveness of the governance structure in managing Kitumbi VLFR.

4.1 Woody resources available in Kitumbi VLFR

4.1.1 Tree species composition

In Kitumbi VLFR, 54 woody species belonging to 20 plant families were recorded in 28 clusters during the field survey. This species richness in the study area is lower compared to 71 and 80 tree species recorded by Lymo and Shaban (2015) at Kitulangalo forest reserve in Morogoro and Mnkonde village (2020) at Mbwego VLFR in Kilindi District respectively for miombo woodlands. The composition compares well with 47 and 46 woody species richness recorded by Isango (2007) at Nyang'oro forest reserve and Mafupa (2006) Igombe River forest reserve respectively. The low number of species richness in the study area may be attributed by the disturbances exerted by anthropogenic activities. However, the forest under study was miombo woodland because the fabaceae family was dominant by 37 percent. Fabaceae is a sub-family of Caesalpinaceae, belonging to the genera Brachystegia, Julbernardia and/or Isoberlinia. When ranking the dominance by tree volume per hectare, *Julbernardia globiflora* was dominant by 22 percent. This justifies that Kitumbi VLFR is among the miombo woodlands.

4.1.2 Stand parameters in Kitumbi VLFR

Table 3 indicates the stand parameters of the Kitumbi VLFR. The results indicate that the recorded stem per hectare (395 stems) of different woody species in Kitumbi VLFR was close to the amounts reported by NAFORMA (URT, 2015). The inventory report by NAFORMA in 2015 registered 354 number of stems/ha in the cultivated vegetation type. This implies that Kitumbi VLFR is highly encroached by farmers, grazers and miners. The number of stems reported in this study was lower compared to 995±256 stems/ha reported by Lyimo and Shaban (2015) in the study conducted at Kitulangalo FR and 1053 stems/ha reported via NAFORMA (URT, 2015) in the national wise growing stocks.

Table 2: S*tand parameters of Kitumbi VLFR*

Statistics	**N**	**G m^2/ha**	**V m^3/ha**
Mean	395	5.11	45.14
Standard Error	44	0.33	3.55
Standard Deviation	457	11.40	36.55
Minimum	28	0.83	3.99
Maximum	2737	15.54	172.09
Number of plots	106	106.00	106.00
CI	88	0.65	7.04
Error%	22	12.73	15.59

The study reports the average basal area per hectare of 5.11 ± 0.65 m^2/ha (Table 4). The basal area was lower than 7.961±0.8m^2/ha and 8.3m^2/ha as recorded by Lyimo and Shaban (2015) at Kitulangalo FR and NAFORMA (URT, 2015) in the national inventory respectively. However, the figures are close to those in scattered cropland (3.8 m^2/ha) recorded by NAFORMA (URT, 2015). Thus, this is an indicator of less stand density and less merchantable timber at the Kitumbi VLFR. Smaller basal area refers more to space and not area occupied by trees in the forest. This may be due to farming, mining and grazing activities taking place in Kitumbi VLFR. The forest was encroached with 44 percent of cultivated or grazed land (HDC, 2019). The mean total volume recorded in this study was 45.14±7.04 m^3/ha (Table 4). This parameter was close to 49.2m^3/ha

recorded by NAFORMA in the open woodland (10-40%). The variation may be due to illegal harvesting of saw log, removal of trees for mining and farming activities in the forest.

Figure 6 shows dominant species based on the number of stems per ha while Figure 7 indicates distribution of the number of stems per ha based on diameter classes for Kitumbi VLFR. The results indicate that C*ombretum fragrans* was a dominant tree species by 12 percent when ranked by the number of stems per hectare (Figure 6). Combretaceae was abundantly recorded in highly cultivated land in Kitumbi VLFR. Trees with diameter class equal or less than 10 is dominant by far as compared to other diameter classes (Figure 7) of various woody species. The result revealed that the trees with diameter equal and greater than 45cm were lower compared to the rest of tree diameter classes in the forest. This implies that trees with diameter at breast height equal and greater than 45 cm were removed from the forest for timber production and/ or charcoal making.

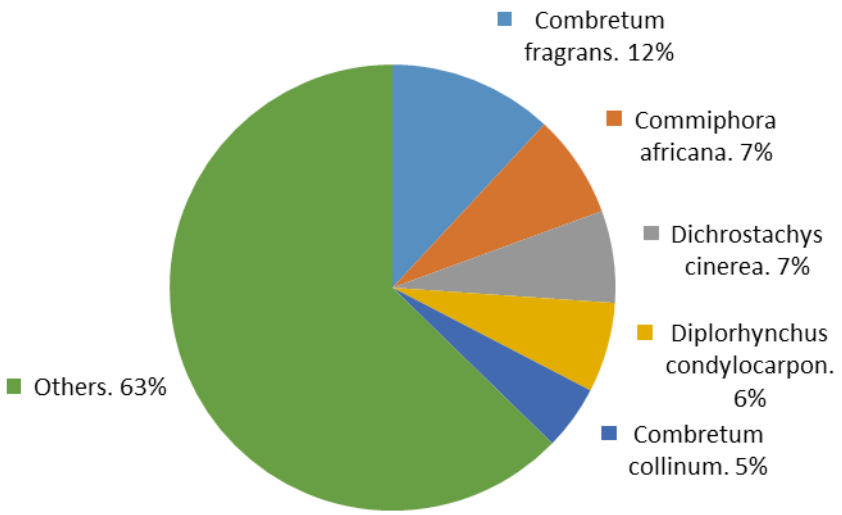

Figure 6: Five dominant tree species based on number of stems per hectare

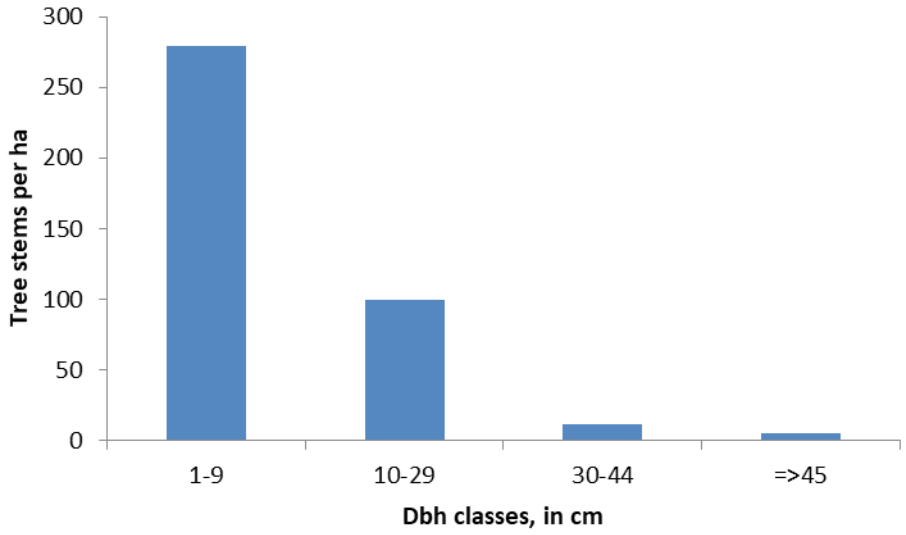

Figure 7: Distribution of number of stems per ha by diameter classes in Kitumbi VLFR

Figure 8 shows tree species dominance based on basal area while Figure 9 indicates distribution of tree basal area per ha by diameter classes in Kitumbi VLFR. The results indicate that *Julbernardia globiflora* was dominant by 18 percent amongst all the recorded trees species (Figure 8) when ranked in the basis of tree basal area per hectare. The trees with diameter less than 10 showed to have less basal area per hectare than trees with diameter between 10-30 and 30-55 (Figure 9). This implies that there was a shortage of woody regenerants; therefore, the forest is unhealthy.

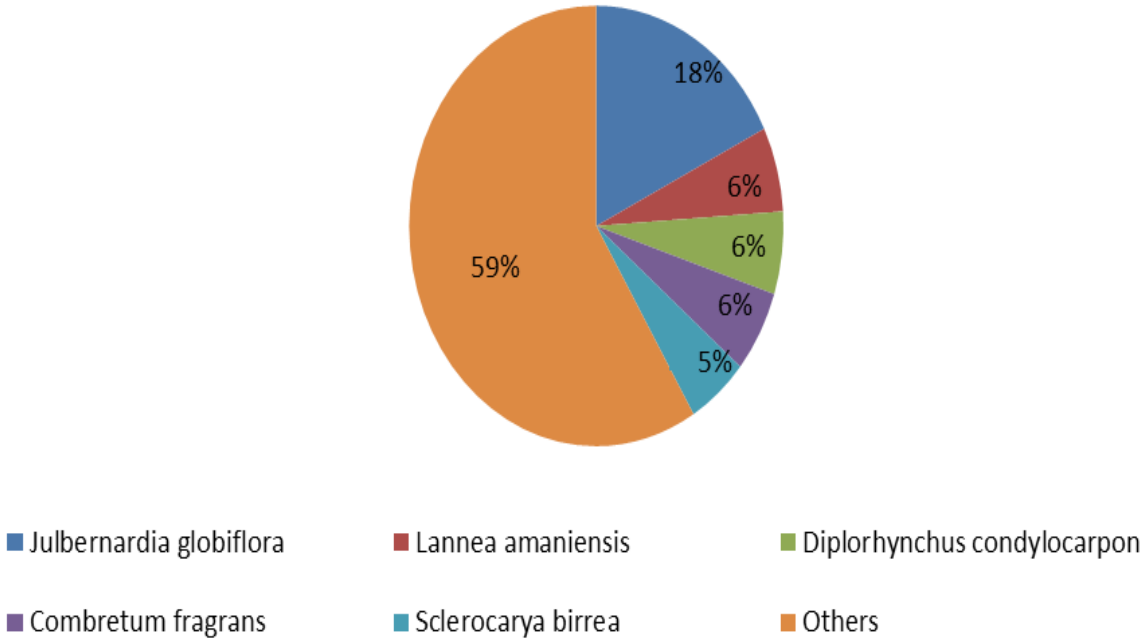

Figure 8: Five dominant tree species based on basal area in Kitumbi VLFR

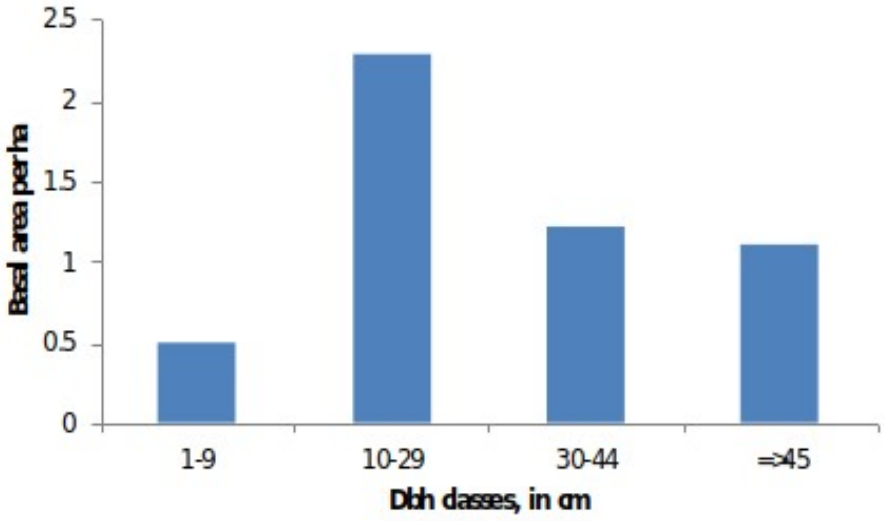

Figure 9: Distribution of tree basal area per ha by diameter classes in Kitumbi VLFR

Figure 10 shows tree species dominance based on volume per ha, while Figure 11 indicates the distribution of tree volume per ha by diameter classes in Kitumbi VLFR. The results indicate that *Julbernardia globiflora* contributed 22.02 percent of all woody tree species recorded in this forest (Figure 10). This indicates that Kitumbi VLFR is woodland although no *Brachystegia and Isoberlinia* tree genera were recorded. Trees with diameter class of between 31 and 55 were dominant compared to other diameter classes (Figure 11) of various tree species. This suggests that Kitumbi VLFR is still potential although it hangs between various dangers.

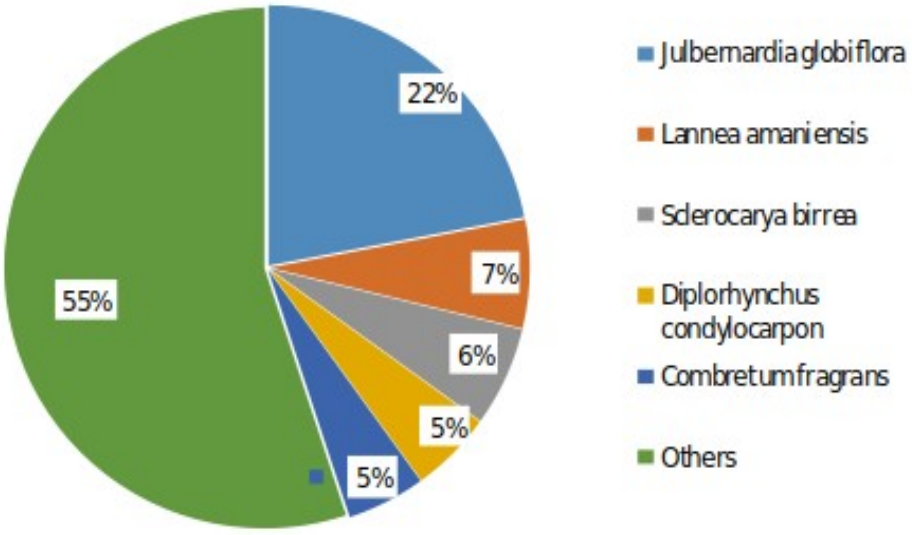

Figure 10: Five dominant tree species based on tree volume per hectare in Kitumbi VLFR

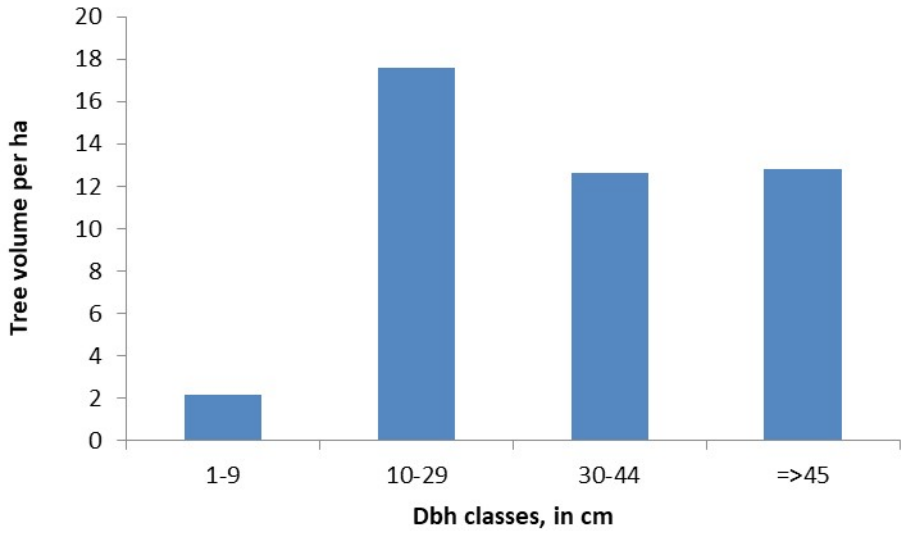

Figure 11: Distribution of tree volume per ha by diameter classes in Kitumbi VLFR

4.1.3 Harvestable volume from timber tree species in Kitumbi VLFR

Table 5 shows harvestable volume from timber tree species in Kitumbi VLFR. The results indicate that there were 26 potential timber species in Kitumbi VLFR (Table 4). Out of 26 potential timber species recorded in this study, only 8 qualify for harvesting by meeting the minimum harvestable size of > 45 cm Dbh (Table 5). The harvestable timber species ensures only 784 tree stems equivalent to 1 847.24 m^3 should be harvested annually in 20 years. The average volume per tree was 2.35 m^3. Similar results are reported in a study on miombo woodland of Mbwego VLFR at Mnkonde village (2020) in Kilindi, which recorded 15 potential timber species but those meeting minimum harvestable size were only 7.

Table 3: Harvestable volume from timber tree species in Kitumbi VLFR

Botanical Name	Value per ha N	V(m3)	Total 4,315 ha for 20 years Stems	Volume (m^3)	Annual harvestable volume Stems	Volume (m^3)
Julbernardia globiflora	1.9	4.9	8326	21176.3	416	1058.8
Lannea amaniensis	0.5	0.9	1959	3913.4	98	195.7
Manilkara discolor	0.3	0.7	1469	3156.4	73	157.8
Pterocarpus tinctorius	0.1	0.3	490	1118.4	24	55.9
Sclerocarya birrea	0.5	1.0	1959	4305.1	98	215.3
Spirostachys africana	0.1	0.2	490	902.0	24	45.1
Terminalia mollis	0.1	0.2	490	830.7	24	41.5
Xeroderris stuhlmannii	0.1	0.4	490	1542.4	24	77.1
				Total	**784**	**1847.2**

*The total forest area is 7 705.3 ha, about 3 390.3 ha are encroached, remained with 4315 ha of the forest not encroached.

The harvestable volume for timber species in Mbwego VLFR was 1021.8 m^3 expected from the sales of only 317 tree stems annually in 20 years. The study at Mbwego VLFR, average volume per tree was 3.22 m^3 (MVC, 2020). A study reported by Liweta village for Lupagalo – Liweta VLFR indicate that, out of 34 potential timber species recorded, only 13 qualified for harvesting by meeting the minimum harvestable size of ≥ 45 cm Dbh (LVC, 2020). The average volume per tree was 2.9 m^3 this implies that the harvestable tree size in Kitumbi VLFR is lower than that recorded in Lupagalo–Liweta (LVC, 2020) and Mbwego VLFRs (MVC, 2020). Kitumbi VLFR is expected to be harvested 1 847.2 m^3 of tree standing volume from 4 315 ha annually in 20 years. This was higher standing volume compared to 1 021.8 m^3 and 562.5 m^3 recorded in Mbwego (853 ha) and Lupagalo–Liweta (968 ha) VLFR respectively. However, when comparing harvestable volume ratios per hectare, Kitumbi VLFR has 0.428 m^3/ha which was lower than 0.834 m^3/ha and 0.58 m^3/ha respectively.

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4.2 Contribution of woodland to the livelihood of surrounding communities of Kitumbi VLFR

Table 6 indicates the contribution of Kitumbi VLFR to improved livelihood of the village community while Table 7 shows the contribution of economic activities to household cash income of Kitumbi village community. The results show that in 10 years Kitumbi VLFR contributed 1140 pcs equivalent to 55.03 m^3 of timber of various species to the community of Kitumbi village and of the nearby villages (Table 6). Kitumbi VLFR was estimated to generate revenue of TZS 5 782 40, which was used to support health, education and other sectors in the village between year 2012 and 2020 (Table 6). The study revealed that Agriculture contributed 44 percent of the household income, while miombo woodlands within agricultural land contributed 27 percent to the household income (Table 7). The contribution of other economic activities to the livelihood of Kitumbi community was 18 per cent salaried employment, 8 percent livestock keeping and 3 percent casual works (Table 7). The Kitumbi village community obtained a minimum of TZS 36 000 and maximum of TZS 6 500 000 annually for household cash income from the forest produce (Table 7). This was monetary contribution to household income per annum. Similar findings are reported in a study by Njana *et al*. (2013) in Tabora (Urumwa) who revealed that woodlands contributed 59 percent of monetary income at household level per annum. A similar study by Kalaba *et al.* (2013) in Zambia shows that 43.9 percent of the total household cash income was contributed by miombo woodland resources in rural areas. The variation in the contribution of woodland between the study area and other cited areas may be due to absence of proper forest management planning in the study area.

Table 4: Contribution of Kitumbi VLFR to improved livelihood of the village community

Response from key informants about tangible contribution of Kitumbi VLFR			
Sector	Years 2012-2020	Wood provided in m^3	Wood provided in cash (TZS)
Healthy	Timber provided to nearby village dispensary for shelves, benches and cupboards. 60 pcs of *Sterculia appendiculata* (Mgude) timber sized 1' by 10' by 10 ft	3.47	347 000
Education	Timber provided for kenching Tewe primary school and Kitumbi secondary schools (670 pcs of *Xeroderris stuhlmannii* (Mnyinga) sized 2' by 4' by 10 ft)	31.01	3 101 852
Social services	Timber providedfor mosques kenching at Kwenkwale, Kwamabawu, Mkuyuni (370 pcs of *Xeroderris stuhlmannii* (Mnyinga) sized 2' by 4' by 12ft) and	20.55	2 055 555
Financial (credits)	No credits from Kitumbi VLFR revenue		0
Total		55.03	5 504 407

Table 5: *Contribution of economic activities to income of Kitumbi village community*

	Responses		Descriptive						
Activities involved	**N**	**%**	**Minimum**	**Maximum**	**Range**	**Sum**	**Mean**	**Std. Deviation**	**Individual % contribution**
Livestock	94	87.0	30 000	2 400 000	2 370 000	14 777 000	157 202	254 725	8
Agriculture	108	100.0	80 000	14 000 000	13 920 000	78 950 000	731 019	1 326 874	44
Salaried employment	5	4.6	5 000 000	8 000 000	3 000 000	33 500 000	6 700 000	1 303 840	18
Forest produce	61	56.5	36 000	6 500 000	6 464 000	48 224 500	790 566	1 224 589	27
Casual works	50	46.3	30 000	800 000	770 000	6 040 000	120 800	146 271	3
Sum						**181 491 500**	**8 499 586**	**4 256 300**	**100**

Figure 12 indicates the sources of forest produce based on their importance at Kitumbi village while Figure 13 shows the sources of energy the Kitumbi community depends on. The study findings indicate that, 61 percent of Kitumbi village community regards the reserve not as a useful resource to them. The study indicates that only 2 percent of the community members ranked Kitumbi VLFR as the most important resource. Otherwise others 5 percent ranked Kitumbi VLFR as important, 1 percent as moderate and 31 percent as a less important resource. Therefore only 39 percent of Kitumbi village community members considered Kitumbi VLFR as somehow useful (Figure 12). About 91 percent of the community members in the study area regard woodlands within their agricultural expansion land as most important, 6 percent as important and 2 percent as moderate (Figure 12). This may be due to availability of woody resources outside Kitumbi VLFR and which is located 28 kms from highly populated sub villages (Kitumbi village headquarter).

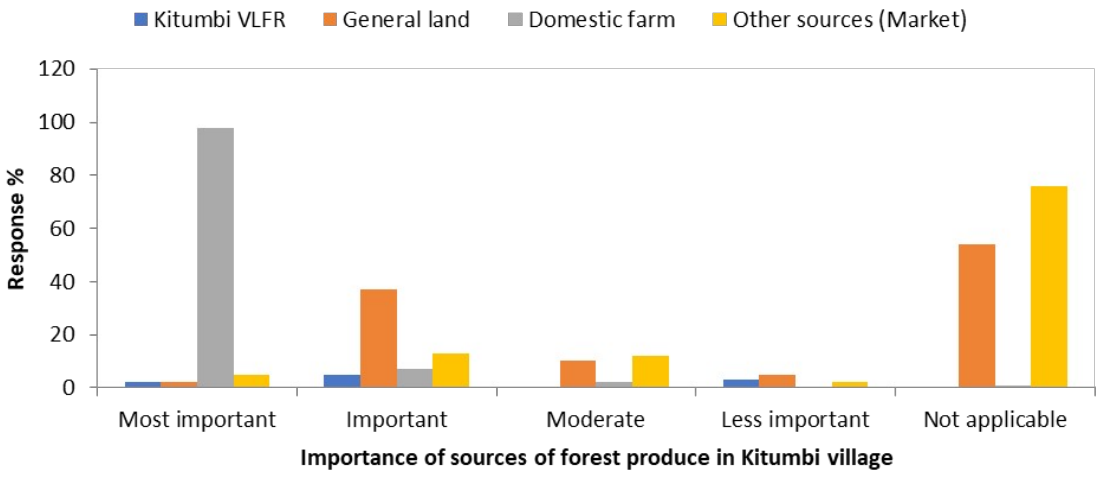

Figure 12: Ranking of sources of forest produce based on importance at Kitumbi village

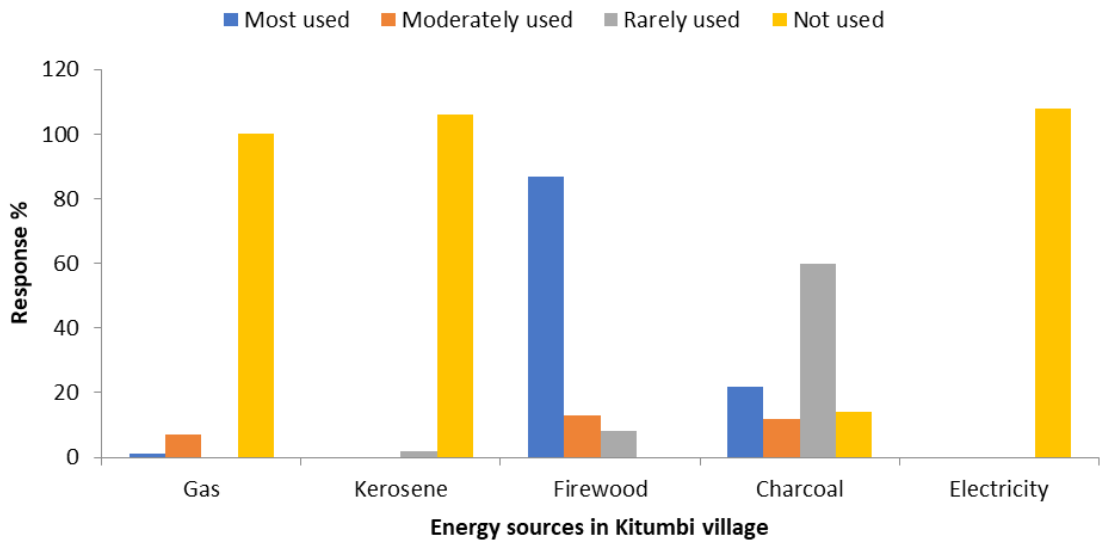

Figure 13: Sources of energy the Kitumbi community depend on

Specifically, the study revealed that woodland was the main source of cooking and heating energy. About 81 and 20 percent of the community in the study area ranked fire wood and charcoal respectively as the most important sources of cooking energy (Figure 13). None of the households in the study area was not using fire wood while only 13 percent of the community did not use charcoal (Figure 13). Electricity was not utilized as a source of cooking energy in the study area. Gas was regarded as the most important source of cooking energy by 1 percent, while 93 percent of the community in the study area did not use gas for cooking purposes (Figure 13). The consumption of cooking energy in the study area may be due to matters of affordability and availability of the resources. Similar findings are reported in a study by Malimbwi *et al*. (2001) who revealed that households in the Southern Africa Development Community region consume 97 percent of wood energy, mostly for cooking and heating. Elsewhere, Schlag and Zuzarte (2008) reported that 76 percent of Sub-Sahara Africa population depends on traditional biomass as their primary source of energy.

A study by Reddy and Ramachandra *et al*. (2005) reveals that in Sub-Sahara Africa, the percent of households using wood fuel varies from 86 to 99 percent in rural areas; and from 26 to 96 percent in the urban areas. According to Reddy and Ramachandra *et al.* (2005) 94 percent of African rural population and 73 percent of urban population use wood fuel as their primary source of energy, mainly in the form of firewood in rural areas and charcoal in urban areas. According to Carissa *et al.* (2005) woodlands in Tanzania are the main source of energy and constitute 70 percent of the total urban wood energy requirements and 95-98 percent of rural energy consumption. Specifically, Lusambo, (2016) reported that 81 percent of households relied on fire wood, 58 percent on charcoal and 0.2 percent on gas from the study conducted in Morogoro municipality and Songea District. These results correlate to the results recorded in the current study.

Figure 14 indicates other forest products based on the importance at Kitumbi village while Figure 15 shows the level of involvement of the community in economic activities in Kitumbi village. The results show that when ranked on the importance, wild vegetables were reported about 65 and 25 percent of the households as the most important and important forest produce respectively, while wild fruits, mushroom and honey were referred as less important and not used by many households in the study area (Figure 14). Building materials were regarded as most important and important by 28 and 61 percent of the households respectively while medicinal plants contribution was ranked by 13 and 50 percent as less important and not useful respectively in the study area (Figure 14). Also, the study revealed that 50 percent of Kitumbi villagers rely on forest produce in famine periods. This is consistent with the findings reported in a study by Ngaga *et al.* (2006) suggesting that the miombo woodlands can act as a cushion to famine by providing famine foods; thus, it may serve as a safety net. All this demonstrates a significant role played by miombo woodlands to the livelihood of the community in the

study area. However agriculture (crop cultivation) was a dominant means of livelihood, almost 100 percent of the community was involved in agriculture followed by livestock keeping activity 87 percent (Figure 15).

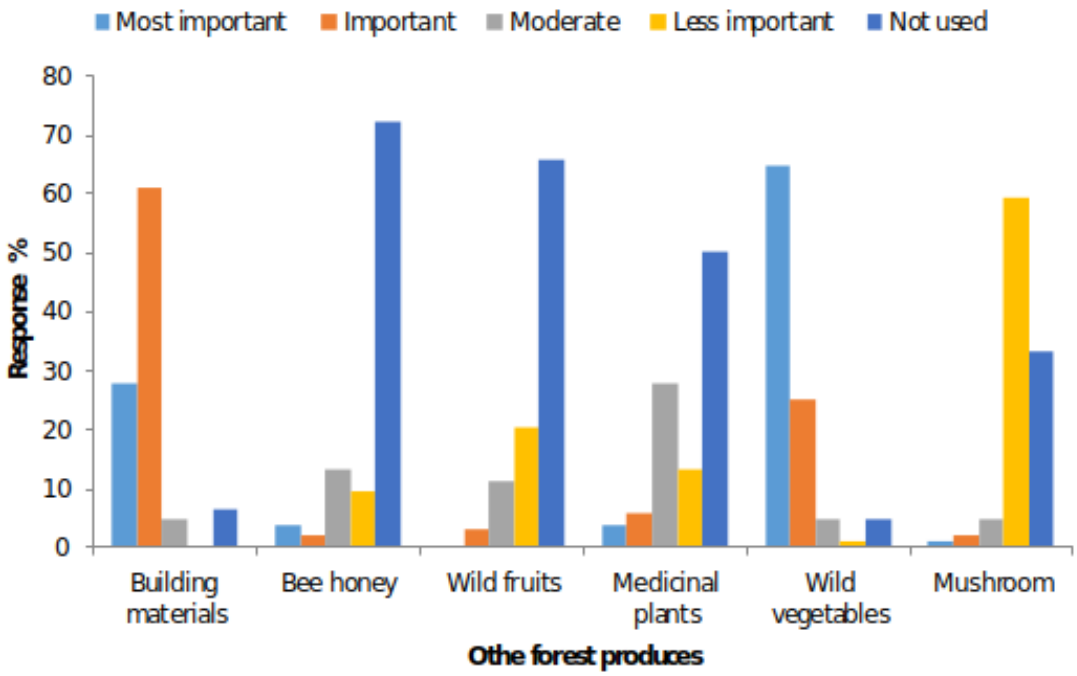

Figure 14: Ranking of other forest products based in importance at Kitumbi village

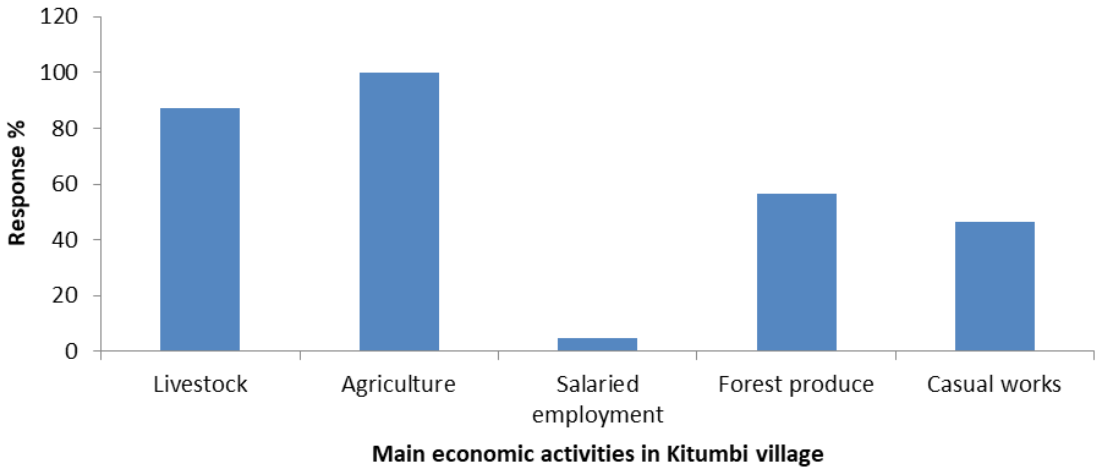

Figure 15: Level of involvement of the community in economic activities in Kitumbi village

Only 5 percent of the community in the study area was in salaried employment. About 46 percent of the community in the study area is engaged in casual labour. A similar study in Urumwa, Tabora reported that farming accounted for 100 percent of livelihood activities practiced in the area (Njana *et al.,* 2016). Other livelihood activities reported by Njana *et al.* (2016) in Urumwa, Tabora included beekeeping (32%), livestock keeping (31%), business (23%), charcoal making (21%), collection of medicinal plants (15%), brick making (12%) and lumbering (10%). The above observations reveal similar information about the importance and pivotal role played by farming, livestock keeping and forest produce in the study area.

4.3 Effectiveness of the governance structure in managing Kitumbi VLFR

The result revealed that there was mix of opinion in rating effectiveness of forest governance for Kitumbi VLFR. Figure 16 indicates how effective the forest governance structure at Kitumbi village was as per households and key informants. The result shows that forest governance structure in the study area was considered not effective by 84% and 55.81% of the Kitumbi community and leaders in the district respectively. Therefore the forest governance structure for Kitumbi VLFR was effective only by 16% and 44.19% of Kitumbi community and leaders in the district respectively (Figure 16). The great variation in opinion towards effectiveness of forest governance structure was probably due to the nature of the two groups involved. The leaders in helm could not vote negatively against themselves thus why the results by key informants proposed there was effective forest governance structure by 44.1% compared to 16% voted by village community in study area.

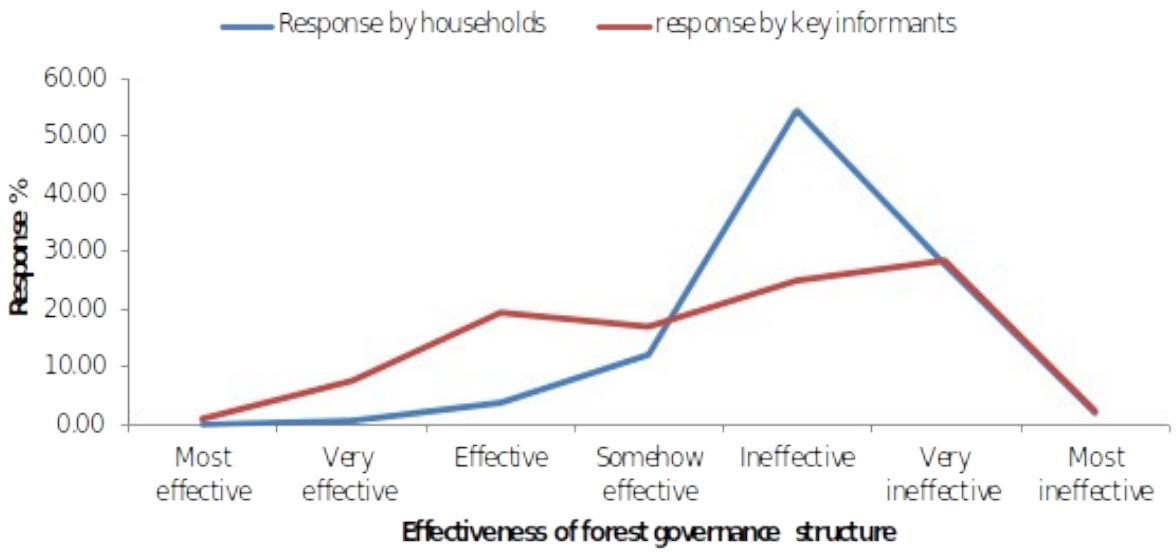

Figure 16: Effectiveness of forest governance structures at Kitumbi for Kitumbi VLFR

The community opinion may reflect the truth about the effectiveness of the forest governance structure in their village. Specifically the community suggested that forest governance structure in study area was considered ineffective by 54.49%, very ineffective by 27.72 % and most ineffective by 1.78% while leaders ranked it as ineffective by 24.96%, very ineffective by 28.47 % and most ineffective by 2.38%. Also, the community in study area ranked the forest governance structure as most effective by 0.02%, very effective by 0.44%, effective by 3.62% and somehow effective by 11.92% while leaders proposed it as most effective by 0.79%, very effective by 7.38%, effective by 19.25% and somehow effective by 16.77%. According to the study by Rija *et al*. (2015), Handeni District had poor and satisfactory governance structure in managing forest resources at Madebe and Vibaoni village respectively.

Figure 17 and 18 shows effectiveness of each of the seven (7) forest governance structures at Kitumbi village per households and leaders respectively. The community in

study area voted on capacity of owner and manager of Kitumbi VLFR to manage the woody resource as ineffective by 78.7%, very ineffective by 18.6% and most ineffective by 0.2% while somehow effective and very effective was 2.4% and 0.2% respectively. The reason from the community of Kitumbi to suggest that the capacity of the owner and manager of Kitumbi VLFR was not effective by 97.5 was due to deforestation taking place in their forest resource and inability of the owner and manager to deliver to the livelihood of the community. The leaders proposed that the capacity of owner and manager of Kitumbi VLFR to manage the woody resource was ineffective merely by 12.5% while the rest voted as very effective, effective and somehow effective by 25%, 50% and 12.5% respectively.

Forest fire management and surveillance as governance structures were considered by the community in study area as not effective by 99.8% while leaders ranked them as not effective by 100%. Both sides mentioning reason that no sufficient equipment to carry out the activities in the study area. The community in study area voted very effective, effective and somehow effective by 1.9%, 11.6% and 30.8% respectively on influence of governance to livelihood and management due to the presence of institutions which instructs about the benefits of owning and managing the woodland in their village. The community believes that the governance was enough to improve their livelihood but the capacity of the owner and manager of the Kitumbi VLFR was ineffective. However the leaders voted differently from the view of the community to the influence of governance to livelihood and management registering it as very effective by 26.7%, effective by 33.3% and somehow effective by 33.3%.

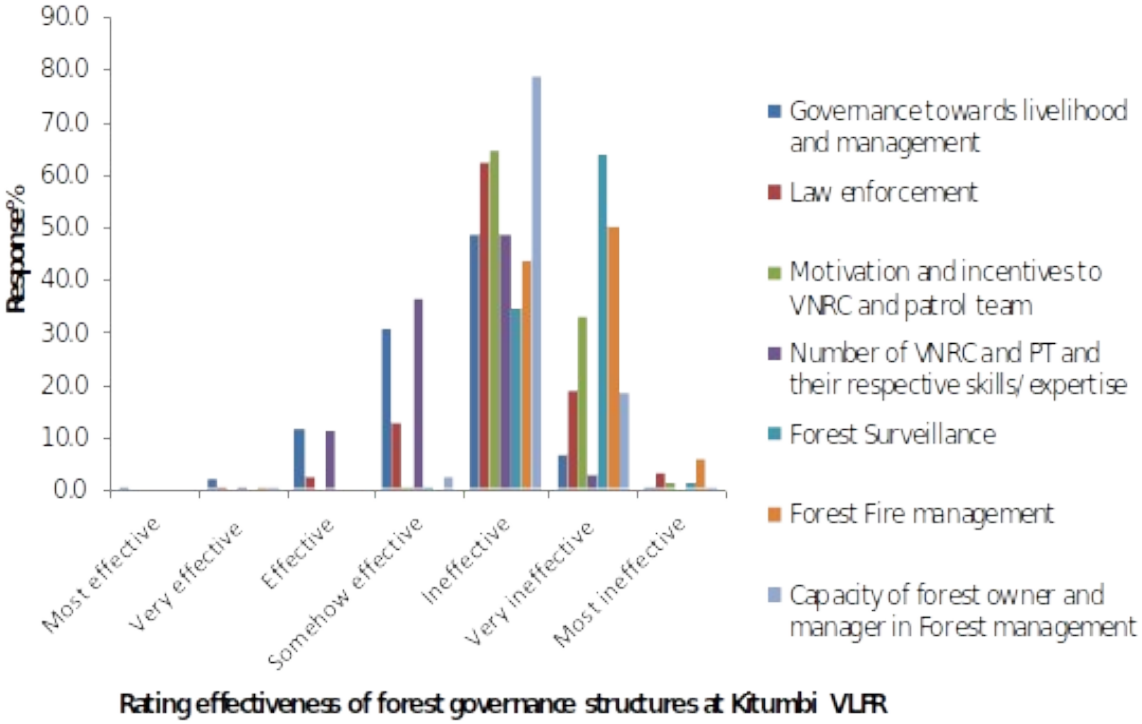

Figure 17: Effectiveness of each of the seven (7) forest governance structures for Kitumbi VLFR by households

The community in study area proposed that law enforcement was ineffective, very ineffective and most ineffective by 62.4%, 19.0% and 3.1% respectively (Figure 17). Rija *et al.* (2015) reported that despite their existence laws and by-laws governing forest resources have never been enforced effectively in districts of Handeni, Kilosa and Kilwa. The community of Kitumbi village was not satisfied with the way suspects of forest crimes prosecuted or handled, the level the villagers complied with the forest management bylaws and penalties on those violating the rules regarding forest use and management in general. The leaders thought the forest law enforcement was effective by 56.3% while not effective by 43.7% (Figure 18).

The figures were quite different from what the community felt towards forest law enforcement. May be the leaders were trying to hide truth although they conceded that forest surveillance was not effective by 100% votes.

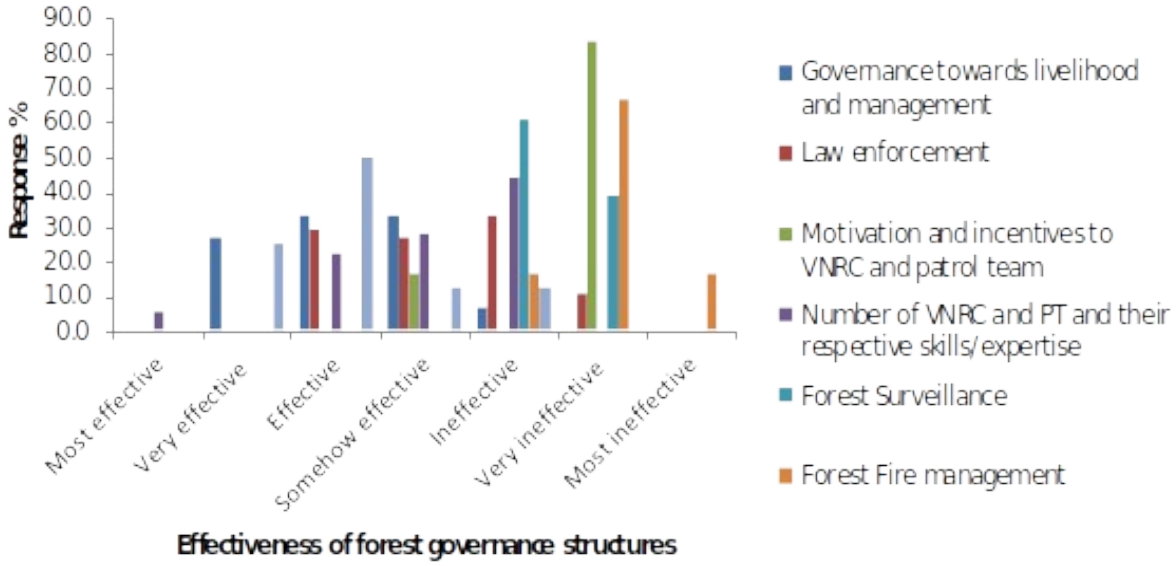

Figure 18: Effectiveness of each of the seven (7) forest governance structures for Kitumbi VLFR by key informants

Probably it is impossible to enforce the law by 56.3% as stated before with zero effort in forest surveillance in study area. In another study in Mufindi District in Tanzania, Raphael and Swai (2009) reported a failure of authorities to exercise granted institutional powers to protect forests because of various reasons. The authors also reported that poor coordination; severe underfunding and poor support from the villagers were the stumbling blocks for sustainable forest management. Obviously, due to the lowest contribution of forest resources to livelihood, the villagers offer poor support to the forest resource management.

Both law enforcement and surveillance were gauged not effective may be due to the fact that motivation and incentives for VNRC and patrol team was very ineffective by 83.3%.

The study by Rija *et al.* (2015) reported that the members of VNRC were lacking motivation and incentives of executing their responsibilities on forest protection. It was difficult for the VNRC and patrol team to operate successful at this motivation in study area. The key informants in study area were not satisfied with the way suspects of forest crimes prosecuted or handled and the level the villagers complied with the forest management bylaws (Figure 18).

When studied the effectiveness of forest governance structure between nine (9) sub villages in study area the results exposed ineffectiveness above 77 percent in all. Figure 19 indicates the response on effectiveness of forest governance structure within sub villages in study area. Tewe lead the way the governance structure in study area was ineffective while Chofo voted least on the same. Tewe and Chofo community proposed that the governance structure was not effective by 87.10% and 77.90% respectively. Tibili, Kwagosi and Komsanga community proposed similarly that the forest governance structure in study area was not effective by 83.03%, 83.93% and 83.20% respectively. Also,Kwedilima and Malumbi felt in similar way by suggesting that the forest governance structure in study area not effective by 85.50% and 85.66% respectively. It was clear that the communities within nine sub villages in study area thought the forest governance structure was effective only 22.10% the highest. The community of Chofo and Lugala felt that the governance structure in study area was effective by 22.10% and 17.71% respectively. The community of Mkuyuni felt least effectiveness of governance structure compared to other sub villages by proposing very effective 0.94%, effective 3.04% and somehow effective 8.68% in study area.

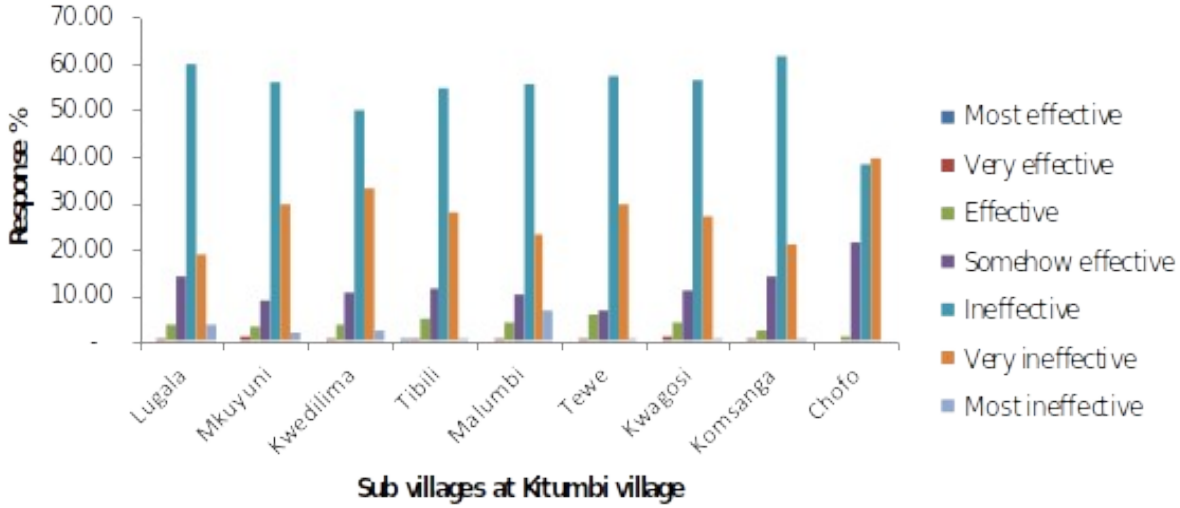

Figure 19: Effectiveness of forest governance structures at each sub villages in Kitumbi village

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Generally the results showed Kitumbi VLFR possesses invaluable resources of numerous woody families and species. The VLFR is typically miombo woodland dominated by woody species namely *Julbernardia globiflora, Combretum fragrans, Diplorhynchus condylocarpon, Sclerocarya birrea, Dichrostachys cinerea, commiphora Africana and Lannea amanuensis.* The woody resources available in Kitumbi VLFR have abundant harvestable timber tree species which when sold will bring financial power of the owner to manage the VLFR and improve the lives and livelihood of the community in study area.

Furthermore, woodlands in study area showed to have potentials to support the livelihoods of the communities surrounding the woody resources. The livelihood in study area was supported by woodlands through harvesting of various woody resources for firewood, charcoal making, building poles, vegetables and medicinal plants. The community in study area relies on woodlands for cooking and heating.

The results revealed that forest governance structures in study area was a weak link to reach sustainable management of Kitumbi VLFR and barrier to improved livelihood of the community in Kitumbi village. The community and leaders in study area acknowledged that the governance structure in study area was not effective to operationalize the management of Kitumbi VLFR and ensure the tangible benefits to the community from their forest resource.

5.2 Recommendations

In order to address the shortcomings observed in this study and make Kitumbi VLFR contribute significantly to the improvement of livelihoods of the owners of the reserve, the following should be done immediately and later;

i. Management of the VLFR should follow the forest management that considers both improved livelihood of the community and sustainable management of the woody resource in study area.

ii. Forest governance structure for Kitumbi VLFR must be improved.

iii. There is a growing concern in supporting and understanding the link between sustainable forest management and livelihoods. On the basis of this study, it is worth reiterating that the interface between woodlands (forests) and livelihoods is strong, thus current and future management strategies in the forest sector should greatly consider the prosperity of the community managing and surrounding those woody resources.

iv. Further studies should be conducted to find ways to fix weaknesses exposed in the study area especially having ineffective forest governance structure

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APPENDICES

Appendix 1: Coordinates for clusters and plots for inventory at Kitumbi VLFR

Cluster	Eastings	Northings	PLOTS	Eastings	Northings
1	448777.090	9360601.844	1	448677	9360601
			2	448877	9360601
			3	448677	9360701
			4	448877	9360701
2	448777.090	9362201.844	5	448677	9362202
			6	448677	9362301
			7	448877	9362202
			8	448877	9362301
3	448777.090	9363801.844	9	448677	9363802
			10	448677	9363901
			11	448877	9363802
			12	448877	9363901
4	448777.090	9365401.844	13	448677	9365402
			14	448677	9365501
			15	448877	9365402
			16	448877	9365501
5	448777.090	9367001.844	17	448677	9367001.844
			18	448677	9367101.844
			19	448877	9367001.844
			20	448877	9367101.844
6	448777.090	9368601.844	21	448677	9368601.844
			22	448677	9368701.000
			23	448877	9368701.000
			24	448877	9368601.800
7	448777.090	9370201.844	25	448677	9370201.844
			26	448677	9370301.844
			27	448877	9370301.800
			28	448877	9370201.844
8	450377.090	9371801.844	29	450277	9371801.844
			30	450277	9371701.844
			31	450477	9371701.800
			32	450477	9371801.844
9	450377.090	9370201.844	33	450277	9370202
			34	450477	9370102

			35	450277	9370102
			36	450477	9370202
10	450377.090	9368601.844	37	450277	9368602
			38	450477	9368502
			39	450277	9368502
			40	450477	9368602
11	450377.090	9367001.844	41	450277	9367002
			42	450477	9366902
			43	450277	9366902
			44	450477	9367002
12	450377.090	9365401.844	45	450277	9365402
			46	450477	9365302
			47	450277	9365302
			48	450477	9365402
13	450377.090	9363801.844	49	450277	9363802
			50	450477	9363702
			51	450277	9363702
			52	450477	9363802
14	450377.090	9362201.844	53	450277	9362202
			54	450477	9362102
			55	450277	9362102
			56	450477	9362202
15	451977.090	9362201.844	57	451877	9362202
			58	452077	9362302
			59	452077	9362202
			60	451877	9362302
16	451977.090	9363801.844	61	451877	9363802
			62	452077	9363902
			63	452077	9363802
			64	451877	9363902
17	451977.090	9370201.844	65	451877	9370202
			66	452077	9370302
			67	452077	9370202
			68	451877	9370302
18	451977.090	9367001.844	69	451877	9367002
			70	452077	9367102
			71	452077	9367002
			72	451877	9367102
19	451977.090	9368601.844	73	451877	9368602

			74	452077	9368702
			75	452077	9368602
			76	451877	9368702
20	451977.090	9365401.844	77	451877	9365401.844
			78	452077	9365501.844
			79	452077	9365401.844
			80	451877	9365501.844
21	453577.090	9370201.844	81	453477	9370202
			82	453677	9370102
			83	453477	9370102
			84	453677	9370202
22	453577.090	9368601.844	85	453477	9368602
			86	453677	9368502
			87	453477	9368502
			88	453677	9368602
23	453577.090	9367001.844	89	453477	9367002
			90	453677	9366902
			91	453477	9366902
			92	453677	9367002
24	453577.090	9365401.844	93	453477	9365402
			94	453677	9365302
			95	453477	9365302
			96	453677	9365402
25	453577.090	9363801.844	97	453477	9363802
			98	453677	9363702
			99	453477	9363702
			100	453677	9363802
26	453577.090	9362201.844	101	453477	9362202
			102	453677	9362102
			103	453477	9362102
			104	453677	9362202
27	455177.090	9363801.844	105	455077	9363802
			106	455277	9363802
			107	455277	9363902
			108	455077	9363902
28	455177.090	9365401.844	109	455077	9365402
			110	455277	9365502
			111	455277	9365402
			112	455077	9365502

Appendix 2: Inventory plot Form for Kitumbi VLFR

TRANSECT NO. ……..…….. CLUSTER No……. PLOT No……

DATE……EASTINGS.....NORTHINGS.....ELEVATION.....

VILLAGE NAME …… ……POPULAR NAME …… …….…….

Tree	STEM No		Dbh	Height	Remarks

Appendix 3: Households questionnaire form

A: Basic Information

1. Date of interview……

2. Household No. …….

3. Village name ……4. Ward ……..5. Division ……6. District…….. 7. Stratum number……

1. Household within 5 km from the VLFR

2. Household between 5.1 km to 10 km from the VLFR

3. Household above 10 km from VLFR

B: Socio-Economic Characteristics of the Household

8. The respondent and household characteristics

Position in the household

Sex (01= Male, 02= Female) ( )

9. Marital status

(01=Head

(02=Spouse ( )

(03=Member

01= Married; 02= Single; 03= Separated; 04= Divorced; 05= widowed ( )

10. Education (highest)

01= none; 02=primary school; 03= Secondary school; 04= college (Certificate, Diploma); 05=University; 06=others (specify) ( )

11. How many people are there in your household

(1) up to 5 (2) 6-10 people (3) greater than 10 people ( )

12. For how long have you been in this area? ( )

13. Do you know Kitumbi VLFR?.....Yes=1, No= 0 ( )

14. Who owns and manages Kitumbi VLFR?.....

15. Who harvests the Kitumbi VLFR?.....,……,……..

16. Distance from household to Kitumbi VLFR…….

C: Household Information

17. What are main sources of income to your household

S/N	Source of income	Yes	No	Weekly/monthly/annual income
1.	Livestock			
2.	Fishing			
3.	Agriculture			
4.	Salaried employment			
5.	Forest produce			
6.	Casual labour			

18 Estimate the amount of income generated above on each of the mentioned sources on the household income (TZS per year)

19. What are main sources of energy for your household (in cooking /heating substance)

Source of energy	Mostly used (01)	Moderately used (02)	Rarely used (03)	Not used at all (04)
Gas				
Kerosene				
Firewood				
Charcoal				
Electricity				
Cow dung				
Others(specify)				

20. What are other forest produce used in your household

Product from a forest	Tick	Rank
Building material		
Bees honey		
Wild fruits		
Medicinal plants		
Wild vegetable		

Mushroom		
Others(specify)		

1. Most important 2. Important 3. Moderate 4 less important

21. Where do you get the forest produce for your household?

Source of forest produce	Tick	Rank
Kitumbi VLFR		
General land		
My farm		
Buying/markets		

1. Most important 2. Important 3. Moderate 4 less important

The response should be this unless stated otherwise (7. Most effective 6.Very effective 5. Effective 4. Somehow effective 3. Ineffective 2.Very ineffective 1. Most ineffective)

General questions towards livelihood and management of Kitumbi VLFR

22. Do you feel governance towards the management of the Kitumbi VLFR is effective? ( )

23. How do you rate effectiveness of governance towards VNRC manage Kitumbi VLFR for improved livelihood? ( )

24. How do you rate effectiveness of governance towards patrol team enforce the law for management of Kitumbi VLFR and livelihood? ( )

25. How do you rate effectiveness of governance about village council towards management of Kitumbi VLFR and livelihood? ( )

26. How do you rate effectiveness of impacts of forest governance towards the livelihood of Kitumbi community? ( )

The reason(s) for your response……

Law enforcement

27. Are there bylaws for management of Kitumbi VLFR? Yes=01, No= 0

28. If yes for Qn 47, are those bylaws were effective? ( )

29. Is the way to inform the community about those bylaws for management of Kitumbi VLFR effective? ( )

30. Are those bylaws revised whenever needed? Yes=01, No= 0

31. If yes for Qn 50, Is the way those bylaws were revised effective? ( )

32. Is the way suspects of forest crimes prosecuted or handled effective? ( )

33. The level villagers comply to the forest management by laws effective? ( )

34. Are penalties on those violating the rules of forest use and management in general effective? ( )

35. Is there a patrol team to enforce laws for Kitumbi VLFR? Yes= 01, No=0

36. If yes for Qn 55, is number of members making the team effective? ( )

37. Is the schedule or routine of the activity for patrol team effective? ( )

The reason(s) for your response……

Motivation and incentives to VNRC and patrol team

38. Is level members of VNRC and PT motivated and incentivised effective? ( )

39. Is the mechanism or ways VNRC and PT motivated and incentivised effective? ( )

40. Is the source of fund to motivate and incentivise VNRC and PT effective? ( )

Number of VNRC and PT and their respective skills/expertise

41. Is a number of VNRC members helping to manage Kitumbi VLFR effective? ( )

42. Is expertise and skills of VNRC members helping to manage Kitumbi VLFR effective? ( )

43. Is a number and skills of patrol team helping to manage Kitumbi VLFR effective? ( )

The reason(s) for your response……

Surveillance tools

44. Are there bicycles for forest Surveillance? Yes= 01, No=0

45. If yes, are the number and quality of those bicycles effective for forest Surveillance? ( )

46. Are there motor cycle for forest Surveillance? Yes= 01, No=0

47. If yes, are the number and quality of motor cycles available for forest surveillance effective? ( )

48. Are there vehicle for patrol teams for Kitumbi VLFR? Yes= 01, No=0

49. If yes, are the number and quality of vehicle available for forest surveillance effective? ( )

50. Generally, are facilities available to facilitate forest surveillance effective? ( )

The reason(s) for your response……

Fire management teams

51. Is there a firefighting team for Kitumbi VLFR? Yes= 01, No=0

52. Is firefighting team for Kitumbi VLFR effective? ( )

53. Are there tools and equipment to support firefighting crew for Kitumbi VLFR? Yes= 01, No=0

54. Are tools and equipment to support firefighting crew for Kitumbi VLFR effective? ( )

55. Are there monitoring and notification systems like fire tower to facilitate early detection of fire for Kitumbi? Yes= 01, No=0 ( )

56. Is the system for monitoring and notification to facilitate early detection and control of fire for Kitumbi effective? ( )

The reason(s) for your response……

Capacity of forest owner and manager in Forest management

57. Forest owner and or manager have effective range of expertise? ( )

58. Forest owner and or manager have effective financial resources? ( )

59. Forest owner and or manager have access to effective tools and equipment necessary for forest management? ( )

60. Do you think the owner and or manager have capacity to manage Kitumbi VLFR effectively? ( )

The reason(s) for your response……

Appendix 6: Key informants for Objective II

61. How important is Kitumbi VLFR? 1. Very important 2. Important 3 Moderate 4. Not important ( ) why…….

62. Do you know who owns and manages Kitumbi VLFR? Yes……..No……..

63. What are contributions of Kitumbi VLFR from 2012 to 2017 and from 2018 to date 2020?

Sector	2012 to 2017 (year) TZS	2018 to 2020 (TZS)	
Healthy			
Educational			
Social			
Financial(credits)			

Appendix 7: Key informants for objective three

The response should be this unless stated otherwise (7. Most effective 6.Very effective 5. Effective 4. Somehow effective 3. Ineffective 2.Very ineffective 1. Most ineffective)

General questions towards livelihood and management of Kitumbi VLFR

64. Do you feel governance towards the management of the Kitumbi VLFR is effective? ( )

65. How do you rate effectiveness of governance towards VNRC manage Kitumbi VLFR for improved livelihood? ( )

66. How do you rate effectiveness of governance towards patrol team enforce the law for management of Kitumbi VLFR and livelihood? ( )

67. How do you rate effectiveness of governance about village council towards management of Kitumbi VLFR and livelihood? ( )

68. How do you rate effectiveness of impacts of forest governance towards the livelihood of Kitumbi community? ( )

The reason(s) for your response……

Law enforcement

69. Do the currently village council elected by villagers in democratic way? Yes…….No…….. ( )

70. Is there VNR committee? Yes…….No…….. ( )

71. If yes for 45, is the VNR committee available effective?

72. Are there bylaws for management of Kitumbi VLFR? Yes=01, No= 0

73. If yes for Qn 47, are those bylaws were effective?

74. Is the way to inform the community about those bylaws for management of Kitumbi VLFR effective? ( )

75. Are those bylaws revised whenever needed? Yes=01, No= 0 ( )

76. If yes for Qn 50, Is the way those bylaws were revised effective? ( )

77. Is the way suspects of forest crimes prosecuted or handled effective? ( )

78. The level villagers comply to the forest management by laws effective? ( )

79. Are penalties on those violating the rules of forest use and management in general effective? ( )

80. Is there a patrol team to enforce laws for Kitumbi VLFR? Yes= 01, No=0 ( )

81. If yes for Qn 55, is number of members making the team effective? ( )

82. Is the schedule or routine of the activity for patrol team effective? ( )

The reason(s) for your response……

Motivation and incentives to VNRC and patrol team

83. Is level members of VNRC and PT motivated and incentivised effective? ( )

84. Is the mechanism or ways VNRC and PT motivated and incentivised effective? ( )

85. Is the source of fund to motivate and incentivise VNRC and PT effective? ( )

The reason(s) for your response……

Number of VNRC and PT and their respective skills/expertise

86. Is a number of VNRC members helping to manage Kitumbi VLFR effective? ( )

87. Is expertise and skills of VNRC members helping to manage Kitumbi VLFR effective? ( )

88. Is a number and skills of patrol team helping to manage Kitumbi VLFR effective? ( )

89. Is expertise and skills of patrol team helping to manage Kitumbi VLFR effective? ( )

The reason(s) for your response……

Surveillance tools

90. Are there bicycles for forest Surveillance? Yes= 01, No=0 ( )

91. If yes, are the number and quality of those bicycles effective for forest Surveillance?

88. Are there motor cycle for forest Surveillance? Yes= 01, No=0 ( )

92. If yes, are the number and quality of motor cycles available for forest surveillance effective? ( )

93. Are there vehicle for patrol teams for Kitumbi VLFR? Yes= 01, No=0 ( )

94. If yes, are the number and quality of vehicle available for forest surveillance effective? ( )

95. Generally, are facilities available to facilitate forest surveillance effective? ( )

The reason(s) for your response……

Fire management teams

96 Is there a firefighting team for Kitumbi VLFR? Yes= 01, No=0 ( )

97. Is firefighting team for Kitumbi VLFR effective? ( )

98. Are there tools and equipment to support firefighting crew for Kitumbi VLFR? Yes= 01, No=0 ( )

99. Are tools and equipment to support firefighting crew for Kitumbi VLFR effective? ( )

100. Are there monitoring and notification systems like fire tower to facilitate early detection of fire for Kitumbi? Yes= 01, No=0 ( )

101. Is the system for monitoring and notification to facilitate early detection and control of fire for Kitumbi effective? ( )

The reason(s) for your response……

Capacity of forest owner and manager in Forest management

102. Forest owner and or manager have effective range of expertise? ( )

103. Forest owner and or manager have effective financial resources? ( )

104. Forest owner and or manager have access to effective tools and equipment necessary for forest management? ( )

105. Do you think the owner and or manager have capacity to manage Kitumbi VLFR effectively? ( )

The reason(s) for your response……

Appendix 7: Table showing stand parameters N, G, and V on sample plots in Kitumbi VLFR

Plot Number	N	G	V
1	2.70	0.09	0.88
2	4.01	0.07	0.61
3	3.94	0.11	1.05
4	3.54	0.12	1.19
5	4.31	0.12	1.14
6	1.47	0.05	0.44
7	0.67	0.06	0.57
8	2.24	0.12	1.20
9	2.10	0.05	0.39
10	4.77	0.03	0.20
11	2.17	0.09	0.88
12	3.34	0.07	0.64
13	3.64	0.03	0.24
14	3.60	0.04	0.27
15	2.97	0.15	1.62
16	5.84	0.02	0.11
17	1.03	0.01	0.06
18	15.05	0.08	0.65
19	2.34	0.02	0.15
20	7.71	0.07	0.48
21	5.34	0.04	0.28
22	6.34	0.08	0.67
23	23.12	0.10	0.93
24	3.74	0.01	0.07
25	18.99	0.05	0.31
26	0.53	0.06	0.70
27	9.04	0.07	0.52
28	2.84	0.04	0.25
29	2.60	0.02	0.16
30	0.67	0.05	0.49
31	1.24	0.03	0.20
32	1.37	0.03	0.19
33	8.81	0.02	0.10
34	4.37	0.04	0.27
35	25.83	0.03	0.14
36	3.54	0.02	0.16
37	0.93	0.04	0.35
38	9.84	0.07	0.68
40	1.17	0.03	0.21
41	4.97	0.04	0.24

42	11.35	0.04	0.25
43	2.00	0.02	0.17
44	3.37	0.02	0.11
45	11.91	0.05	0.33
46	7.04	0.06	0.55
47	1.60	0.10	1.07
48	1.80	0.04	0.27
49	4.37	0.05	0.45
50	3.20	0.02	0.16
51	10.31	0.07	0.47
52	4.27	0.06	0.47
53	2.60	0.03	0.24
54	1.10	0.03	0.27
55	2.47	0.02	0.12
56	0.80	0.02	0.18
57	1.64	0.04	0.29
58	1.10	0.03	0.24
59	5.44	0.10	1.04
60	4.17	0.08	0.68
61	0.93	0.02	0.16
62	0.67	0.01	0.08
63	2.47	0.03	0.22
64	0.97	0.06	0.57
65	2.17	0.02	0.17
66	3.10	0.02	0.17
67	2.44	0.11	1.18
68	0.80	0.05	0.48
69	6.94	0.06	0.55
70	5.01	0.11	1.18
71	7.01	0.06	0.54
72	1.30	0.08	0.97
73	5.97	0.07	0.78
74	6.64	0.04	0.27
75	1.27	0.02	0.12
76	6.07	0.03	0.24
77	6.11	0.14	1.31
78	0.27	0.02	0.17
79	4.94	0.01	0.04
80	0.93	0.06	0.59
81	1.64	0.02	0.14
82	4.04	0.01	0.04
83	0.83	0.01	0.08
84	0.57	0.01	0.05
85	3.17	0.10	0.99

86	1.70	0.03	0.26
87	1.90	0.01	0.11
88	1.00	0.01	0.06
89	2.30	0.04	0.33
90	2.34	0.03	0.23
91	1.30	0.02	0.11
92	1.03	0.01	0.04
93	0.40	0.02	0.12
94	0.80	0.07	0.70
95	1.24	0.04	0.33
96	0.40	0.04	0.43
97	1.50	0.05	0.38
98	0.93	0.03	0.29
99	1.67	0.05	0.43
100	0.97	0.07	0.70
101	0.53	0.01	0.11
102	0.93	0.05	0.42
103	0.67	0.02	0.16
104	0.67	0.02	0.17
105	0.97	0.05	0.43
106	1.10	0.03	0.24
107	1.50	0.09	0.92
Grand Total	**395.40**	**5.11**	**45.14**

Appendix 8: Table showing stand parameters N, G, and V on clusters in Kitumbi Kitumbi VLFR

1	0.392081504	14.05325858	3.695823716
2	0.347724672	8.597791795	3.323607069
3	0.240285035	12.26743799	2.094093269
4	0.238258502	15.90401344	2.219744371
5	0.183322103	25.88655152	1.331219346
6	0.225429805	38.18102414	1.939561504
7	0.211854575	31.10750498	1.764242262
8	0.122761017	5.819848664	1.017065519
9	0.118274718	42.14830711	0.662572734
10	0.130756058	11.83510378	1.227398935
11	0.117971541	21.48934879	0.767239118
12	0.244072326	22.1501602	2.203745086
13	0.203045331	21.95294292	1.531286128
14	0.103445617	6.910579853	0.799871657
15	0.244888918	12.23316002	2.236833031
16	0.119313884	4.993079874	1.025464499
17	0.202218337	8.430627201	1.981256476
18	0.306723645	20.06670286	3.203226755
19	0.159480532	19.77027332	1.400825346
20	0.225013481	12.13274054	2.091901621
21	0.047334743	7.009188496	0.305382891
22	0.152919044	7.704277891	1.413058392
23	0.087405026	6.910579853	0.707889402
24	0.16748702	2.811013883	1.569176704
25	0.195181724	5.026754238	1.772102965
27	0.10086189	2.777943132	0.854742601
28	0.170477674	3.538570418	1.576089085
Grand Total	5.058588721	391.7087855	44.71542048

Appendix 9: Timber Species Stand Parameters N, G and V on Dbh classes in Kitumbi VLF

	DBH CLASSES														
	I			II			III			IV			TOTAL		
Botanical Name	**N**	**G**	**V**	**N**	**G**	**V**	**N**	**G**	**V**	**N**	**G**	**V**	**N**	**G**	**V**
Albizia anthelmintica	4.51	0.01	0.07	1.54	0.02	0.12							6.04	0.03	0.19
Albizia gummifera				0.53	0.03	0.23	0.27	0.03	0.29	0.13	0.02	0.24	0.93	0.08	0.76
Albizia harveyi				0.70	0.02	0.15							0.70	0.02	0.15
Albizia zimmermannii				0.13	0.00	0.04							0.13	0.00	0.04
Baphia kirkii	1.20	0.00	0.01	0.70	0.02	0.18	0.13	0.02	0.21				2.04	0.04	0.41
Combretum collinum	10.81	0.02	0.09	7.54	0.18	1.40	0.13	0.01	0.11				18.49	0.22	1.60
Combretum molle	12.01	0.03	0.14	2.80	0.05	0.35							14.82	0.08	0.49
Dalbergia melanoxylon	1.20	0.00	0.00	0.13	0.00	0.03							1.33	0.00	0.03
Julbernardia globiflora	3.90	0.01	0.04	4.47	0.10	0.82	2.54	0.31	3.30	2.27	0.48	5.77	13.18	0.90	9.94
Lannea amaniensis	1.80	0.00	0.02	3.57	0.11	0.95	1.20	0.10	1.00	0.53	0.10	1.07	7.11	0.32	3.04
Lecaniodiscus fraxinifolius	0.30	0.00	0.00	2.07	0.04	0.28	0.53	0.06	0.66				2.90	0.10	0.95
Leptonychia usambarensis	1.80	0.00	0.02	0.57	0.01	0.08							2.37	0.02	0.10
Manilkara discolor	0.30	0.00	0.00	1.40	0.04	0.35	0.67	0.06	0.65	0.40	0.08	0.86	2.77	0.19	1.87
Markhamia sp.	1.20	0.00	0.01	0.53	0.01	0.07							1.74	0.01	0.08
Pseudolachnostylis maprouneifolia	6.31	0.01	0.05	0.93	0.03	0.24	0.13	0.01	0.11				7.37	0.05	0.39
Pteleopsis myrtifolia				0.43	0.00	0.03							0.43	0.00	0.03
Pterocarpus angolensis	0.60	0.00	0.01	1.10	0.03	0.21							1.70	0.03	0.22
Pterocarpus tinctorius	0.30	0.00	0.00	1.64	0.04	0.30	0.80	0.08	0.88	0.13	0.03	0.30	2.87	0.15	1.48
Sclerocarya birrea	0.30	0.00	0.00	1.64	0.06	0.49	0.93	0.11	1.13	0.53	0.10	1.17	3.41	0.27	2.79
Senegalia nigrescens				0.93	0.04	0.32	0.27	0.03	0.36	0.40	0.07	0.80	1.60	0.14	1.47
Spirostachys africana	15.62	0.03	0.15	1.30	0.02	0.17				0.13	0.02	0.25	17.05	0.08	0.56
Terminalia mollis	3.60	0.01	0.05	5.37	0.12	0.90	0.80	0.08	0.86	0.13	0.02	0.23	9.91	0.23	2.04
Trichocladus ellipticus				0.13	0.00	0.01							0.13	0.00	0.01
Vachellia robusta	5.11	0.01	0.04	4.97	0.17	1.34	0.67	0.05	0.53				10.75	0.23	1.91
Vachellia xanthophloea	0.60	0.00	0.01	5.21	0.11	0.79	0.40	0.03	0.31				6.21	0.14	1.11
Xeroderris stuhlmannii	2.70	0.00	0.01	3.74	0.13	1.06	0.40	0.04	0.43	0.13	0.03	0.42	6.98	0.21	1.91
Grand Total	**279.00**	**0.49**	**2.14**	**99.31**	**2.28**	**17.61**	**11.75**	**1.23**	**12.60**	**5.34**	**1.10**	**12.78**	**395.40**	**5.11**	**45.1**

Appendix 10: T*ree species in Kitumbi VLFR*

Tree number	Local name	Scientific name	Family name
1	Mtuntwi	*Commiphora africana*	Burseraceae
2	Mnyumbunyumbu	*Lannea amanuensis*	Anacardiaceae
3	Mkaakaa	*Ozoroa insignis*	Anacardiaceae
4	Mgongo/Mng'ongo	*Sclerocarya birrea*	Anacardiaceae
5	Mnyinga	*Xeroderris stuhlmannii*	Anacardiaceae
6	Mtopetope	*Annona senegalensis*	Annonaceae
7	Mtogo	*Diplorhynchus condylocarpon*	Apocynaceae
8	Msalaka	*Spirostachys africana*	Apocynaceae
9	Mtalawanda	*Markhamia sp.*	Bignoniaceae
10	Mhande	*Stereospermum kunthianum*	Bignoniaceae
11	Mguruka	*Boscia salicifolia*	Capparaceae
12	Mlama ng'ombe	*Combretum collinum*	Combretaceae
13		*Combretum fragrans*	Combretaceae
14	Mlama mweusi	*Combretum molle*	Combretaceae
15		*Combretum zeyheri*	Combretaceae
16	Mngoji	*Pteleopsis myrtifolia*	Combretaceae
17	Mpululu	*Terminalia mollis*	Combretaceae
18	Mdaa	*Euclea divinorum*	Ebenaceae
19	Mdimu pori	*Suregada zanzibarensis*	Euphorbiaceae
20	Mfumbii	*Philenoptera violacea*	Fabaceae
21	Mfuleta	*Albizia anthelmintica*	Fabaceae
22	Mzundu	*Albizia gummifera*	Fabaceae
23	Msisimisi	*Albizia harveyi*	Fabaceae
24	Mchenje	*Albizia zimmermannii*	Fabaceae
25	Mkuruti	*Baphia kirkii*	Fabaceae
26	Mpingo	*Dalbergia melanoxylon*	Fabaceae
27	Mchele jembe	*Dichrostachys cinerea*	Fabaceae
28	Hombo-muungu	*Erythrina abyssinica*	Fabaceae
29	Mtondoro	*Julbernardia globiflora*	Fabaceae
30	Mfumbii	*Philenoptera bussei*	Fabaceae
31	Mninga	*Pterocarpus angolensis*	Fabaceae
32	Mninga maji	*Pterocarpus tinctorius*	Fabaceae
33	Mkambala	*Senegalia nigrescens*	Fabaceae
34	Mhumba	*Senna singueana*	Fabaceae
35	Mkwaju	*Tamarindus indica*	Fabaceae
36	Msasa	*Vachellia mellifera*	Fabaceae
37	Mkongoe	*Vachellia robusta*	Fabaceae
38	Mgunga	*Vachellia xanthophloea*	Fabaceae
39	Mfunda	*Zenkerella grotei*	Fabaceae
40	Mkombati	*Trichocladus ellipticus*	Hamamelidaceae
41	Mluati	*Dombeya rotundifolia.*	Malvaceae
42	Mtengwe	*Leptonychia usambarensis*	Malvaceae

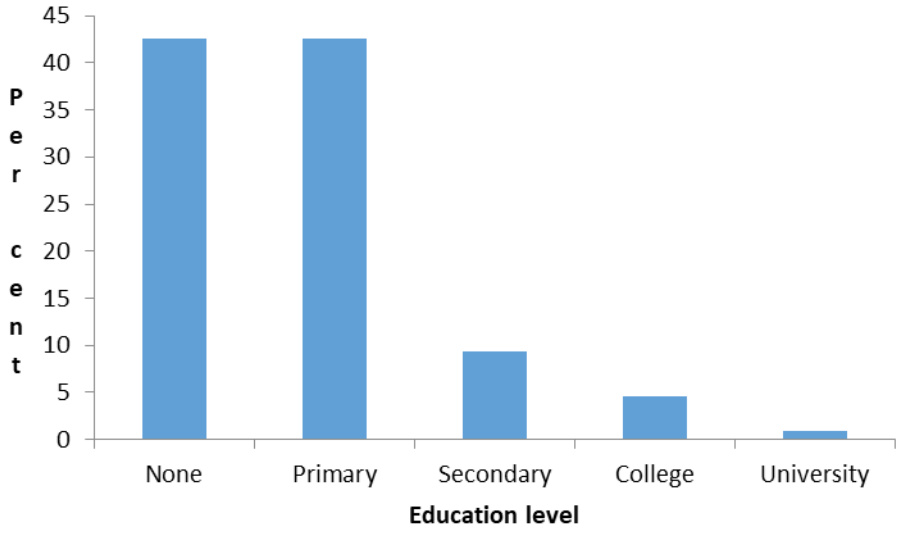
43	Moza	*Sterculia africana*	Malvaceae
44	Mvungawiza	*Xymalos monospora*	Monimiaceae
45	Mkuyu	*Ficus sycomorus*	Moraceae
46	Mbangwe	*Ochna sp.*	Ochnaceae
47	Mkarati	*Bridelia micrantha*	Phyllanthaceae
48	Msolo	*Pseudolachnostylis maprouneifolia*	Phyllanthaceae
49	Mkogho	*Crossopteryx febrifuga*	Rubiaceae
50		*Zanthoxylum chalybeum*	Rutaceae
51	Mbwakabwaka	*Deinbollia sp.*	Sapindaceae
52	Mbwewe	*Lecaniodiscus fraxinifolius*	Sapindaceae
53	Mgama	*Manilkara discolour*	Sapotaceae
54	Mkole	*Grewia bicolor*	Tiliaceae

Appendix 11: Response from key informants for the study area

Response from key informant 1 about tangible contribution of Kitumbi VLFR years			
Sector	2012 - 2017	2018 - 2020	Tangible gain
Healthy	No records	No records	NIL
Education	No records	No records	NIL
social services	Villagers were allowed to collect dry firewood	No records	Firewood
Financial (credits)	No records	No records	NIL
Response from key informant 2 about tangible contribution of Kitumbi VLFR years			
Healthy	Provided timber to nearby village dispensary for shelves, benches and cupboards	Provided timber to nearby village dispensary for shelves, benches and cupboards	Timber
Education	provided timber to Tewe primary school for kenching classrooms	No records	Timber
Social services	Provided timber for mosque kenching at Kwenkwale, Tewea nd Komkonga	No records	Timber
Financial (credits)	No credits from Kitumbi VLFR revenue	No credits from Kitumbi VLFR revenue	
Response from key informant 3 about tangible contribution of Kitumbi VLFR years			
Healthy	No records	Provided timber for making dispensary shelves and benches - 40 pcs of sized 1' by 10' by 12 ft of Mgude	277 778
Education	No records	Provided timber for kenching Tewe primary school and Kitumbi secondary school	Timber
Social services	Villagers were allowed to collect dry firewood	Provided timber for mosque kenching at Kwenkwale, Tewe and Komkonga	Timber
Financial (credits)	No credits from Kitumbi VLFR revenue	No credits from Kitumbi VLFR revenue	

Response from key informant 4 about tangible contribution of Kitumbi VLFR years			
Healthy	No records	Provided timber to nearby village dispensary for shelves, benches and cupboards	Timber
Education	No records	Provided timber for kenching Tewe primary school and Kitumbi secondary school	Timber
Social services	Villagers were allowed to collect dry firewood	Provided timber for mosque kenching at Kwenkwale, Tewea nd Komkonga	Timber
Financial (credits)	No credits from Kitumbi VLFR revenue	No credits from Kitumbi VLFR revenue	
Response from key informant 5 about tangible contribution of Kitumbi VLFR years			
Healthy	No records	Provided timber to nearby village dispensary for shelves, benches and cupboards	Timber
Education	No records	Provided timber for kenching Tewe primary school and Kitumbi secondary school	Timber
Social services	No records	Provided timber for mosque kenching at Kwenkwale, Tewea nd Komkonga	Timber
Financial (credits)	No credits from Kitumbi VLFR revenue	No credits from Kitumbi VLFR revenue	
Response from key informant 6 about tangible contribution of Kitumbi VLFR years			
Healthy	No records	Provided timber to nearby village dispensary for shelves, benches and cupboards. 60 pcs of Mgude timber sized 1' by 10' by 10 ft	347 222
Education	No records	Provided timber for kenching Tewe primary school and Kitumbi secondary school. 670 pcs of Mnyinga sized 2' by 4' by 10 ft	3 101 852
Social services	No records	Provided timber for mosques kenching at Kwamabawu Mkuyuni (370 pcs of Mnyinga sized 2' by 4' by 12ft) and kwenkwale	2 055 556
Financial (credits)	No credits from Kitumbi VLFR revenue	No credits from Kitumbi VLFR revenue	

Appendix 4: Education status in Kitumbi village



Appendix 5: Marital status in Kitumbi village