

An ecosystem service perspective on benefits that people derive from biodiversity of coastal forests in Lamu County, Kenya

Linda Mbeyu, Jan De Leeuw, Grace Koech, Josephat Nyongesa



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LIST OF ABBREVIATIONS

AFC	Agricultural Finance Corporation
ANOVA	Analysis of Variance
BMP	Biodiversity Management Program
CFA	Community Forest Association
EARPO	Eastern Africa Regional Programme Office
EU	European Union
FGD	Focused Group Discussion
GIS	Geographical Information System
ICRAF	World Agroforestry Centre
IGAD	Inter-Governmental Authority on Development
KCB	Kenya Commercial Bank
KES	Kenya Shillings
KFS	Kenya Forest Service
KI	Key Informants
KWFT	Kenya Women Finance Trust
KWS	Kenya Wildlife Service
LAPSSET	Lamu Port-South Sudan-Ethiopia-Transport
LCG	Lamu County Government
MEA	Millennium Ecosystem Assessment
NRT	Northern Rangeland Trust
PFM	Participatory Forest Management
RMG	Research Management Unit
UN	United Nations
WCMA	Water Conservation Management Act
WWF	World Wildlife Fund

ABSTRACT

Natural resources provide a foundation for economic development today. However, global biodiversity is under threat due to among other things, increasing population over the years leading to an increased demand on natural goods and services such as fuel, timber and medicine. High demand for natural resources has led to increasing degradation of ecosystems thereby threatening sustainability of ecosystem services. Involvement of people living in the vicinity of such ecosystems in conservation activities becomes integral in ensuring that the resources are not only well utilized, but also properly managed.

In this report we test two assumptions; one, that people living in the vicinity of Witu and Boni Dodori forests derive their food, energy, medicine and construction material from these forests, and second, that since they benefit from the ecosystem services provided by biodiversity from the forest, they then have a self-interest to secure the benefits that they derive from biodiversity and participate in preventing forest destruction and degradation. Next, we investigated the second assumption that people living closer to natural forest ecosystems would be more inclined to conserve the biodiversity that they depend on.

The research revealed a striking similarity in the source of food and construction materials as these were primarily derived from farm land and not from natural biodiversity in the coastal forests. Closer examination revealed more subtle differences; for instance, the Awer who live close to the dryland forests of Boni and Dodori National Reserve consumed game meat, honey, wild fruits and wood fuel collected from the wild more frequently than communities in Mpeketoni and around Witu Forest.

Loss of forest habitat through deforestation and degradation was not considered a significant threat by the interviewed communities. Instead, the three communities perceived conservation authorities who denied them access and right to utilization of the forest environment as the major threat to their livelihoods. In conclusion, we recommend that forest management authorities consider developing a more participatory management approach for coastal forests.

BACKGROUND OF THE BIODIVERSITY MANAGEMENT PROGRAM

The Biodiversity Management Program (BMP), implemented in the Horn of Africa, is a 48-month cross-border project initiated in 2013. The program aimed to contribute to poverty reduction by improving the social and economic wellbeing of populations in the IGAD region through better regional integration in the environmental sector, and more specifically, to contribute to conservation and sustainable management of ecosystems in the IGAD region in order to contribute to lasting ecosystem goods and services.

One of the interventions supported by the BMP Tana Kipini Laga Badana Bush-Bush land and seascapes project is **Activity Output 2.1** which states: *Biodiversity and socioeconomic information about the cross-border ecosystem is collected, compiled and made accessible and understandable to stakeholders and decision makers by Q4 2015 so that biodiversity is mainstreamed into ongoing planning processes.* To achieve this, the project conducted research on benefits that people derive from biodiversity of coastal forests in Lamu County, Kenya to generate information on benefits, threats and opportunities presented by biodiversity.

1.0 INTRODUCTION

Kenya's coastal forests though small and fragmented, are vital to the country as they host unique biodiversity (Matiku 2005). This biodiversity hotspot hosts an increasing number of people who traditionally make use of the biodiversity of these forests to derive their livelihoods. Rising population pressure as a result of high population growth and immigration now challenge the sustainability and use of this biodiversity (Matiku 2005).

It is recognized that human beings enjoy the benefits of ecosystem services that are provided by nature and its biodiversity. The Millennium Ecosystem Assessment (MEA 2005), a body that was formed in 2000 by the then UN Secretary General, Kofi Annan, clustered the benefits that nature provides to humanity into four categories of ecosystem services: [1] Provisioning services are services obtained from the ecosystem that directly benefit humanity. They include renewable resources such as food, water, raw materials and medicine; [2] Cultural services are non-material services that support spiritual wellbeing, recreation, tourism and leisure; [3] Regulating services are benefits obtained from regulation of ecosystem process and include erosion and flood control, climate regulation, plant pollination and water purification; [4] Supporting services include services that support production and supply of all other services such as biodiversity and fertile soils that support primary production of oxygen through photosynthesis, nutrient cycling and habitat provisioning (Proença et al 2008).

Biodiversity has a strong influence on the provision of ecosystem services and thus human well-being. For example, biodiversity influences a number of key ecosystem processes such as primary production, nutrient cycling, pollination and seed dispersal that support production of provisioning services such as food, fibre, drinking water, energy and medicine that support human well-being. It also supports climate regulation, carbon sequestration, agricultural pest and disease control, and human health regulation.

Given the benefits that biodiversity provides, there is an increasing need to conserve biodiversity to ensure its continued use. Though biodiversity significantly contributes to socio-economic wellbeing in many places, non-sustainable use threatens the benefits derived from it. For example, the forests that form the backbone of the East African Coastal

Forest which are biodiversity hotspots are disappearing at a high rate (Matiku 2005). Similarly, these forests are highly vulnerable as they are small, disjointed, and have communities living in their vicinity.

Globally, studies have been conducted to determine benefits from biodiversity (Egoh et al 2012). However, along Kenya's coast, specifically Lamu County, there is no documented information about the views on biodiversity of communities living in the vicinity of the forests, leading to inadequate or limited information that could enable relevant bodies such as civil society organizations and government to generate appropriate policies to inform decisions and plans. Hence, there is a knowledge gap regarding how exactly people perceive biodiversity and the benefits that they derive from the biodiversity of the coastal forests. It is against this background that the research was conducted.

The research started with the assumption that people living close to the forest would benefit significantly from the biodiversity from these forests in aspects like provisioning of food, energy, medicine and construction materials. The Awer community are known to be hunters and gatherers throughout history (Nunow 2012). They rely on nature and the forest diversity for their sustenance. The inhabitants of Maisha Masha from Witu, originated from Kilifi County, home to the Arabuko Sokoke Forest where they have also obtained the provisioning services of food, medicine, construction materials and energy as well as benefited from the cultural role of forests such as tourism. Further, because the communities benefit from the biodiversity therein, the other assumption was that they would be willing to protect and conserve the natural resource and save it from overexploitation. Therefore, they would consider forest degradation and deforestation a threat to their livelihood. This study was premised on these assumptions.

The research report aims to establish and document the benefits from biodiversity that the inhabitants of Lamu County obtain. The paper further identifies activities and issues that threaten the continued biodiversity benefits and lastly, presents opportunities for improved conservation such as collective action for conservation and participation in community-based action planning. The study was carried out in Awer, Mpeketoni and Witu in Lamu County, Kenya in September 2015.

2.0 METHODOLOGY

Provisioning and cultural ecosystem services were the yardsticks used to establish benefits, threats and opportunities in this study. The two services were singled out as they have a direct bearing on communities and their livelihoods.

Study area

The study was carried out in three areas in Lamu County: Awer, Mpeketoni and Witu (Figure 1).

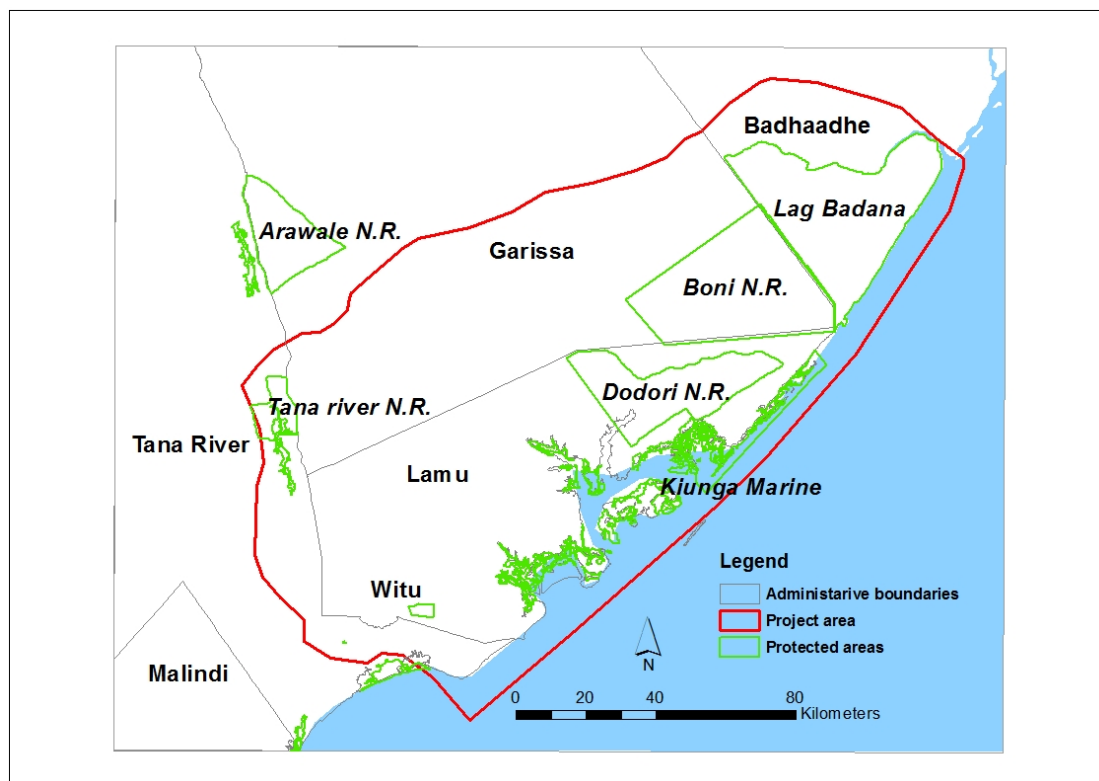


Figure 1: Study area in Witu, Boni and Dodori forest reserves (ICRAF GIS)

Awer study area

Awer area is located between Lamu and the Somali border and consists of three national reserves; Boni, Dodori and Kiunga Marine National Reserve and adjacent stretches of government land. Sandwiched between Boni and Dodori National Reserve is an approximately 10km-wide stretch of government land, known as the Lunghi Forest, which is inhabited by the Awer.

The climate is tropical monsoonal with two rainy seasons and average annual rainfall of 750-1000mm. The long rainy season is from April to June and the short rains are from October to December. The average annual daily temperatures ranges from 15°C to 32°C, with higher temperatures during the dry season from December to April and lower temperatures from May to July. Boni and Dodori Natural Reserves both have soils that are generally highly permeable and erodible. In effect they also have a low water and nutrient storage capacity.

The Awer study site is mainly inhabited by two indigenous communities; the Awer and the Bajun. Formerly known as the Boni, they changed their name to the “Awer” with the new constitutional dispensation due to the derogatory undertones that the name “Boni” carried. They occupy the villages of Basuba, Mararani, Milimani, Bargoni, Mangai and Kiunga, and are considered one of the least populous tribes in Kenya. The Kenya Population and Housing Census of 2009 places their population at 7,026 inhabitants, (3,896M 3,130F). They are almost exclusively Muslim and occupy the northern-most coastal region in Lamu and Garissa County.

Mpeketoni study area

Mpeketoni area has the highest population in Lamu County which may be due to an agricultural settlement scheme that was initiated by the Kenyan government as part of a countrywide rural agricultural programme back in the 1970s (KFS 2015). Mpeketoni has a vibrant economy, mainly agriculturally led which has attracted banks such as Equity, KWFT and KCB and loaning institution like Agricultural Finance Corporation (AFC) and tertiary institutions including Egerton University. The road network is murram. Other social amenities found in the area include churches, mosques and entertainment hotspots which contribute to the economy.

Witu study area

Witu is situated on the southern part of Lamu County with an altitude of 1-20m above sea level. Its soil is highly fertile, making it fit for agricultural production. It experiences few seasonal differences with temperatures ranging from 26.3°C and 26.8°C. High temperatures are experienced from December to April while low temperatures are from May to July. Seasons in Witu are divided by short and long rains both of which contribute to approximately 750-1,075mm annually.

Witu town is cosmopolitan as it has people from different communities including indigenous people in the area such as the Bajuni, the largest indigenous group in Lamu, as well as the Orma and Swahili. It also has immigrants who include the Watta, Pokomo, Awer, Giriama, Somali, Kikuyu and more recently, the Kamba, presenting a rich blend of religion and culture.

There are a myriad of economic activities in Witu, albeit small-scale. There is trade in agricultural products and small-scale business enterprises. The area's economy is also propelled by sale of charcoal. Majority of the inhabitants in Witu depend on farming for their livelihood. They then sell the produce to the community members in the area and to middlemen. There are no banking institutions in Witu, but cooperative societies and bank subsidiaries exist.

Target communities

Three communities were selected according to their vicinity to forest resources and the progress they have made on the trajectory from traditional livelihoods. The first is the Awer, an indigenous community who mostly occupy the northern most coastal region in Lamu. Previously, they were hunters and gatherers who collected natural products from the forests in the nearby national reserves. The introduction of stricter conservation over the years and the associated denial of access to the national reserves made the hunting-gathering livelihood impractical, and as a result the Awer have settled and switched to agriculture.

The second community is the Giriama, one of the communities found in Witu. They live in the buffer zone of the Witu Forest Reserve in a village known as Maisha Masha where they

emigrated mainly from Kilifi County. They came to the area from around 2007 bringing with them knowledge and tradition in crop-based agriculture. Living in the south east of the Witu Forest Reserve are the Orma in Didewaride location; these have lived here for many years and considered as inhabitants of the area and are pastoralists who live communally. The Witu area is also more cosmopolitan with facilities such as hotels, hospitals, tertiary institutions, video dens, churches and mosques, and services such as mobile money transfer, email and printing.

The third community is the Kikuyu living in Mpeketoni without forest cover in their direct vicinity. They were selected to serve as an experimental control as Mpeketoni is predominantly an agricultural area. The large majority of the population in Mpeketoni consists of Kikuyu immigrants who were brought into the area by first the Kenyan President the late Jomo Kenyatta and received title deeds in the late 1970s. Other Kikuyus immigrating into the area later on received land for hire allocated by a *Witemere* committee. Together, these three communities offered us the possibility to interview people that were living closer and further away from forests resources.

Key informant surveys and focus group discussions

Focus group discussions (FGDs) targeting men and women separately as well as key informant interviews were done in Witu and Mpeketoni. The FGDs were conducted to draw on the community members' knowledge, attitudes, beliefs, feelings and experiences around the foods that they eat and where they get them, materials that they use to construct their homes and energy for cooking and lighting, as well as construction materials. Further, the challenges and threats that they face as well as opportunities for biodiversity management were also discussed in these groups. This was done with a view of complementing data collected from households. Key informant (KI) interviews were conducted with individuals who had a wealth of information on the study areas and topic. They comprised the local leadership and opinion leaders, personnel working with conservation bodies, as well as practitioners dealing with traditional medicine. Details of these questions are included in the Annexes.

Household surveys and questionnaire

A total of 116 respondents were interviewed; 36 residing in Witu (29) from Maisha Masha and (7) from Didewaride, 50 in Mpeketoni, drawn from the locations of Mpeketoni (9), Hongwe (8), Ndambwe (11), and Mkunumbi (22) and 30 from Awer drawn from Kiunga (17) and Basuba (13) locations. Purposive sampling was used to select study participants as they needed to be fluent in Swahili. The villages were selected by virtue of their close proximity to the forest in Witu and the Awer living in the forest. In Witu, focus was on the people living on the buffer zones and in the forest hence Maisha Masha and Awer. Owing to the security situation in Awer, focus was placed on areas that were considered safe, hence Kiunga and Basuba were selected for the study. Mpeketoni was selected by virtue of it being far from the forest (approximately 35km from Witu and 187km to Kiunga) and its inhabitants being predominantly farmers.

Overall, the respondents had to be people that had resided in the area for a period of not less than six months. Prior to the household survey, a questionnaire was developed at ICRAF which consisted of general questions to describe the households, a set of questions to describe the use of cultural ecosystem services and four categories of provisioning ecosystem services, namely construction materials, foods, medicine and energy. Following a process of internal review, pre-testing and revision at ICRAF, the questionnaire was then taken to Lamu County for further review and discussion with five enumerators and interpreters. Given that these are coastal communities, majority of them understand Swahili. However, efforts were made to identify interviewers who were able to communicate using the local languages (Kikuyu, Giriama, Boni and Orma) in order to allow for translation of technical terms during interviews.

In the course of holding FGDs with the men and women in Mpeketoni and Witu, the questions in the household questionnaire were fine-tuned. For example, a complete list of food items that are consumed by the three communities was prepared during these FGDs, and the questionnaire was revised based on the feedback. The process of testing and review improved the quality of the questionnaire and the interviewers were then trained to execute the surveys with the final questionnaire. The study was conducted on 14-18 September 2015. Enumerators visited households in Maisha Masha, Didewaride and Mpeketoni to administer the questionnaires.

Four FGDs were conducted with women and men separately in Maisha Masha, Didewaride and Mpeketoni. Key informant interviews were relatively easier to conduct as there was no language barrier with the respondents. Due process was followed in engaging with the community as the gatekeepers of the different communities were involved and used to guide the team on which household would be interviewed putting into consideration aspects such as language, acceptability of the community members and distance.

A challenge faced while conducting the household interviews was managing the communities' expectations on receiving handouts as many of them are used to receiving something when outsiders come to visit. To address this situation, refreshments were offered during group sessions, while communication was sent out in advance that no payments would be made for the interviews.

The other challenge was culture; some women could not participate in the exercise as their husbands were away and they needed their consent. This forced the team to look for alternative respondents.

Group discussions on threats and opportunities

The FGDs were conducted in Swahili. Before administering the questions, the group members were assured of confidentiality; the same was also done during household interviews in a bid to build trust with the respondents, as well as obtain optimal information. The authors of this report enquired from the groups what threats they faced with biodiversity and whether or not they addressed these challenges communally. Opportunities were established by asking a question on whether the groups would be interested in a community-based action plan to improve management of natural resources in future.

Data management and statistical analysis

Data collected during the household surveys and group discussions were noted on paper copies of the questionnaires and in notebooks, respectively. At the end of each day the information entered on the questionnaire sheets and in the notebooks were checked for consistency and archived. Upon completion of the survey, the data was entered using

CSPPro50 for proper management and later converted into excel spreadsheets. Figures and descriptive statistics such as sums and averages were calculated in Excel. SPSS was used to perform chi square tests and analysis of variance.

3.0 RESULTS AND DISCUSSION

The results of the household survey are divided into two main sections. The first describes the demography and characteristics of the households that were surveyed in the Awer, Mpeketoni and Witu communities. The second section describes the findings on the use of the various ecosystem services with excerpts from the FGDs and Key Informant interviews.

3.1 Household characteristics

Table 1: Characteristics of households surveyed in Awer, Mpeketoni and Witu

Household characteristics	Site			Test			
	Awer (N=30)	Mpeketoni (N=50)	Witu (N=36)	Pearson's chi-square value	df	Asymp. Sig.	Sig. level
Household type	(%)	(%)	(%)	13.481	8	0.096	•
Male-headed monogamous	66.7	78.0	75.0				
Male-headed polygamous	10.0	4.0	11.1				
Male-headed Single/divorced/widowed	16.7	4.0	0.0				
Female-headed Single/divorced/widowed	6.7	14.0	8.3				
Child-headed	0.0	0.0	5.6				
Occupation of household head				4.069	2	0.131	
Farming	86.6	82.0	72.2				
Other	13.4	18.0	27.8				
Occupation of spouse				21.017	4	0.000	***
Farming	53.3	100.0	50.0				
Housewife	13.3	0.0	27.7				
Other	33.4	0.0	22.3				
Education level of HH				32.516	10	0.001	***
None	33.3	2.0	33.3				
Primary	46.7	76.0	63.9				
Secondary	13.3	18.0	2.8				
College	6.7	2.0	0.0				
Connection to electricity	30.0	4.0	0	11.838	4	0.019	*

Significance codes: 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.' 1''

Table 1 reveals that the majority of households were male-headed and monogamous for all three communities (Awer, 66.7%, Mpeketoni, 78% and Witu, 75%). Polygamous male-headed households made up a higher proportion of the households in Witu (11.1%) and Awer (10%) communities. Table 1 further shows that farming is the major occupation of the household head. This is surprising given their history as hunters and gatherers.

This shift in their livelihoods could be attributed, among other factors, to increased restriction of entry into the forest, thus forcing them to look for alternative means of survival. It could also mean that the current literature on the lifestyle of the Awer is outdated. Table 1 further shows strong and significant difference in occupation of the spouse ($\chi^2=21.017$, $df=4$, $P < 0.001$), with all spouses engaging in farming in Mpeketoni, but only half in the other two communities.

Finally, Table 1 reveals that in Witu and Awer, one third of the heads of households have not had any form of education. In all three areas, primary level of education is the category that has the largest number of household heads. While education levels are low across all three sites, there are significant differences between the three sites, with Mpeketoni having a higher proportion of household heads that have primary education (76%).

Table 2: Household characteristics for Awer, Mpeketoni and Witu with ANOVA

Household characteristics	Site			Test		
	Awer (N=30)	Mpeketoni (N=50)	Witu (N=36)	F	p-value	Sig.
Average age of HH head	50	46	43	1.754	.178	
Average family size				5.017	.008	**
1-3	43.3	16.0	16.7			
4-6	46.7	62.0	38.9			
7-9	10.0	22.0	44.4			
No of members contributing to HH income				4.336	.015	*
1	36.7	14.0	16.7			
2	60.0	68.0	69.4			
3	3.3	8.0	8.3			
4	0.0	8.0	5.6			
5	0.0	2.0	0.0			

Significance codes: 0.001 '***' 0.01 '**' 0.05 '*' 0.1 '.' 1''

The average age of the head of the households surveyed in Awer, Mpeketoni and Witu was 50, 46 and 43 years, respectively (Table 2). Although household heads were on average older in Awer and youngest in Witu, these differences were statistically not significant (One-way ANOVA, $F=1.754$, $df=1,2$, $P=0.178$).

In relation to the family size, majority of the households in Awer and Mpeketoni comprising between four and six people were 46.7% and 62%, respectively. In Witu, on the other hand, majority of households (44.4%) had between seven and nine people depicting the communal lifestyle that this community has adopted. These results imply that the fertility rate is high. In the three sites, the average number of people that contribute to income is low, although the dependency ratio varies in the three sites with Witu taking the lead in the number of dependents. In Awer a significant number of households – 43.3% – have between one and three people and only 10% of households have seven to nine people.

Table 3: Percentage of immigrants and non-immigrants in Awer, Mpeketoni and Witu

	Awer (N=30)	Mpeketoni (N=50)	Witu (N=36)	Chi-square	df	P	Sig. level
Immigrants	3.3	96.0	80.6	77.296	2	.001	***
Non-immigrants	96.7	4.0	19.4				

Table 3 reveals that there are significant differences in the proportion of immigrants in the three areas ($\chi^2 = 77.296$, $P < 0.001$). The large majority of the population in Mpeketoni (96%) and Witu (80.6%) consist of immigrants, whereas there are very few (3.3%, 1 person) in Awer (Figure 2). The increase in the number of people joining an area means the demand for resources also increases, yet sometimes these products are unsustainably harvested. A survey that was carried out by ICRAF in Lamu County looking at trends and drivers of change to deforestation revealed that increase in human population was the main factor leading to loss in tree cover in Southern and Central Lamu.

The immigrant populations in Mpeketoni are majorly Kikuyu who were brought into the area in the late 1970s by the then president, the Late Jomo Kenyatta. Later on other Kikuyus have continued to move into the area through a system known as *Witemere* where new entrants are allocated land by the Witemere committee that consists of elders and community members. This study revealed that the major reason for moving to the area is because land was easily available (96.4% of respondents in Witu and 100% in Mpeketoni) (Table 4).

Table 4: Primary reason for migrating

	Awer	Mpeketoni	Witu
Employment	100%	-	-
Land and natural resources available	-	100%	96.4%
Other reasons	-	-	3.6%

Witu also carries a significant number of immigrants (80.6%) who are predominantly Giriama. The Orma are the non-immigrants in Witu as they are the ones who were born and bred in Witu. In terms of level of immigration Lamu County is ranked 9th in Kenya with an immigration rate of 31.1% against 20.9% for the nation as a whole, according to the socio-economic atlas of Kenya 2014.

Table 5: Sources of water for cultivation in Awer, Mpeketoni and Witu

Water Source	Awer	Mpeketoni	Witu
Rainfall	96.3%	71.8%	96.8%
Groundwater	0.0%	23.1%	0.0%
Surface rainwater storage	3.7%	5.1%	3.2%

A question was posed on the main source of water used for farming in the three communities; it emerged that the main source of water used for cultivation for the three places was rainwater, giving a clear indication that the communities in this part of the coastal area, like many others, depend on rain fed agriculture. Mpeketoni has more diversified sources of water for cultivation when compared to Awer and Witu.

Table 6: Proportion of households with and without land title deeds

Title deed	Awer	Mpeketoni	Witu
No	93.3	66.0	91.7
Yes	6.7	34.0	8.3

Land tenure remains an issue in this coastal region as depicted in Table 6. It is clear that in all the three study areas, none of the three places had 100% of the interviewed population claiming ownership of land that they use with title deeds. Less than 10% of the respondents in Awer and Witu hold title deeds. Among the Giriama, the community that immigrated in the Lamu area, none holds a title deed; the 8.3% of the total in Witu who hold a title are Orma who are indigenous to the area. A much higher fraction of the respondents interviewed in Mpeketoni (34%) have title deeds because these were settled in the area in the 1970s and were issued with title deeds. The remaining 66% of the people in Mpeketoni do not hold title deeds but were given land at a fee under the *Witimere* arrangement. The lack of title deeds is also backed up with the collected data that indicates that 74.4% of the respondents in Mpeketoni bought the land that they reside in (Table 7).

Table 7: Forms of land acquisition for Awer, Mpeketoni and Witu

Land Acquisition	Awer	Mpeketoni	Witu
Inherited	86.7	20.5	71.9
Bought	13.3	74.4	28.1
Hired	0.0	5.1	0.0

The assertion that land is easily available as given by inhabitants in Mpeketoni (97.9%) and Witu (89.3%) in the area is supported by data that indicates that households in Awer, Mpeketoni and Witu have an average of 10.6, 6.8 and 5.4 acres respectively (Table 8). While Witu holds the least number of acres among the three areas, given that they are disadvantaged among the three areas, the size of land that they own is significant vis-à-vis their socio economic status.

Table 8: Average land size (acres) in Awer, Mpeketoni and Witu

	Awer			Mpeketoni			Witu		
	Min	Average	Max	Min	Average	Max	Min	Average	Max
Land size	3	10.6	45	1	6.8	18	0	5.4	15

In summary, demographic data is useful as it aids in making informed decisions for interventions. Similarities can be seen in the aspects of occupation, type of household heads and the level of education of the household heads in the three areas. What is surprising is that farming is the main occupation in the three areas including among the Awer who have always been depicted as hunters and gatherers. An interesting aspect presented by the data is the high level of immigrants in Witu and Mpeketoni as land is easily available. This has translated to a fewer number of people with title deeds in these areas.

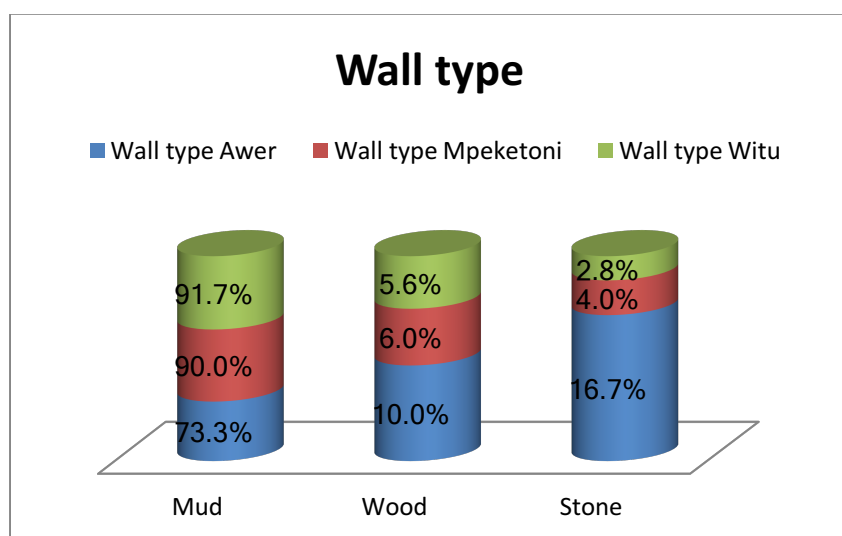
Finally, from the demographics, it can be concluded that Witu is the weakest of the three socio-economically.

3.2 Benefits derived from biodiversity

3.2.1 Provisioning ecosystem services

The provisioning services derived from biodiversity in the study area include:

Construction materials

**Figure 2: Wall construction material in Awer, Mpeketoni and Witu**

The study revealed that all three communities depend on nature for the material that they use to construct their houses; subsequently, the common construction material for walls in these areas was mud. Interestingly, 90% of households in Mpeketoni use mud for constructing their walls, a figure that is close to their Witu counterparts and lower than the community in Awer (Figure 2). This phenomenon could be attributed to the fact that majority of the respondents in Mpeketoni are immigrants who settled in the area through the *Witemere* process. *Witemere* is a Kikuyu word loosely translated to mean ‘cut for yourself’. It is a form of land adjudication where people select committee members from among themselves who allocate land to those who need the land. The committee is paid some money for the process. Those who have bought the land then clear the area and start to live there as they await official adjudication. As such, they live in a place with no title deeds and are uncertain of their future. In view of this, having simple, affordable structures is considered the better option in these parts of Mpeketoni. Notable also is that wood is hardly used even in Witu where the community lives in the vicinity of the forest.



Sample of materials used for roofing and walls in Witu (Photo credit: Linda Mbeyu/ICRAF)

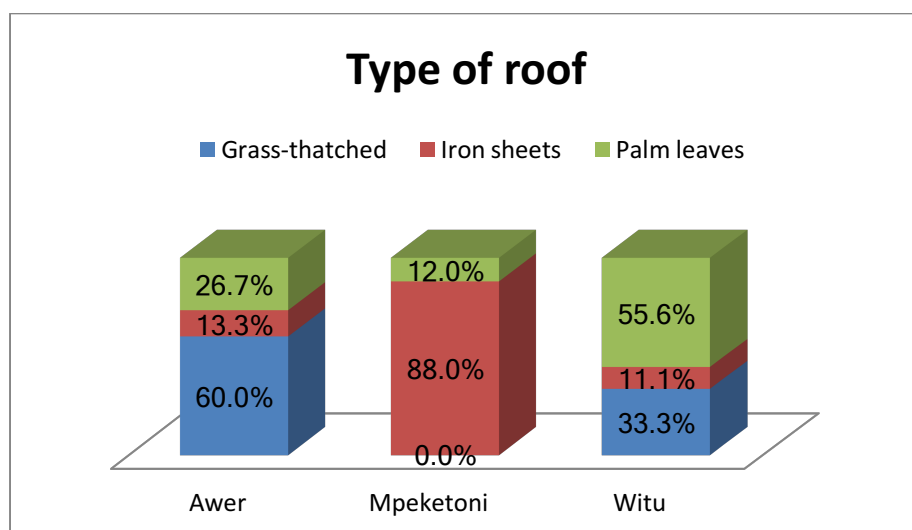


Figure 3: Roofing materials in Awer, Mpeketoni and Witu

For the construction material, differences lie in roofing material. 88% of the interviewed households in Mpeketoni have used iron sheets for their roofing material in comparison to 13.3% and 11.1% in Awer and Mpeketoni respectively (Figure 3). This could translate to a higher purchasing power on the part of Mpeketoni. Awer and Witu use locally available materials: palm leaves in Witu (56%) and grass thatch in Awer (60%). None of the households interviewed in Mpeketoni use grass thatches for roofing, even for households that use mud for their walls and bare soils for their floors; a great percentage (90%) use iron sheets for roofing.

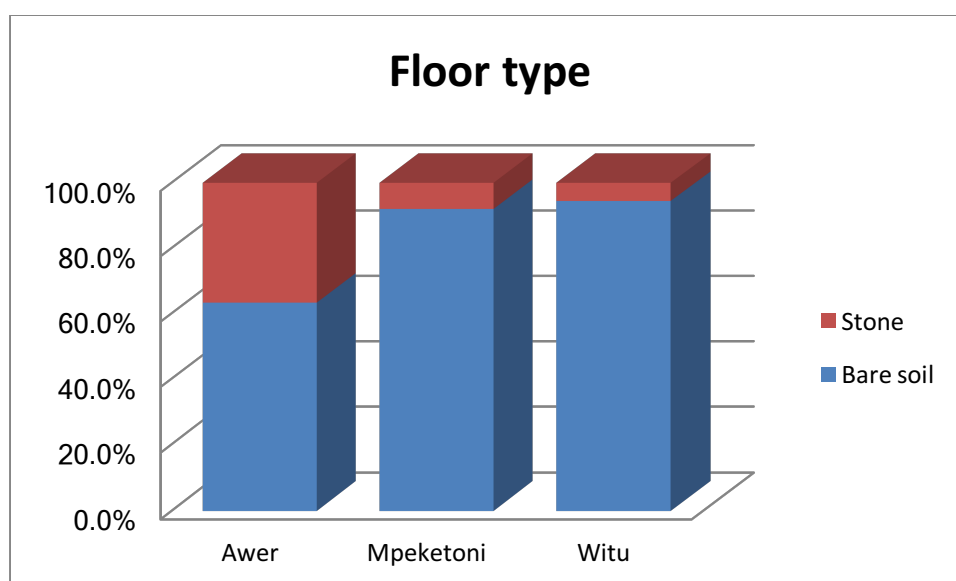


Figure 4: Flooring material in Awer, Mpeketoni and Witu

The study revealed that bare soil stood out as the flooring material of choice for the three communities (Figure 4). However, a larger majority of households in Awer (37%) use stones for their floors.

In concluding this section, it is evident that minor differences were observed in the three communities as regards their dependence on natural resources for use in constructing of their walls and floors of their houses. A remarkable difference however, was observed in the material used for roofing as seen in Mpeketoni where the greater majority of houses have corrugated iron roofs whereas grass and palm leaves were the most frequently used materials for roofing in Awer and Witu, respectively.

These findings are in line with (Wells & Haddar 1998) who in their study on the housing and building materials used in Dar es Salaam, Tanzania, revealed that the construction materials used for low-cost housing comprised poles which were filled with mud, and palm trees were used for roofing.

Food

This research started with the assumption that there would be significant differences in reliance of foods consumed in the three communities based on their proximity to the forest biodiversity. Indeed, households in Awer reported consuming three food items that were derived from nature more regularly than the two other communities, namely honey, game meat and freshwater fish (Tables 9 and 11). The Awer and Witu communities also reported consuming wild fruits more regularly than the inhabitants of Mpeketoni. Apart from these few food items, our survey reveals little dependence of people living closer to the forest to draw and consume their food on biodiversity of the forests.

Instead our data reveal a remarkable congruence of the three communities in relying on foods from farmland for their livelihoods (Tables 9 and 11). Table 11 indicates that most of the food items that were reported as their frequent diets (Table 9) were harvested from the farms. One possible reason for this finding could be the mistaken perception that these communities have inefficient agricultural practices. Another reason to explain our finding could be that people under-report their reliance on foods that are derived from natural biodiversity. Being well aware

of this hypothetical bias, the interviewers, before administering the questionnaires were trained to explain to the respondents the importance of providing honest responses.

Table 9: Frequency (daily (D), weekly (W), monthly (M), and only when available (A)) of consumption of food eaten in Awer, Mpeketoni and Witu

Food	Awer				Mpeketoni				Witu			
	D	W	M	A	D	W	M	A	D	W	M	A
Maize	0%	3%	7%	90%	0%	0%	0%	100%	4%	48%	26%	22%
Maize meal	40%	46%	14%	0%	82%	18%	0%	0%	83%	11%	3%	11%
Rice	54%	43%	3%	0%	52%	46%	2%	0%	9%	21%	32%	38%
Wheat flour	43%	43%	14%	0%	4%	76%	20%	0%	9%	12%	42%	36%
Cassava	47%	37%	6%	10%	2%	33%	13%	51%	42%	24%	12%	21%
Arrow roots	0%	4%	34%	62%	0%	0%	4%	96%	100%	0%	0%	0%
Sweet potatoes	0%	0%	29%	71%	0%	5%	10%	85%	19%	25%	12%	44%
Coconut milk	42%	38%	13%	8%	9%	0%	9%	82%	30%	30%	18%	22%
Milk	27%	23%	30%	20%	98%	0%	0%	2%	40%	15%	15%	30%
Fermented milk	4%	10%	17%	69%	0%	0%	5%	95%	6%	27%	27%	40%
Beef	0%	7%	31%	62%	2%	0%	71%	27%	0%	16%	12%	72%
Goat meat	0%	24%	17%	59%	4%	4%	73%	19%	0%	6%	24%	70%
Rabbit meat	0%	0%	0%	100%	0%	0%	40%	60%	0%	0%	0%	100%
Game meat	0%	15%	11%	74%	0%	0%	0%	100%	0%	0%	14%	86%
Lamb	0%	0%	0%	100%	0%	0%	68%	32%	0%	27%	0%	73%
Beef	0%	7%	31%	62%	2%	0%	71%	27%	0%	16%	12%	72%
Chicken	0%	24%	59%	17%	0%	16%	76%	8%	0%	3%	73%	24%
Fresh water fish	6%	50%	6%	38%	4%	13%	2%	81%	3%	23%	20%	53%
Sea fish	43%	13%	10%	33%	3%	3%	3%	91%	0%	10%	37%	53%
Crabs	0%	0%	10%	90%	0%	0%	0%	100%	0%	0%	17%	83%
Prawns	0%	0%	3%	97%	2%	0%	0%	98%	0%	3%	22%	75%
Honey	47%	33%	17%	3%	0%	0%	9%	91%	14%	0%	43%	43%
Sugar	100%	0%	0%	0%	100%	0%	0%	0%	49%	21%	9%	21%
Cooking oil	100%	0%	0%	0%	100%	0%	0%	0%	85%	9%	0%	6%
Cooking fat	11%	7%	35%	47%	90%	0%	10%	0%	43%	0%	14%	43%
Margarine	7%	0%	18%	75%	0%	4%	4%	92%	0%	0%	33%	67%
Beans	3%	43%	47%	7%	40%	54%	4%	2%	6%	39%	42%	12%
Green grams	7%	62%	28%	3%	77%	19%	2%	2%	3%	73%	15%	9%
Cowpeas	21%	52%	24%	3%	65%	28%	2%	5%	3%	76%	17%	3%
Peanuts	11%	22%	0%	67%	0%	5%	5%	90%	0%	56%	12%	32%
Mnavu	0%	8%	0%	92%	0%	13%	6%	81%	43%	39%	14%	4%
Mkunde	4%	36%	39%	21%	68%	12%	2%	23%	53%	43%	0%	4%
Mchicha	3%	70%	17%	10%	72%	22%	2%	4%	56%	35%	6%	3%
Sukuma wiki	0%	13%	53%	34%	34%	56%	8%	2%	7%	23%	13%	57%
Cabbage	0%	3%	20%	77%	0%	6%	4%	90%	0%	13%	0%	87%
Mangoes	0%	24%	63%	13%	0%	0%	10%	90%	3%	9%	50%	38%
Bananas	0%	23%	53%	24%	13%	0%	80%	7%	24%	50%	11%	15%
Oranges	0%	10%	43%	47%	0%	0%	20%	80%	0%	7%	13%	80%
Cashew	0%	17%	17%	66%	4%	2%	27%	67%	0%	12%	68%	20%
Pawpaw	3%	73%	17%	7%	0%	4%	25%	71%	43%	40%	8%	8%
Madafu	7%	70%	16%	7%	6%	9%	34%	51%	32%	52%	8%	8%
Passion	0%	0%	18%	82%	0%	0%	7%	93%	40%	23%	27%	10%
Kunazi	0%	0%	27%	73%	0%	0%	0%	100%	0%	67%	33%	0%
Guavas	0%	0%	7%	93%	0%	0%	0%	100%	25%	25%	38%	12%
Matomoko	0%	0%	0%	100%	0%	0%	0%	100%	0%	25%	0%	75%
Wild fruits	14%	14%	10%	62%	0%	0%	0%	100%	38%	7%	24%	31%

Daily (D), weekly (W), monthly (M), and only when available (A)

*Colours codes: Orange colour range 70-100%, Blue 40-70%, and Green from 10-40%

In the African context, a significant percentage of the diet is drawn from maize, rice, sorghum and millet which are starchy in nature (Oniang'o & Malaba 2003). This study revealed the same, with variations in the type of starchy foods consumed. The starchy diet of the Awer consists of maize meal, rice and wheat flour. This they interchange throughout the week as they do not have a specific food (starch) that they eat on a daily basis. In

Mpeketoni, maize meal is taken daily, but this is interchanged majorly with rice (52%). However, in Witu, maize meal is the main staple (83%) which is taken on a daily basis; rice and wheat flour, which is taken on a daily basis by the Awer is consumed only when available in Witu.

The data reveals that cassava is eaten more frequently in Awer and Witu than in Mpeketoni, and of the three, Awer takes the lead (80%). Cassava is complemented with arrow roots in Witu. This could mean that arrow roots are available in Witu, but not in Awer.

There are differences between communities in type of animal proteins consumed. A total of 43% of the informants from Awer indicated that they consume fish from the sea on a daily basis, most likely due to their proximity to the sea. A high proportion of respondents (91%) from Mpeketoni indicated that they eat sea fish only when available. This could be more of a social than an economic issue as it is well known that culturally, the Kikuyu do not indulge in fish, but prefer beef or goat meat. This is true as data collected indicates that 71% and 73% of the respondents in Mpeketoni eat beef and goat meat respectively, on a weekly basis. This is high in comparison to Awer (7% and 24%) and Witu (16% and 6%).

Milk is readily available in Mpeketoni where 98% of the households reported that they consume milk on a daily basis in comparison to only 27% in Awer and 40% in Witu. A total of 26% of respondents in Awer eat game meat on a daily or weekly basis; for the other places the meat is taken only when available, indicating scarcity of the same.

In all the three areas, crabs and prawns are a rare delicacy and are taken only when available. This could be attributed to their prohibitive price.

The three communities further differed on the types of oils consumed. The data revealed that cooking oil is more commonly used than cooking fat in all the three communities. All the respondents in Awer and in Mpeketoni mentioned that they used cooking oil on a daily basis. Up to 85% of the respondents in Witu use cooking oil on a daily basis; however, there is a small pocket of the population that use the oil only when it is available. Cooking fat is also utilized in these areas but in varying degrees. It is more popular in Mpeketoni, 90% of the respondents reported that they consume it on a daily basis. Coconut and hence coconut milk is widely used by the Awer – 42% of the respondents use it daily and 38% weekly in

comparison to respondents in Mpeketoni where a paltry 9% use it on a daily basis. Witu communities use coconut milk often. The reason for this could be that the Awer and Witu communities originated from the Coast and are more dependent on the palm tree and its products. This is supported by data that indicates that the coconut fruit (*Madafu*) is eaten on a weekly basis by 70% of the respondents in Awer while the same is eaten by only 9% of the population in Mpeketoni. A relatively significant number (52%) of respondents in Witu utilize it on a weekly basis.

Sugar is consumed on a daily basis by 100% of the respondents in Mpeketoni and the Awer community. It is consumed less frequently in Witu – 49% on a daily basis while up to 21% of respondents only use it when available. This is a reflection of the relative poverty of some members in this community. Of the three places, honey is widely available in Awer as up to 80% of the respondents therein use it either on a daily or weekly basis. This is in contrast to Mpeketoni where 91% of the population use it only when it is available. This could be attributed to the fact that 67% of respondents indicated that they source the honey from nature (Table 11). In Witu, only 14% of the population consumes honey on a daily basis while 43% use it when available. In Witu, 86% of people indicated that they obtain their honey from the shop (Table 11) which could explain the low percentage of respondents indicating consuming it frequently.

The three communities differed on the types of vegetables consumed. The data reveals that the green vegetable that is easily available in the three areas is *mchicha* (*Amaranthus hybridus*). Green vegetables play a significant role in the diets of communities in Witu as they interchange between *mchicha* (*Amaranthus hybridus*) (56%), *mnavu* (*Solanum nigrum*) (43%), and *kunde* (*Vigna unguiculata*) (53%), on a daily basis. Those from Awer do not eat green vegetables on a daily basis. *Sukuma wiki* (kale) is easily and locally available in Mpeketoni as 34% consume the vegetable on a weekly basis. On the contrary, none of the respondents in Awer indicated consuming this vegetable on a daily basis and only 13% stated using it on a weekly basis, while 53% of respondents alluded to consuming it only when available, an indication of its scarcity in the area. In Witu, the vegetable is consumed but in lower amounts which could be attributed to preference being placed on the other vegetables as seen above.

Cabbage is not consumed much in all the three areas (Table 9). The FGDs that were conducted in Mpeketoni and Witu revealed that cabbage is one of the vegetables purchased from the market; 97% and 94% of respondents in Awer and Mpeketoni respectively, consume it at least once a month or when it is available. Only 13% of respondents in Witu stated that they consume cabbage on a weekly basis. The rest consume it when it is available. Having to purchase the vegetable in the market as opposed to sourcing it from the farm could explain its low consumption in the three areas, and the fact that there is a variety of other vegetables in the farms to choose from.

There are further differences in the type of fruits consumed in the three areas. In Witu, 45% of the respondents eat wild fruits on a daily or weekly basis. This is followed by Awer which has 28% of the population eating these fruits on a daily or weekly basis. In Mpeketoni these wild fruits are only eaten when available. Witu is seen as having a greater variety of fruits that are eaten either on a daily or weekly basis, while Mpeketoni has the least variety of fruits of the three places. Pawpaw, *kunazi*, passion and guavas are eaten on a daily basis in Witu.

The wild fruits that were identified and commonly found in all the three areas include the duom palm, *udaudo*, *wamo* in Orma, while *zambarau* (*Syzygium cuminsi*), *vitoria* (*Garcinia Mangostana*), *kongojii* and *kungu* are eaten among the Giriama in Witu. The FGDs in Witu and Mpeketoni revealed that both places grow a variety of fruits. In Mpeketoni for instance, mangoes, oranges, passion, pineapples, bananas and *matomoko* were identified as some of the fruits grown in the area while in Witu pawpaw, mangoes, oranges, passion and sugarcane were mentioned as some of the fruits grown in the area. However, these fruits are seasonal which explains why majority of the respondents in all the three areas indicated that they eat these fruits on availability.

The three communities vary in the consumption of pulses; consumption of pulses is higher in Mpeketoni where 40%, 77% and 65% of the population consume beans, green grams and cowpeas on a daily basis, compared to less than 10% consumption in each of the pulses in Witu and the same for Awer, save for cowpeas (21%). Green grams and cowpeas are highly consumed in Awer while in Witu, cowpeas are consumed slightly more than green grams;

they are more available in comparison to beans in the three areas. From the data, it can be concluded that pulses greatly contribute to the protein diet in the three areas.

Table 10: Percentage of people who sell their farm produce

Sale of farm produce			
	Awer	Mpeketoni	Witu
Do not sell	7%	4%	22%
Sell produce	93%	96%	78%

In all the three study areas, the respondents indicated that aside from eating the food that they grow on their farms, they also sell the surplus foods and products, mostly in the local markets. What they sell varies from one area to another depending on its availability as well as market for the same. From the analysed data, what is common across the three areas is that game meat is hardly sold.

However, during an FGD with men in Mpeketoni, they revealed that wild animals are eaten as they are sold at night in drinking dens known as *mangwenis* at KES 200 per kilo. The wild animals include buffaloes, hippos, topi and antelopes (Table 10).

Table 11: Main food sources in Awer, Mpeketoni and Witu

Food	Awer						Mpeketoni						Witu					
	Farm		Nature		Shop		Farm		Nature		Shop		Farm		Nature		Shop	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Maize	30	100%	0	0%	0	0%	48	96%	0	0%	2	(4%)	29	91%	0	0%	3	9%
Maize meal	11	37%	0	0%	19	63%	48	96%	0	0%	2	(4%)	28	80%	0	0%	7	20%
Cassava	27	93%	0	0%	2	7%	19	49%	0	0%	20	51%	25	74%	0	0%	9	26%
Arrow roots	0	0%	0	0%	28	100%	1	4%	0	0%	26	96%	1	50%	0	0%	1	50%
Sweet potatoes	1	3%	0	0%	28	97%	13	36%	0	0%	23	64%	7	41%	0	0%	10	59%
Rice	1	3%	0	0%	29	97%	2	4%	0	0%	48	96%	0	0%	0	0%	35	97%
Wheat flour	1	3%	0	0%	29	97%	0	0%	0	0%	50	100%	0	0%	0	0%	34	94%
Sugar	2	7%	0	0%	28	93%	0	0%	0	0%	50	100%	0	0%	0	0%	35	97%
Honey	3	10%	20	67%	7	23%	1	2%	11	30%	25	68%	0	0%	3	14%	19	86%
Cooking oil	1	3%	0	0%	29	97%	0	0%	0	0%	49	100%	0	0%	0	0%	35	97%
Coconut oil	4	14%	0	0%	25	86%	1	3%	0	0%	29	97%	6	27%	1	5%	15	68%
Ghee	1	33%	0	0%	2	67%	1	4%	0	0%	24	96%	5	56%	0	0%	4	44%
Castor oil	0	0%	0	0%	1	100%	0	0%	0	0%	24	100%	0	0%	1	10%	9	90%
Chicken	23	77%	0	0%	7	23%	47	96%	0	0%	2	4%	34	94%	0	0%	0	0%
Beef	2	7%	0	0%	28	93%	0	0%	0	0%	46	100%	2	7%	0	0%	26	93%
Goat meat	3	10%	0	0%	27	90%	0	0%	0	0%	48	100%	6	22%	0	0%	21	78%
Rabbit meat	0	0%	0	0%	5	100%	0	0%	0	0%	26	100%	0	0%	0	0%	1	100%
Lamb	1	4%	0	0%	26	96%	1	4%	0	0%	26	96%	1	7%	0	0%	13	93%
Game meat	0	0%	21	84%	4	16%	0	0%	0	0%	3	11%	0	0%	4	57%	3	43%
Fresh water fish	0	0%	12	80%	3	20%	0	0%	1	2%	45	98%	1	3%	4	12%	29	85%
Sea fish	1	3%	1	3%	27	94%	0	0%	2	6%	34	94%	0	0%	0	0%	23	100%
Prawns	0	0%	1	4%	26	96%	0	0%	0	0%	25	100%	0	0%	0	0%	19	100%
Crabs	0	0%	1	4%	25	96%	0	0%	0	0%	25	100%	0	0%	0	0%	4	100%

Food	Awer						Mpeketoni						Witu					
	Farm		Nature		Shop		Farm		Nature		Shop		Farm		Nature		Shop	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Beans	1	3%	9	31%	1	66%	2	4%	0	0%	4	96%	2	6%	0	0%	3	94%
Green grams	2	97%	0	0%	1	3%	4	96%	0	0%	2	4%	2	77%	0	0%	8	23%
Cowpeas	2	93%	0	0%	2	7%	4	96%	0	0%	2	4%	2	84%	0	0%	5	16%
Peanuts	3	100%	0	0%	0	0%	1	30%	0	0%	2	70%	1	62%	0	0%	1	38%
Mnavu	2	29%	0	0%	5	71%	4	12%	0	0%	3	88%	2	90%	0	0%	3	10%
Mkunde	2	100%	0	0%	0	0%	4	12%	0	0%	3	88%	2	91%	0	0%	3	9%
Mchicha	2	93%	0	0%	2	7%	4	88%	0	0%	6	12%	2	80%	0	0%	7	20%
Sukumawiki	3	10%	0	0%	1	45%	1	37%	0	0%	3	63%	1	38%	0	0%	1	62%
Mangoes	1	55%	0	0%	1	45%	4	82%	0	0%	9	18%	2	79%	0	0%	7	21%
Bananas	1	34%	0	0%	1	66%	1	37%	0	0%	3	63%	2	83%	0	0%	6	17%
Oranges	0	0%	0	0%	2	100%	3	69%	0	0%	1	31%	4	29%	0	0%	1	71%
Cashew	2	97%	0	0%	1	3%	4	95%	0	0%	2	5%	2	84%	0	0%	5	16%
Pawpaw	2	100%	0	0%	0	0%	2	56%	0	0%	2	44%	3	86%	0	0%	5	14%
Madafu	2	86%	0	0%	4	14%	2	54%	0	0%	1	46%	2	95%	0	0%	1	5%
Passion	9	36%	0	0%	1	64%	1	26%	0	0%	3	74%	2	85%	0	0%	4	15%
Kunazi	1	62%	1	38%	0	0%	0	0%	1	59%	1	41%	3	75%	0	0%	1	25%
Matomoko	0	0%	0	0%	1	100%	3	10%	3	10%	2	80%	1	25%	0	0%	3	75%
Guavas	2	13%	0	0%	1	87%	3	11%	0	0%	2	89%	3	43%	0	0%	4	57%
Wild fruits	1	5%	2	95%	0	0%	0	0%	4	100%	0	0%	2	68%	1	32%	0	0%

*Colours codes: Orange colour range from 70-100%, yellow 40-70% and blue 10-40%

It is evident that people acquire food from nature, crop and livestock farming. Those that are derived from the shops are the ones that require manufacturing and processing such as cooking oils, wheat flour and rice, as well as foods that are not grown on their farms like beans and cabbages. Further, although the Awer derive more products from nature than those from Mpeketoni and Witu, the difference is insignificant. Indeed, the Awer, who live closer to nature practise farming as much as the communities in Mpeketoni and Witu. They do however, rely on biodiversity for a few specific food items, notably honey, game meat and freshwater fish and wild fruits.



A vegetable farm in Mpeketoni (Photo Credit: Linda Mbeyu/ICRAF)

3.2.1.3 Medicine

Similar to the foregoing sections, the research started with the assumption that communities living closer to nature would rely more on medicine derived from natural biodiversity. When asked to indicate their primary source of medicine for the 10 ailments listed in Table 12, respondents from the Awer community reported using medicine from nature in 15.4% of the cases on average. This reliance on medicine from nature among the Awer was higher than the 3.1% and the 2.5% among respondents from Witu and Mpeketoni, respectively.

Hence, the analysis revealed evidence in favour of the assumption that people living closer to forest biodiversity rely to a large extent on medicine that is derived from biodiversity.

Table 12: Sources of medicine (% of respondents) for ailments in Awer, Mpeketoni and Witu

	Awer			Mpeketoni			Witu		
	Farm	Nature	Shop	Farm	Nature	Shop	Farm	Nature	Shop
Headache	6.9	3.4	89.7	4.3	6.4	89.3	2.8	5.6	91.6
Toothache	15.4	11.5	73.1	8.3	6.3	85.4	15.0	10.0	75.0
Stomach upset	20.0	10.0	70.0	6.1	4.1	89.8	30.8	11.5	57.7
Sprains	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	100.0
Eye problems	8.0	16.0	76.0	0.0	0.0	100.0	22.7	0.0	77.3
Teething in children	0.0	3.8	96.2	0.0	0.0	100.0	0.0	4.8	95.2
Body ache	0.0	53.3	46.7	6.3	2.1	93.8	15.0	0.0	85.0
Ear ache	3.4	0.0	96.6	0.0	0.0	100.0	0.0	0.0	100.0
Animal sting/bite	0.0	35.5	65.5	0.0	2.1	97.9	0.0	0.0	100.0
Skin infection	0.0	17.9	82.1	92.0	4.0	4.0	10.0	0.0	90.0
Average	5.37	15.4	79.59	11.7	2.5	86.02	9.63	3.19	87.18

Table 12 shows that the differences between the communities in their reliance on medicine from nature are significantly large for a few specific ailments. The Awer take the lead in using products from nature to treat ailments compared to the communities in Mpeketoni or Witu.

The study revealed that the Awer depend on nature to treat eight out of the 10 ailments identified while Witu only draws medicine from nature to treat only four of the ailments (headache, toothache, stomach ache and teething in children), and while Mpeketoni follows Witu with six ailments. In Awer 16% of medicine obtained from nature to treat eye problems is honey and simsim oil which they administer as eye drops. A significant percentage in Awer (53.3%) rely on nature to address body aches when compared to Mpeketoni that has only 2% of the population depending on nature. In habitants in Witu purchase medication from the shop to address body pains. The study established that they use material from the neem tree to address this issue. Aside from this, they also identified *Balamal* and *Akakar* as other products from nature that they use to address this issue.

Further, the Awer treat animal stings with products from nature (35.5%) and identified trees known as *Yonge* and *Warkoni* as those used to treat animal stings and bites. Around 18% of respondents in Awer use products from nature, specifically *Mjafari* and *Msabuini* to treat

skin infection. In Witu, the highest percentage of medicine from nature is used to treat stomach upsets by using aloe vera (*kisikiro paka*) followed by toothache where either a tree known as *Gadayu* or castor oil is used. Bearing in mind that Maisha Masha is close to the forest, it is expected that there would be a greater reliance on nature to address these ailments just like in Awer. However, the results are contrary. This phenomenon could be attributed to cultural restrictions that prohibit access to these plants, trees and herbs by the general population; only a select older people are allowed to access and use these products, also a way of sustainably using the available resources.

A Key Informant interview with an elder from Mpeketoni Mr. Kamau Kimani (*Mzee Nyuki*) established that a section of the populace in Mpeketoni use traditional medicine. Being a herbalist himself, Mr. Kamau outlined the following trees and herbs that he uses as part of his treatment regimen; neem tree for treating malaria, *Mnyondo tree* for relieving body pain, *Muthithi tree* (*Mayterus Senegalensis*) for treating skin diseases, bark of the cedar tree is used to treat liver infection while the roots of the *Mkodoro* tree help to relieve joint pains. Mzee Nyuki has grown many of these trees and herbs in his farm.

An FGD with community members in Witu established that the following trees are used to address various ailments: Neem-treating malaria, Aloe vera used for cleansing the blood, treating pneumonia and treating skin diseases, ribena is used for adding blood, passion leaves used to stop diarrhoea, moringa tree and leaves used for regulating pressure and diabetes, as well as strengthening eye sight, and finally tobacco as well as guava leaves are used to stop toothache and diarrhoea. In Mpeketoni, two FGDs were held separately with the men and women from the area and the following were identified as the trees and herbs used as traditional medicine for treating different ailments: Neem for treating malaria, aloe vera leaves for treating skin disease, cleansing the blood and curing pneumonia, moringa seeds for cleansing the digestive system, an appetizer, improving eye sight and treating blood pressure and diabetes, as well as increasing libido, *mjafari* use to strengthen joints and the leaves for treating ulcers, aloe vera for typhoid, guava used to stop tooth ache and diarrhoea.

Interestingly, some of the Awer use honey to address eye problems by putting drops of honey in the eyes.



Mzee Nyuki, flanked by the enumerators, displays his herbal medicine and honey sourced from his farm (Photo credit: Linda Mbeyu/ICRAF)



From L-R *Ocimum basilicum* (Mvumbani) and Aloe vera used as traditional medicine (Photo credit: Linda Mbeyu/ICRAF)

Based on the discussions held with the different groups in Witu and Mpeketoni, it emerged that these communities use herbs and trees in varying degrees for treating different ailments. More importantly, the study revealed that these herbs and trees are obtained from their farms and not from nature. In Awer however, traditional medicine is used and this medicine is obtained from nature.

Overall, the results provide evidence that the community living closest to nature (Awer) rely to a greater extent on medicine that they collect from natural biodiversity than the other two communities.

3.2.1.4 Energy

This study was premised on the assumption that significant differences would be observed in the three communities on the type of energy used for lighting and cooking; that the communities nearer biodiversity-rich areas would rely heavily on those resources than those further away, and that the latter would rely on the more conventional energy sources like electricity and solar. The results herein depict otherwise.

Figure 10 below shows that the energy used for lighting in the three places is kerosene, Witu taking lead on its reliance followed by Awer then Mpeketoni. Aside from kerosene, Witu and Mpeketoni rely on solar energy as an alternative source, while Awer relies greatly on electricity. The communities in Awer and Witu also use firewood for lighting while torches are used in Mpeketoni and Awer. Of the three, Witu has the least variety in terms of energy sources.

Results therefore indicate that communities close to the forest rely on it for their lighting needs but on a small scale as they have identified alternative sources for lighting which are more conventional.

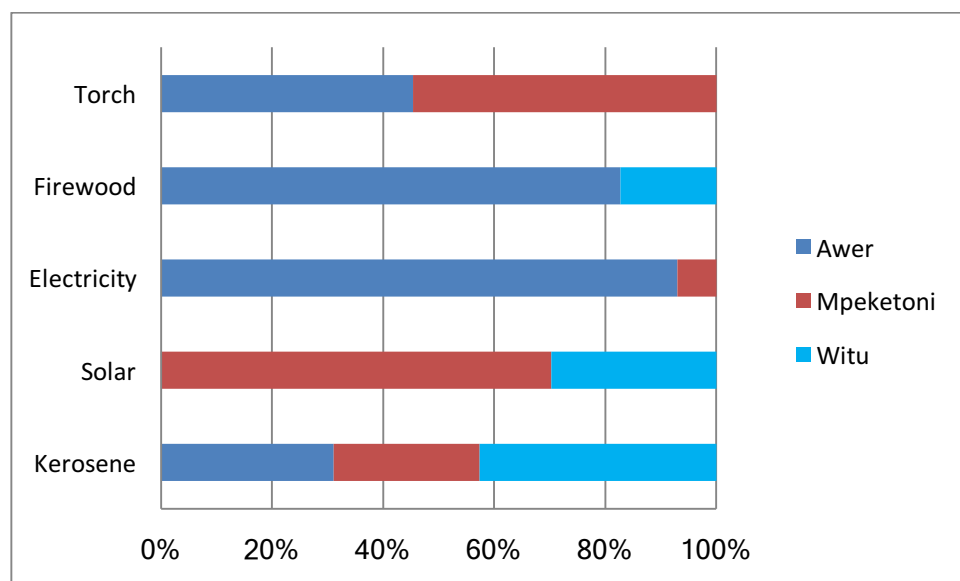
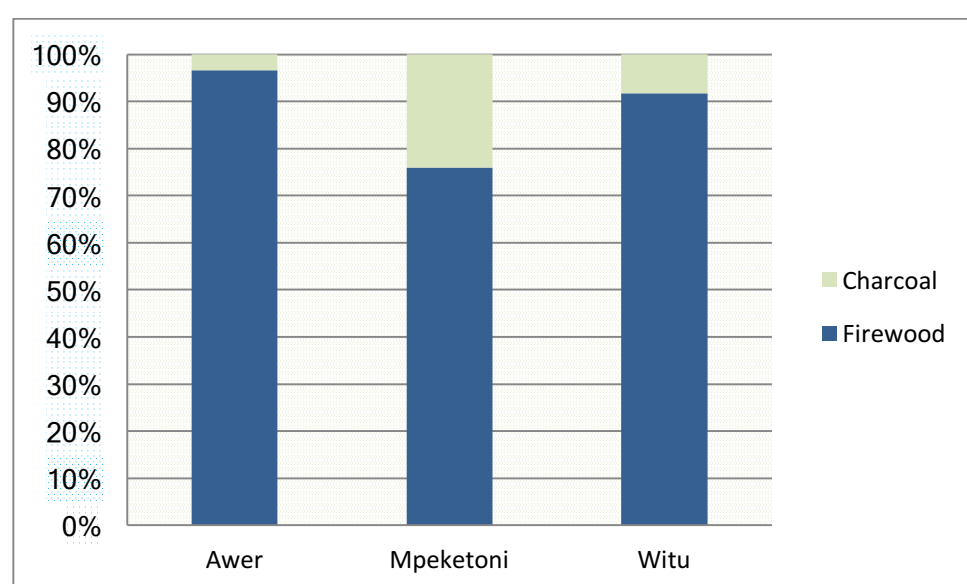


Figure 5: Types of lighting energy in Awer, Mpeketoni and Witu

Table 13: Sources of lighting energy

	Awer	Mpeketoni	Witu
Market/Shop	86.7	96.0	97.1
Nature	10.0	2.0	0.0
Farm	3.3	2.0	2.9

The source of lighting differs from the source of cooking in all the three areas. While kerosene is used as the main lighting energy, and is obtained from the shop, firewood is the main cooking energy for the three areas (Figure 6).

**Figure 6:** Cooking energy used in Awer, Mpeketoni and Witu

While all the three places use firewood as their main source of cooking energy, differences lie in the source of firewood. Table 14 reveals that the Awer draw the bulk of their fuel from nature (approximately 57%) but also from the farm. This is in contrast to the community from Mpeketoni whose source of fuel is mainly from the farm. Witu source their fuel from their farms (78%) although there is a smaller percentage that draws their firewood from nature (22%).

Table 14: Source of cooking energy

	Awer	Mpektoni	Witu
Market/Shop	6.7	4.0	0
Nature	56.6	2.0	22.2
Farm	36.7	94.0	77.8

This data therefore supports the assumption that communities living close to the forest rely on the same to source for their cooking energy and thereby benefit from nature.

3.2.2 Benefits of biodiversity-cultural ecosystem service

Biodiversity supports the provisioning of a number of cultural ecosystem services, including religion, community recreation and tourism. During the surveys, little evidence was found to support the role of trees in religion which could be interpreted to mean that the traditional practice of worshipping trees may have disappeared. However, people value trees for their contribution to community building and potentially the biodiversity of the region could support tourism.

People worship in particular places and trees have a role to play in cultural services (Kinyanjui *et al.*, 2014). Traditionally, the coastal people, like the Mijikenda, used forests to set up sacred places known as *Kayas*, where they performed spiritual sanctification rituals and ceremonies. The sites are considered important for biodiversity conservation and certain plant species can only be found there (Githitho & Forest 1998). However, the validity of these examples on the cultural role of trees in religious practices was questioned during interviews with respondents who were questioned whether this still holds today. In discussing with the communities it was evident that there has been a shift in culture. In the past, trees were instrumental among the Mijikenda, the Giriama being one of them, as they would identify big trees, conduct traditional ceremonies such as circumcision, communicate with the spirits and offer sacrifices. During the FGD with the women in Maisha Masha, the respondents noted that their children are circumcised in hospitals and as such do not conduct any ceremonies in the homestead. They also stressed that they no longer communicate with the deities on rites of passage because they have converted to Christianity or Islam. “...*hayo mambo yamekuwa ya kizamani sasa, siku hizi twaenda kanisani... (those have become things of old; nowadays we go to church!)*” These remarks

were made by Sidi Ziro on enquiring whether they still make offerings under big trees. The case was the same in Mpeketoni where the FGD revealed that people no longer conduct religious or spiritual ceremonies under trees. However, they are used as meeting places as they provide adequate shade.

Apart from their role in religion, which may have slowly disappeared, biodiversity and trees play an important role in building communities. This community building is done in a variety of ways. First, trees play a role in community building by providing a sheltered environment where people can gather for meetings. Further, there are certain trees that are so ingrained in a local culture that they become a symbol of that culture. While the oak tree has such symbolic cultural value in Europe, the palm trees have a similar deeply engrained symbolic value to the coastal cultures of East Africa. So symbolic was the palm tree to the coastal communities in Kenya that it was taboo for the tree to be cut down for use as fuel wood or construction material unless it was old. Preceding data revealed that the Awer and Giriama in Witu use coconut and palm oil for cooking and its leaves for roofing. These uses are part of their culture and differentiate them from other communities such as the Orma and the Kikuyu who do not consume the palm oil. The palm leaves also become a pointer to people's culture because the Kikuyu and the Orma use corrugated iron sheets and grass thatches for their roofing. The FGD with the Orma women in Witu revealed that the Duom palm may have a similar cultural value as they make brooms, and are valued for non-religious uses as it provides the material for mats (*jamvi*), baskets (*kikapu*) and praying mats (*mswala*). Some of the women sell these products at the local market.

Tourism and recreation are common ecosystem services provided by nature and the biodiversity that it supports. For reasons of insecurity, the coastal forests of Lamu County do not attract tourists and hence do not provide such cultural service. However, if security could be provided there would be good potential for tourism because the terrestrial part of the county hosts a variety of wildlife, including the endemic Hirola and unique forests. Together with the Lamu County Government which is responsible for security, other government agencies like KFS and KWS play an important role in developing nature-based tourism in the area. Further, the commitment of organizations such as the Northern Rangelands Trust and Lamu Conservation Trust to develop conservancies in Lamu district is a step in the right direction.

3.3 Threats to benefits of biodiversity

In relation to threats and benefits, the survey started with the assumption that local communities living close to forests do rely significantly on ecosystem services from these forests and would therefore consider deforestation and forest degradation a threat to their livelihoods. Literature indicates that people relying on forest biodiversity for their livelihood consider deforestation and degradation a threat. For example, Blay *et al.* (2008) in their study of three communities in Ghana established that the locals were willing to participate in forest rehabilitation as they wanted to regain the forest resources, get money and timber, as well as gain access to fertile forest lands, resources that they had previously benefited from. Boissie (2009) in interviewing local residents of a village in Vietnam established that the locals agreed that having open access by all and sundry to the natural forest would be detrimental to its existence and they would lose out on its benefits.

Following the household interviews which had revealed a detailed picture of the various ecosystem services that people derived from their farms and from nature, FGDs were then organized to identify aspects and issues that threaten the continued provisioning of these ecosystem services. Interestingly, many of the threats that were mentioned were crop and livestock related. Consequently, a distinction has been made between crops and livestock related threats which were frequently mentioned and the threats that affect the benefits that arise from natural biodiversity.

Table 15 reveals a large number of threats to the provisioning of food, medicine, energy and construction materials on farms. Some of these threats were common agricultural problems that have little to do with the neighbouring forest environment like unreliable rainfall, pests, grazing land, etc. For instance, pests have been identified as a major hindrance to a bountiful harvest in Awer as they attack the food that has been grown; in addition, they do not have extension service officers who would advise them on what to do. Insecurity, unpredictable rainfall and wild animals also contribute in equal measure to the provision of food challenge. In Mpeketoni, a few people mentioned that they have a challenge accessing food; they shared that their challenge had to do with restrictions from KWS on entry into the forest, hence limiting their access to food.

Table 155: Specific threats/constraints faced in sourcing food, medicine, construction material and energy

	Awër	Mpeketoni	Witu
Food from farm	<ul style="list-style-type: none"> • Pests (73.3%), • Unpredicted rainfall (6.7%) 		<ul style="list-style-type: none"> • Lack of food for livestock (23.1%) • Access to water (7.6%) • Land is unavailable (23.1%)
Food from nature	<ul style="list-style-type: none"> • Wild animals (6.7%) • Insecurity limiting access (6.7) 	<ul style="list-style-type: none"> • KWS restriction (100%) 	<ul style="list-style-type: none"> • KWS restriction (15.4%) • Wild animals (30.8%)
Medicine from farm			
Medicine from nature	<ul style="list-style-type: none"> • Identification of tree species (6.2%) • Distance (12.5%) • Wild animals (81.3%) 	<ul style="list-style-type: none"> • KFS restrictions (100%) 	<ul style="list-style-type: none"> • Culture (33.3%) • Unavailability owing to overutilization (66.7%)
Construction material from farm			
Construction material from nature	<ul style="list-style-type: none"> • Permit (38.5%) • High transport cost (23.0) • Wild animals (38.5%) 	<ul style="list-style-type: none"> • Permit (100%) 	<ul style="list-style-type: none"> • Permit (94.7%) • Wild animals (5.3%)
Energy from farm			
Energy from nature	<ul style="list-style-type: none"> • Permit (20%) • Wild animals (80%) 	<ul style="list-style-type: none"> • KFS (100%) 	<ul style="list-style-type: none"> • Scarcity due to over exploitation (7.7%) • Permit (84.6%) • Wild animals (7.7%)

Respondents in Witu mentioned a myriad of challenges ranging from wild animals such as baboons, elephants and monkeys attacking their farms. The damage created by wildlife however, is directly related to the adjacent forest and its biodiversity. When asked about threats, respondents considered biodiversity a threat to their crop land (wild animals like elephants, monkeys and baboons). The pastoralists in Witu also had a challenge on land. In the village where the interview was conducted, there was an invasive species in the delta linked to drying up of water. Lack of livestock feeds, especially during the dry season was another challenge identified; access to water is also a challenge to some of the respondents as they have to walk long distances to access a water source. The residents complained that access to food and water was greatly hampered by a plant that grows on their delta resulting in complete loss of water as the plant completely absorbs the water. The cattle that they possess are unable to feed on the plant as well. One resident complained, “Hii

mmea haitusaidii na haisaidii ng'ombe zetu; ni hasara tupu (This plant does not benefit us or our animals, it is a total waste)!"



A Didewaride resident displaying *Typha latifolia* (Photo credit: Linda Mbeyu/ICRAF)

During FGDs, land tenure security or lack of it, emerged as a major threat in the three areas. All of them cited land-related conflicts, which was also alluded to by the Assistant County Commissioner, Mr. Elijah Kipterop who noted, “Lamu is a county that has problems with land; if you solve the land issue, you will have solved 70% of the issues in Lamu.”

In Awer, the major issue had to do with lack of titles. Residents felt that the government needed to address the issue of title deeds. In Witu the main land-related conflict is between pastoralists and farmers. Pastoralists feel that the land belongs to them and they have a right to graze their animals, while the farmers feel that the pastoralists are infringing on their land and actually feeding on their hard earned crops. Indeed, so serious is the issue that there is infighting between these communities. On interviewing the Orma members, one man said “...this issue is very serious, it is a ticking time-bomb”. In Witu, while holding the FGD with the women, the women shared horror stories of pastoralists invading their *shambas* (farms) and threatening to come back at night to avenge if the cows are not allowed to feed. Aside from them attacking, they have also threatened to rape them.

Mrs. Tabu Katana narrated how a herdsman got into her *shamba* and as she was warding off the cows she was told, “...acha ng’ombe ikule!”...unajua hii kiboko? (*Leave the cow alone to graze... do you understand this cane?*)” pointing to his manhood. The herdsman was threatening to rape her. Both communities, the Orma and Giriama reported that their youth were being attacked by the other community.

In Mpeketoni, land-related conflicts touch on pastoralist communities and title deed allocation. There is the fear that ‘big shots’ could invade the area and displace the local residents who do not have title deeds. Land tenure remains a big issue in all the three areas. This information is corroborated with the available data which indicates that up to 93% of the population in Awer, 66% in Mpeketoni and 91.7% in Witu do not possess land titles. Lack of title deeds means that the residents live in perpetual uncertainty thus making it challenging for them to make any long-term plans around the land they reside in for biodiversity conservation.

Aside from land conflicts, the FGD in Mpeketoni revealed different responses between men and women. Surprisingly, the men identified increase in population and charcoal burning resulting in reduced tree and water density due to farming along water routes as threats. These have a bearing on the biodiversity of the area. On the other hand, the women in Mpeketoni identified loss of soil fertility and reduced rainfall as challenges. These are in relation to the crops that they grow.

As regards threats that arise from the benefits derived from natural biodiversity, wild animals like snakes limit access to the forest, KWS restriction and insecurity resulting in limited access were identified as the main threats to access of food from nature. In relation to medicine, its unavailability due to its overutilization, distance coupled with KFS restriction, culture and inability to identify the appropriate tree species for a specific ailment were the threats identified. For instance, medicine that was available in the past is difficult to access nowadays and it is the reason why the FGD members were suggesting that only mature trees ought to be harvested; this and encouragement of community members to practise reforestation.

Inability to obtain a permit due to the process and cost involved, high transportation costs due to poor road infrastructure and wild animals were the threats hindering access to construction material from nature, while the threats from energy were related to scarcity

due to overexploitation, expensive permits, KFS restriction and wild animals. Forest degradation and destruction do not factor in any of those that have been identified.

Noteworthy also, is that for all the provisioning services, the issue of LAPSET did not emerge in any of the discussions, both in the FGDs and household interviews, as a threat yet it is recognized that infrastructure developments of such magnitude have challenges such as displacement which may affect the livelihoods of many (Gellert & Lynch 2003).

Looking at the threats, the emergent issue is that the communities herein regard challenges that impact on their farm productivity as important as they have a direct bearing on their livelihood. This is true as majority of the threats identified were to do with crop and animal related challenges. The other main challenge aside from the ecosystem services had to do with land tenure security, an issue cutting across the three areas. The assumption therefore that forest degradation and deforestation are considered as a threat does not hold water. Instead, from the interviews conducted, threats that have a bearing on biodiversity include restriction by authorities that be, that is KWS and KFS and scarcity of the natural resource (forest trees) to access products like medicine.

3.4 Opportunities of biodiversity

In the previous sections we have described the reliance of the three communities on ecosystem services derived from their farms, shops and natural biodiversity. Consequently, the results in this section include opportunities for conservation of forest biodiversity as well as on-farm opportunities.

As regards forest biodiversity, participants in groups and at household level were asked whether they consider collective action as important in managing and conserving the natural resources, whether they are involved in any nature conservation efforts, as well as whether they would wish to participate in a community-based action plan. Table 16 below presents the results from the three areas. These opportunities are geared towards forest biodiversity, with the aim of preventing forest degradation and deforestation.

Table 16: List of opportunities of biodiversity

	Awer	Mpeketoni	Witu
Collective action	100.0	100.0	85.7
Involvement in nature conservation efforts	83.3	100.0	65.7
Participation in community-based action plan	100.0	100.0	100.0

Collective action has to do with individuals voluntarily working together as a group to address a common interest. In Awer and Mpeketoni, 100% of the respondents think that collective action is a way or an opportunity to address environmental problems.

Some of the community members felt that if they came together as a group then it would be easier to address the issue of lack of title deeds, as they would handle it as a block, that the possibility of them being heard by the authorities would be higher. In line with that, all the respondents expressed willingness to participate in generating an action plan to improve the management of natural resources at community level.

In Mpeketoni, every household is involved in tree planting in their farm and they view this effort as contributing towards nature conservation. In Awer, those that are involved in nature conservation talked of planting trees as well as being involved and participating in the Awer conservancy as their way of being involved in nature conservation, while in Witu the 65.7% of households involved in nature conservation talked of planting trees as well as desisting from cutting trees as their effort towards nature conservation. Interestingly, the community members do not perceive conservation of the forests around them as a possible threat to their existence.

When asked whether they would be willing to participate in development of a community-based action plan if called upon, all the respondents expressed their willingness to participate. Aside from the forest-related opportunities, the communities also discussed on-farm opportunities which are outlined as below.

Land tenure security: in all the three communities, as has been earlier established, land tenure continues to be challenging issue. Many expressed that this is an issue that needs to be addressed as it will present a sense of satisfaction and settle the residents; they will be

able to carry on their activities without the fear of being evicted any time; they will practise farming wholeheartedly, build permanent structures for their homes and get involved in other long-term plans.

Infrastructure development: Generally, Lamu County has very poor road infrastructure since independence. It was not until 2016 that the Kenyan President, Mr. Uhuru Kenyatta announced the construction of tarmac road in the area. In Awer, farming is practised but ready market is a challenge as access to the place remains a challenge due to poor road infrastructure. Aside from improving road infrastructure, the community in Witu and Awer were proposing that an electric fence be constructed around the protected areas so as to restrict wild animals, such as baboons, from attacking people's farms hence increase productivity.

Working with authorities: the communities expressed that it might be a good opportunity to engage with the authorities like KFS and KWS so as to agree to what extent the community can derive materials from the forest at a favourable rate, as well as work closely with each other to ensure that both animals and plants are protected.

Links to markets: aside from consuming the food that they grow at household level, all the three communities reported selling the produce that they grow as well. Challenges however include obtaining adequate market for their produce and exploitation resulting in poor prices for their produce. Products that are available for sale include honey in Awer, mangoes in Mpeketoni and green grams in Witu. Some women in Mpeketoni expressed that having a juice factory in the area would be a great opportunity to boost their livelihoods.

Women involvement: taking cognizance that community participation is important, the women felt that it would be of greater benefit to involve them more in decision-making regarding agricultural practices and conservation as they would greatly contribute to increased productivity; besides, they are naturally nurturers!

5.0 CONCLUSION

The study revealed that local communities depend on products from nature, their own farms and from the shops. Communities interviewed depended mostly on their farms for food while honey, game meat, wild fruits and freshwater fish were also mentioned as specific cases of foods sourced from natural biodiversity.

In relation to construction materials, the study revealed that people depend on grass, palm leaves and iron sheets to construct their roofs, while soil and mud was mostly used for their floors and walls, respectively. Wood from natural vegetation is used as cooking energy, particularly by the Awer. The two other communities rely on their farms to source their fuel wood, while lighting energy is mainly derived from the shop for all the three communities.

These results have further gone to show that these communities do not mainly rely on biodiversity to carry out cultural activities such as circumcision, but use them for community building such as to hold community meetings. They also use them for making brooms, mats and baskets.

The study has also revealed a shift in lifestyle from dependence on nature to complementing products derived from nature with those from farms and shops. This is as a result of increased restriction to forest products due to previous policies that prevented communities from harvesting products from nature.

This study has identified both on-farm and forest conservation related opportunities. Since these communities depend on the farms for their livelihoods, links to markets, women involvement and development of infrastructure were identified as some of the farm-based opportunities, while collective action and participation in community-based action planning were seen as opportunities for forest conservation.

6.0 RECOMMENDATIONS

The study provides evidence that biodiversity has a significant effect on the livelihoods of communities in Lamu County and thus there is need to conserve the latter for the benefit of future generations. It was evident that some communities (Awer) who were hunters/gatherers have had to change their lifestyles due to restricted access to timber and non-timber products. In addition, the region's unique biodiversity was noted and documented. From these observations, we propose that first, the Lamu land use planning integrate or mainstream the Lamu biodiversity into its spatial plan to protect the endemic species and those that are facing extinction, for example, *Eurphobia tannensis*. Second, that the policy and decision makers take into consideration the dependence of the local community on the biodiversity and formulate policies which could allow the people to continue harvesting medicine and wood fuel in a sustainable manner. Additional specific recommendations include the following:

- On rural development, it has been established that communities rely on crop-based agriculture for their livelihood. There is need for appropriate extension services to assist in sustainable agriculture enterprise development which is inadequate at the moment. In Awer for instance, the communities reported limited extension services as a challenge.
- Policy related to farming and encroachment should promote increased crop productivity and regulate farming practices in protected areas, hence minimize degradation of biodiversity.
- The policy and decision makers should focus on Participatory Forest Management to allow communities work with other stakeholders to ensure protection and conservation of forest biodiversity.
- Policy and decision makers to promote development of biodiversity-based value chains to promote the socio-economic status of local communities in Lamu County. This will reduce pressure on natural resources and diversify their livelihood sources.
- Stakeholders to fast-track CFA formation to encourage communities adjacent to the forests to participate in its protection.

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ANNEXES

Annex 1: Household questionnaire

Benefits of Biodiversity: Communities' Perspectives in Witu and Awer

Department of Sociology and Social Work, University Of Nairobi

Introduction and consent to participate in research

Hello,

My name is Linda Mbeyu, a student at the University of Nairobi pursuing a Master's degree in Rural Sociology and Community Development. In partnership with the Biodiversity Management in the Horn of Africa project at World Agroforestry Centre (ICRAF), University of Nairobi is conducting research to establish the benefits that people in this area derive from on farm and off farm biodiversity. If you agree to participate in this research, the research will take approximately one hour of your time. Please note that all the answer you provide will be treated with utmost confidentiality and the information/data gathered will be used anonymously and that you are free to interject if you are uncomfortable to answer a given question. Feedback and recommendations from this research will be communicated through the Biodiversity Management in the Horn of Africa project.

I hereby seek consent for your participation in the interview.

SECTION A: INTERVIEW INFORMATION

Questionnaire code:	Sub-county:	
Location:	Village name:	
GPS coordinates: Elevation:	Longitude:	Latitude:
Interview date:	Name of interviewer	Mobile number
Start time:		
End time:		
Name of respondent:	Mobile number:	
Sex of respondent: Male = 1 Female = 2	Age of respondent(years)	

SECTION B: RESPONDENT PROFILE/HOUSEHOLD CHARACTERISTICS/DEMOGRAPHICS

The household head is the ultimate decision maker in a household while household members are those that eat and stay in the same house on a regular basis

1. Relation of respondent to household head 1= Self 2= Spouse 59= Other(<i>specify</i>)				
2. Name of household head		3. Age of household head		
4. Household type ¹ [1] [2] [3] [4] [5]		5a. Main occupation of household head 5b. Main occupation of spouse/respondent		
6. Level of formal education of HH head [1] [2] [3] [4] [5] [6] [7] ²		7. Level of education of spouse [1] [2] [3] [4] [5] [6] [7]		
Household composition(include all members including the respondent) NB: Household members are those that eat and stay in the same house on a regular basis				
8.HH member ID	Name	Sex Male=1 Female=2	Age	Does this member contribute to HH income? 0=No 1=Yes
1.				
2.				
3.				
4.				
5.				
6.				

¹ 1=male-headed monogamous; 2=male-headed polygamous; 3=male-headed single, divorced or widowed; 4=female-headed single, divorced, widowed or deserted; 5=child-headed;

² 1=None; 2=Some primary; 3=Primary finished; 4=Secondary; 5=College; 6=University; 59=Other (Specify)

7.				
8.				
9. Ethnic group (of respondents, and/or HoH:				
10. Migrated to current location? 0= No 1=Yes a. If yes, Where from? when? (year)		11. Reason for moving to this area? ³ [1] [2] [3] [4] [59]		
SECTION C: PHYSICAL ASSET AND ON-FARM PRODUCTION				
12. Do you have a title for this land? 0=No 1=Yes		13. What is the size of the land in acres?		
14. How did you acquire it? 1=Inherited 2=Bought 3=Hired		15. What aspects do you consider in choosing land? (list all)		
16. Please indicate name and quantity of different livestock owned below				
Livestock	1=Cattle	2Goat	3=Sheep	4=Chicken 5=Rabbit
Number				
Possession of HH/farm items				
17. At present, how many of the following list does the HH own that are usable (=not broken):				
	Asset name	Total no. owned	Farming implements 0=Absence 1=Presence (Write Code (0/1) where applicable)	
	Radio		Spade	
	Mobile Phone		Fork Jembe	
	Television		Ladder	
	Bicycle		Wheelbarrow	
	Car/pick up/Lorry		Sickle	
	Motorcycle		Sprayer	

³ 1= Employment 2=Easy access to natural resources 3=Land easily available 4=Referred by a relative 59=Other (specify)

	Ox cart		Hammer					
	Fridge		Manual water pump					
	Gas cooker		Storage shed					
	Paraffin stove		Tarimbo					
	Electric stove/oven		Hoe					
	Water tank		Panga					
	Generator		Tractor					
	Solar panel		Plough					
	Computer		Baskets/crates/cases to store fruits					
	Others		Others					
18.	Source of water (1=Rain, 2=Borehole, 3=Tap, 4=Well, 5=Lake,6=River, 59=Other-specify)							
	Water use	Source of water	Distance (Km)	Distance (min.)				
a.	Drinking water							
b.	Cultivation water							
19. Do you have electricity? 0=No 1=Yes								
If yes please specify whether own connection or shared connection 1=own connection 2= shared connection								
Housing								
20. Number of bedrooms available for HH members?								
21. Wall type of main house construction material:			22. Roof type of main house construction material:		23. Floor type of main house construction material			
	Farm=1	Nature		F=1	N=2		F=1	N=2
1=Mud			1=Grass thatch			1=Bare soil		
2=Wood			2=Iron sheets			2=Stone		
3=Stone/brick			3=Palm leaves			3=Wood		

4=Palm leaves			4=Roofing tiles			4=Floor tiles				
5=Mangrove										
24. What is the main source of income for this household? ⁴			25. Are there additional income generating activities in this household? Please specify							

SECTION D: DIRECT BENEFITS FROM BIODIVERSITY (FOOD PROVISIONING, MEDICINE, ENERGY)					
26. Of the food categories below, please indicate your family consumption in the table below					
Food category	Food	Frequency			
		1=Daily	2=At least once a week	3=At least once a month	4=Only when available
Cereals and cereal products (e.g. maize, spaghetti, rice, bread)	Maize				
	Maize meal				
	Rice				
	Wheat flour				
Milk and milk products (e.g. goat/cow fermented milk, milk powder)?	Milk				
	Fermented milk(maziwa mala)				
Sugar and honey?	Honey				

⁴ 1=Employment [on-farm labour] [off-farm labour]; 2=Sale of farm produce; 3=Sale of products from nature (forest); 4=Remittances; 5=Others (specify)

	Sugar				
Oils/fats (e.g. cooking fat or oil, coconut milk ,butter, ghee, margarine)?	Cooking oil				
	Cooking fat				
	Margarine				
	Coconut milk				
Meat, poultry, offal (e.g. goat, beef; chicken or their products)?	Chicken				
	Beef				
	Goat meat				
	Rabbit meat				
	Game meat				
	Lamb				
Pulses/legumes, nuts (e.g. beans, lentils, green grams, cowpeas; peanut,)?	Beans				
	Green grams				
	Cowpeas				
	Peanuts				
Roots and tubers (e.g. sweet potatoes, cassava, arrowroot Irish potatoes)?	Cassava				
	Arrowroot				
	Sweet potatoes				
Vegetables (e.g. green or leafy vegetables, tomatoes, carrots, onions)?	Mnavu				
	Mkunde				
	Mchicha				
	Sukuma wiki				
	Cabbage				
	Mangoes				

Fruits (<i>e.g. water melons, mangoes, grapes, bananas, lemon</i>)?	Bananas				
	Oranges				
	Cashew				
	Pawpaw				
	Madafu				
	Passion				
	Kunazi				
	Guavas				
	Matomoko				
	Wild fruits(specify)				
Fish and sea foods (<i>e.g. fried/boiled/roasted fish, lobsters</i>)?	Fresh water fish				
	Sea fish				
	Crabs				
	Prawns				

27. Please specify in the table below what you grow on your farm

Food category	Specify food
Cereals(<i>e.g maize</i>)	
Pulses/legumes, nuts (<i>e.g. beans, lentils, green grams, cowpeas; peanut, </i>)?	
Roots and tubers (<i>e.g. sweet potatoes, cassava, arrowroot Irish potatoes</i>)?	
Vegetables (<i>e.g. green or leafy vegetables, tomatoes, carrots, onions</i>)?	
Fruits (<i>e.g. water melons, mangoes, grapes, bananas, lemon</i>)?	

28. How much, on average of what you produce do you use yourself in a season?			

29. Do you sell any of these products from your farm or elsewhere? if yes please specify in table below

Product	Frequency ⁵	Market 1=Local market 2=External market	Amount sold per season/ month
1= Fruits			
2= Vegetables			
3=Honey			
4= Sea food			
5=Herbs			
6= Spices			
7= Milk			
8= Game meat			
9= Charcoal			
10= Pole			
11= Firewood			
12= Timber			

⁵ 1=Daily; 2=Weekly; 3=Monthly; 4=Biannually; 5=Annually

30. What are the main sources of your food?

Food category	Food	Source		
		Farm= 1	Nature/Forest = 2	Shop = 3
Cereals and cereal products (e.g. maize, spaghetti, rice, bread)	Maize			
	Maize meal			
	Rice			
	Wheat flour			
Sugar and honey?	Sugar			
	Honey			
Oils/fats (e.g. cooking fat or oil, coconut milk, butter, ghee, margarine)?	Cooking oil			
	Coconut oil			
	Ghee			
	Castor oil			
Meat, poultry, offal (e.g. goat, beef, wild meat; chicken or their products)?	Chicken			
	Beef			
	Goat meat			
	Rabbit meat			
	Lamb			
	Game meat			
Pulses/legumes, nuts (e.g. beans, lentils, green grams, cowpeas; peanut,)?	Beans			
	Green grams			
	Cowpeas			
	Peanuts			

Roots and tubers (e.g. sweet potatoes, cassava, arrowroot Irish potatoes)?	Cassava			
	Arrow root			
	Sweet potatoes			
Vegetables (e.g. green or leafy vegetables, tomatoes, carrots, onions)?	Mnavu			
	<i>Kunde</i>			
	<i>Mchicha</i>			
	<i>Sukuma wiki</i>			
Fruits (e.g. water melons, mangoes, grapes, bananas, wild fruits/indigenous fruits)	Mangoes			
	Bananas			
	Oranges			
	Cashew			
	Pawpaw			
	<i>Madafu</i>			
	Passion			
	<i>Kunazi</i>			
	<i>Matomoko</i>			
	Guavas			
	Wild fruits (specify)			
Fish and sea foods (e.g. fried/boiled/roasted fish, lobsters)?	Fresh water fish			
	Sea fish			
	Prawns			
	Crabs			

<p>31. Are you allowed to openly collect products from the forest/periphery land? 0=No 1=Yes</p> <p>If no what are the restrictions?</p>	<p>32. Are there specific products that can be found only in the forest/periphery land and not on farm? 0=No 1=Yes</p> <p>If yes which ones?</p>
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Benefits of nature-medicine and energy

33. Do you use traditional medicine? 0=No 1=Yes

If yes how often? 1=Always 2=Sometimes 3=Rarely 4=Never

34. Please specify where you source your cooking and lighting energy?

	Energy type	Own farm=1	Forest/Nature=2	Market/Shop=3
Lighting energy ⁶				
Cooking energy ⁷				

Ailment	Name of medicine	Source of medicine			(If traditional) Description of medicine e.g if leaves, bark, roots, seeds	
		1=F	2=N	3=S		
Headache						
Tooth ache						
Stomach upset						

⁶ 1= Firewood, 2=Torch (battery), 3=Gas, 4=Electricity, 5= Solar, 6=Kerosene, 7=Biogas

⁷ 1=Firewood, 2=Charcoal, 3= Gas, 4= Electricity, 5=Biogas, 6=Kerosene, 7=Solar

Sprains					
Eye problem					
Teething in children					
Body ache					
Ear ache					
Animal sting/bite					
Skin infection					
Other (<i>Specify</i>)					

35. For each of the common ailments below, please specify type of medicine use and where sourced

SECTION E: OPPORTUNITIES AND THREATS TO BIODIVERSITY														
Threats to benefits from biodiversity														
<p>36. Do you face any difficulties sourcing medicine, food, construction material and energy from nature?</p> <p>0=No 1=Yes</p>														
<p>37. If yes, what benefits here below are affected and how?</p> <table border="1"> <thead> <tr> <th>Type of benefit</th> <th>Category</th> <th>Problem narrative</th> </tr> </thead> <tbody> <tr> <td>Foods</td> <td>1=Fruits 2=Vegetables 3=Meat 4=Oil 5=Milk</td> <td></td> </tr> <tr> <td>Medicine</td> <td>1=Herbs 2=Bark 3=Leaves 4=Roots</td> <td></td> </tr> <tr> <td>Construction material</td> <td>1=Wood 2=Palm leaves 3=Mangrove 4=Stone</td> <td></td> </tr> </tbody> </table>			Type of benefit	Category	Problem narrative	Foods	1=Fruits 2=Vegetables 3=Meat 4=Oil 5=Milk		Medicine	1=Herbs 2=Bark 3=Leaves 4=Roots		Construction material	1=Wood 2=Palm leaves 3=Mangrove 4=Stone	
Type of benefit	Category	Problem narrative												
Foods	1=Fruits 2=Vegetables 3=Meat 4=Oil 5=Milk													
Medicine	1=Herbs 2=Bark 3=Leaves 4=Roots													
Construction material	1=Wood 2=Palm leaves 3=Mangrove 4=Stone													

Energy sources	1=Firewood 2=Charcoal 3=Electricity	
38. Are there any land related conflicts in this area?		39. What should be done to address these conflicts?
Opportunities of biodiversity to livelihoods		
40. Do you think collective action helps to address any environmental problems and/or opportunities? 0=No 1=Yes	41. Are you involved in any nature conservation efforts? If yes how?	
42. What in your opinion should be done to ensure there is sustainable use of natural resources?		
43. Would you wish to participate in a community based action plan for improving management of natural resources?		
44. Any comments?		

Thank you for your time

Annex 2: FGD questions

1. What do people in this community use land for?
2. Do people in this community lease out/sell their land?
3. What crops do people grow in their farm?
4. What are the staple foods eaten in this community?
5. What are the fruits commonly obtained in this community? And vegetables?
6. List the type of meat obtained and eaten in this community
7. Where do you obtain all these from?
8. Do people in this community use traditional medicine? Which one(s) for what use?
9. What construction material is used to make the following? Where is it obtained?

Houses

Livestock kraal

Fences

Bee hives

10. What are the three important energy sources for **cooking**? Where are they sourced from?
11. What are the three important energy sources for **lighting**? Where are they sourced from?
12. What cultural services does nature provide?
 - i. Rite of passage
 - ii. Religion and spirituality
 - iii. Aesthetics
 - iv. Recreation and tourism

13. As a community what challenges do you face with nature?
14. Do you address any challenges to do with nature communally?
15. Would you be interested in a community based action plan for improving management of natural resources in future?

Annex 3: Questions for Key Informants

1. Tell me about yourself
2. How long have you lived in this community?
3. How long have you worked in this organization?
4. Tell me about your organization and whom it serves/ its mandate
5. Do you engage with the community in executing your mandate? If so, how?
6. What is the role of regulation service in biodiversity (soil erosion prevention, shade provision)?
7. How do the communities here benefit from ecosystem goods and services?
8. Are there any threats to biodiversity? if yes, which ones?
9. Is land tenure an issue in this area?
10. Is the community here involved in protecting nature/biodiversity? If yes, how?
11. What do you think could be done to encourage more community involvement? By whom?
12. What do you think should be done to ensure sustainable natural resource use?
13. What other institutions addressing biodiversity exist in this area?
16. Would you be interested in a community based action plan for improving management of natural resources in future?
17. Are there any other people that you think we should talk to?

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