JONGOWE ENVIRONMENTAL MANAGEMENT ASSOCIATION (JEMA)

PARTICIPATORY ASSESSMENT OF FLORA AND FAUNA IN TUMBATU JONGOWE VILLAGE, ZANZIBAR TANZANIA

PREPARED BY

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List of acronyms

CEPF	Critical Ecosystem Partnership Fund
GDP	Gross Domestic Product
GPS	Global Positioning System
JEMA	Jongowe Environmental Management Association
PRA	Participatory Rural Appraisal
ZPRP	Zanzibar Poverty Reduction Plan

Acknowledgement

Executive Summary

Jongowe Environmental Management Association (JEMA) did a participatory assessment of their village flora and fauna to understand the status of the forest resources so as to develop appropriate plans for its conservation. The assessment conducted between January and September 2006.

The assessment confirms the village to have immense conservation value and identifies three forest types namely high forest of Mwangoni (69ha), Small forest of Kikokwe (60ha) and Mangrove forest (6ha). In Mangrove forest four species were identified these includes *Ceriops tagal*, *Rhizophora sp*, *Brugiera sp*, and *Sonneratia alba. Ceriops tagal* is the dominant species by 49.3%. In Mwangoni high forest seventeen species identified with Mvuvuru/Mviru being a dominant species by 37.5%. In Small forest of Kikokwe twenty two species with Mkwamba being a dominant species by 21.9%. Some of the species in Small forest are also found in high forest. Species diversity is high as 2.5310 in Kikokwe small forest compared to Mwangoni which is 2.1584 and 1.0207 of Mangrove forests respectively. The assessment found also the forest vegetation to harbours ten taxa groups (arthropods and Mulluscs) and its diversity index is 2.19. The diversity index of the taxa groups is high in 2.16 small forest; 2.07 in cultivated land and 1.5 in high forest which is low.

The forest found to harbours wild animals such as Blue duikers, Tree hyrax and monkeys. More duikers are found in Small forest while tree hyrax is well distributed in the forest vegetation especially at the edges, where cock formation provide habitat for them. About 25 birds's species was found both at terrestrial and marine; some of which have migratory characteristics.

On the forest product utilization, firewood is ranked first, withies (fito) the second and the third ranked forest product is pole (boriti). The villages' species prioritization indicates no single tree species has one use except Mpepe which is preferred for firewood, while other species, for instance Mkwamba is used as firewood, medicine and fodder and Mzimya is used for beekeeping and making tool handles and boat ribs.

Efforts to conserve the remaining patches of Jongowe forest need to be strengthened through implementation of proposed programs such tree planting, agroforestry, beekeeping, some studies related to economic values of non-wood forest products and development of forest resource management plan for the village.

The assessment was timely done and explored information which are important for future participatory management of Jongowe proposed forest reserve. Since the community has agreed to upgrade the forest into village forest reserve, it is necessary then to join their efforts and work together to ensure forest resources are perpetuated.

Participatory Assessment of Flora and Fauna at Tumbatu Jongowe Village, Zanzibar Tanzania

1.0 Background: Zanzibar aspect

1.1 Geographical and Population

The "Spice Island" of Zanzibar, Unguja and Pemba, (fig 1.) are situated slightly north of Dar es Salaam about forty kilometres off the East African coast with a total area of about 2,643 square kilometers. Unguja, the larger of the two Islands, comprised 1,658 square kilometers and Pemba about 985 square kilometers (UN: 2001). Pemba lies about 50 kilometres north-east of Unguja Island. Apart from Unguja and Pemba Islands, there are other 30 small islands and islets surrounding the Zanzibar territory; some of which also inhabited like, Tumbatu, Kisiwa Panza, Makoongwe, Kojani, Uzi etc. The Zanzibar islands are renowned as the former centre of the Arab slave trade, and form a country on their own in terms of culture, religion and inhabitants.

The majority of population is Muslims and, like in Tanzania, Kiswahili is spoken language. Zanzibar has a population, according to the 2002 census (www.tanzania.go.tz), of 9894,652 people, with almost 63% (622,459) living in Unguja and 37% (362,166) in Pemba.
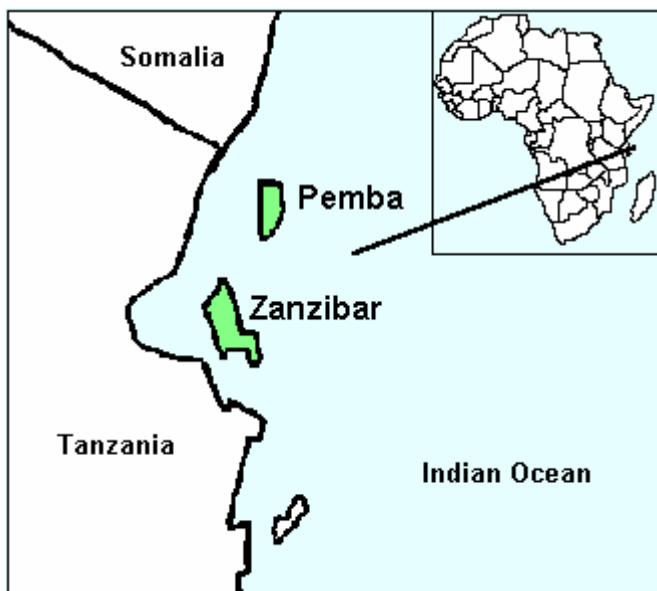
Figure 1: Map showing Zanzibar Islands

Source: www.dewani.ca/zanzibar7.htm

1.2 Economy

Zanzibar's economy is highly dependent on the agricultural sector, and according to the Agricultural Sector review (1999:1) it contributes to 75% of foreign exchange earnings, employs approximately 60% of the labour force and provides 30% of all tax revenues. The

production and export of cloves provide the major source of revenue. The agriculture sector contributes to 40% of Zanzibar's GDP. This contribution has declined from 34% in the 1990s due to the increase in contribution on income fro trade and tourism (21%) and administrative services (23%) in 2001. (ZPRP Progress Report 2002/2003:7) (cited in Household Economy Analysis for Zanzibar, 2003)

2.0 Introduction

Global biodiversity (includes both genetic and ecosystem diversity) is decreasing due to human influence (Sutherland, 2000). Forest habitats are disappearing, taking the gene pools they harbour with them, along with refuge and sustenance they provide to numerous species.

Certain areas in the world are especially diverse and they support high numbers of endemic species due to various reasons such as latitude and level of isolation, placing them under classification of global 'hotspots'. One of this hotspot is found in East Africa in the Northern Zanzibar-Inhambane Coastal Forest Mosaic, where densities of plant species are among the highest in the world. It is estimated that there 4,000 plant species of which 1,500 (35%) are endemic. They also support wide fauna diversity (Additon, 2004).

However, much of the knowledge is lacking in the ecology of these coastal forest especially on the island off the coast, since not many studies have been done, and many species remain unidentified (McClanaham, 1996).

Participatory assessment of flora and fauna of Tumbatu Jongowe villages are necessary in order to explore the status of biodiversity therein so as to effective management and conservation for forest resources of the area. This assessment is commissioned by Jongowe Environmental Management Association (JEMA) that secured fund from CEPF to conduct such exercise.

2.1 General Objective

The assessments is aiming at finding the forest condition, resources available, and its uses and use this information to develop management plan for the forest

2.2 Specific objectives

The study critically examined the following
- Forest boundary demarcation
- Forest product utilization by village community, species preference and estimation of demand of forest product based on the current use and what is available in the forest.
- Vegetation analysis and identification of the most important tree spices based on various uses by local community
- Faunal resource inventory that include small mammals, avifauna, and invertebrates

3.0 Methodology and Materials

3.1   Methods

3.1.1   Field Reconnaissance

This involved the visit of the village and the forest. Conduct meeting with JEMA committee members, members of village council (Shehia) and members of traditional council of the village. Here the PFRA team address the objectives of the assessment and asked for the support from local community to complete the task with success.

3.1.2   Forest boundary demarcation

The forest boundary was surveyed using Global Positioning System (GPS) and tape measure and also compass. The edge of the cultivated land at Mwangoni area was taken as the boundary of the forest so as to separate the forest and cultivation area. The road that dissected high forest of Mwangoni and small forest of Kikokwe has used to be boundary between these two forest vegetation. The GPS points were processed using computer to delineate the boundary and getting the area.

3.1.3   Tools for Participatory Rural Appraisal

3.1.3.1   Ranking

This was done in the estimation of the forest product utilization and ranking, and quantity needed by the village members. Two groups of women and men were gathered separately in the classroom and discussed with facilitation of forest experts. Each member was given a chance to give out her/his idea and opinion and suggestion without any interruptions from either experts or themselves.

3.1.4   Vegetation sampling method

Systematic sampling was used in vegetation analysis. Transect lines were laid in the forest base map and Sample plots were allocated along the transect line. The road which dissected the higher forest of Mwangoni and small forest of Kikokwe was used as boundary between these forests. Based on the size of the total forest area, a sampling intensity of 1.5 % was used to get sample plots will then distributed to different vegetation characteristics. Each plot had and area of 0.04ha. In each sample plot, trees with diameter from 2 cm and above were measured.

3.1.5   Faunal sampling method

3.1.5.1   Small mammals and Birds

A point was established at a distance of 50 m from the edge of the forest where from this point a line transect was established having a distance of 1,300 m long and a width of 20 m. This transect used to assess faunal at higher forest of Mwangoni and back transect of 1,500 was established assess the faunal species of small forest of Kikokwe. The bearing for the

higher forest was 180° North West and back bearing which was used for small forest was 360°

All animal's species found within transect were identified and recorded. A part from direct observation, the faucal found along transect was counted and identified. This means that both direct observation and faucal methods were used. Animal call was also used to identify them through their vocalizations.

For the case of bird species, random sampling blocks were established at the upper land. Three plots were deployed with maximum length of 300metres square. All birds found within the sample block were identified and recorded. This was mainly for terrestrial birds. Marine bird species was involving walking along the beach for identification and recording all birds that are found in the area. The exercise was mainly conducted during the low tide when many birds are feeding to the inter-tidal zone and also easy the accessibility to the area.

3.1.5.2   Arthropods

The method used to assess the arthropods and particularly the order of Lepidoptera (Butterflies) was sweep netting along the road which was used a transect line. Point samples was established at every 200m and about 10 minutes was spent at each point. Other arthropods were assessed using pitfall traps located at cultivated land, small and higher forest areas. At each site, twelve plastics cans were laid at a distance of two metres each. Sutherland (1996) says in order for catches in individual pitfall traps to be independent of each other, as a rule of thumb, traps should be set a least two metres a part. Few drops of mixture of formalin were put into each can. The layout of the pitfall traps is as follows.
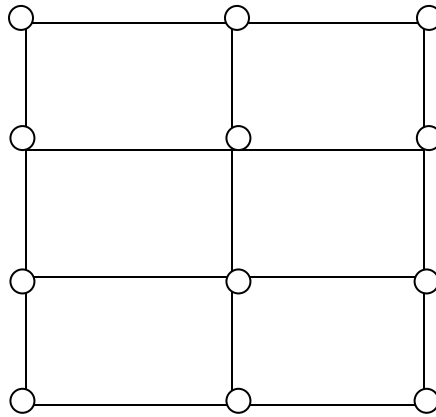
The Shannon Diversity Index was used to further quantify the diversity, it takes into account species richness and number of individuals in a sampled plot raveling the evenness of the diversity. The equation assumes that all individuals are randomly sampled from the infinity large population and all species from community are included in the sample. The equation is (Krebs, 1999):

$$\text{Diversity } H' = \sum_{i=1}^{S} (pi)(\ln pi)$$

Where: H'   = Shannon Weiner Diversity Index
           S   = Total Number of species in the community (i.e. the richness)

$$Pi \quad = \text{Is the proportion of individuals that each species contributes}$$
$$\text{to the total in the sample on a scale of (0-1)}$$
$$lnpi \quad = \text{Natural logarithm of pi}$$

3.1.5.3   Reptiles

Reptiles were assessed using scan method, where piles of stones, logs and around the trees searched for reptiles' existence.

3.2   Materials

The assessment used the following tools and materials

- Note books
- Pen
- Pencils
- GPS
- Digital Camera
- Flip charts
- Marker pen

- Sunto Compass
- Compass bearing
- Plastic cans
- 10% mixture of Formalin
- Tape measure
- Mammals and Bird field guide books

3.3 Limitations

Only rainfall experienced during the assessment. Nevertheless, was not considered as big issues to limit the entire program.

3.4 Study Area

3.4.1   Location

Geographically, Tumbatu Island is situated at north-west of Unguja Main Island about 3 km form Mkokotoni local port (fig 2). It is one among few inhabited Islands around the Islands of Zanzibar. The Island is occupying about 39kmsq (2.5km wide and 15.5km long). The climate is hot and humid with temperature ranging between 20° C to 40° C. The Island experience two rain seasons the Masika rainfall which is the heavy rain that occurs during March to May and the Vuli which is short rain season that occurs during the end of October to December.

3.4.2   Administrative and Population

Administratively, Tumbatu is divided into two parts, Gomani and Jongowe Shehias. Jongowe, which is the study area, is the village that occurs south of island. The village had a total population of about 2,667; of which in 1,498 are women and 1,198 are men. The village has about 561 households (Population and Housing Census, 2002)

3.4.3   Accessibility

The Island is served by several boats using sail and engines. The estimated time to cross the Mkokotoni/Tumbatu channel is about 30-40 minutes boat ride. Within the village there is

only one main road connecting two main villages – Jongowe and Kichangani. The estimated length is 12 km. The island has no vehicle and bicycle considered the major and fast land transportation facility.

Figure 2: Map of Zanzibar showing the Tumbatu Island

Source: www.dewani.ca/zanzibar7.htm

3.4.4 Social and Cultural heritage

In Tumbatu, the Islamic religion influence is the strongest as a result of 99 percent of the inhabitants are Muslims associated with the early contact with Arab countries; and Islamic cultures play an important role in shaping the people's mode of life and expiration. The remnants of old mosque called Masjid al Jami (plate 1 and 2) believed to be the first largest in East Africa is among cultural heritage of Tumbatu. Other includes remnants of old foundation of Palace known as Kikokwe and walls of building built by Belgians that were used as an Office (not photographed).

Plate 1: Main part of Old Mosque at Tumbatu Jongowe and Extension of main mosques

The village has three main Mosques that are used and Islamic madrassats which provide elementary and advance Islamic knowledge for children. The community pays due attention to all Islamic celebration such as the Holy Month of Ramadhan, Eid – Alhaj and Eid –el-Fitri, and the Birth of Prophet Mohammad (S.A.W)

3.4.5   Economic Production Sectors

Fishing is major economic base of the village performed locally by the male population. Women are mostly engaged into agricultural activities and other various domestic related

functions. The most common agricultural practices in the village are shifting cultivation. The main crops produced include cassava, banana and beans family. Shifting cultivation is very serious problems in the island hence it involving killing the indigenous flora and fauna. Tumbatu is coral rag land with poor soil fertility and patches of soil in few areas.

Plate 2: A Cassava farm plot

4.0 Results and Discussion

4.1 Forest Boundary Demarcation

The forest of Jongowe Village has an area of 135 ha categorized into three major areas (1) High forest of Mwangoni (60 ha) (2) Small forest of Kikokwe (69 ha) and (3) Mangrove forest (6 ha). The forest is of coral rag type with stone outcrops especially at Mwangoni high forest. The Jongowe forest is bordered by cultivated land at the south, Kichangani village at the north and west and Indian Ocean at the east and west. The fig. 3 below is a map of the forest.

Plate 3: PFFA Team at work

4.2 Forest Product Utilization

4.2.1 Village Forest Products Preferences

Through PRA processes done with village members, the PFRA team with village community finds out the forest products which are most important for villagers either for domestic or for commercial use. This exercise helped the PFRA team to concentrate on the most important species for the villagers during the field assessment. The task was done based on two Participatory Rural Appraisal (PRA); (1) Forest Product Ranking and (2) Tree Species Prioritization. The results revealed that, firewood is the most important forest product for the Jongowe villagers, with a score of 33. Other important forest products include withies (26), poles – boriti (24), pole – nguzo (23), tree for traps (23) and herbal medicine (23). The table 1 below shows the score which is the results of forest products ranking. The forest product ranking exercise is attached to this document as appendix 1. The results of forest product ranking have been used in tree species prioritization exercise in 4.1.2 below.

4.2.2 Village Tree Species Prioritization

The PFRA team with village community conducted species prioritization matrix and identify the most preferred tree species against a particular forest product. Results show that, Mpepe is only used for firewood, while other species, for instance Mkwamba is used as firewood, medicine and fodder and Mzimya is used for beekeeping and making tool handles. Table 2 in page 9 is a summary which shows the preferred products against species. The result of the matrix is attached to this report as appendix 1. This result has been the focus of PFRA team during the assessment and has been used during the management plan development. It is worth noting that, in the course of ranking and prioritization, it happened to have disagreement within the group of women and men themselves. At that situation, voting was used to find the solution, as seen below in picture plate 5 showing women group voting while men group follow up the ranking exercise.

Figure 3: Map showing Tumbatu Proposed Forest Reserve

KEY.

PROPOSED

Mwangoni High Forest
Kikokwe Small Forest
Mangrove Forest
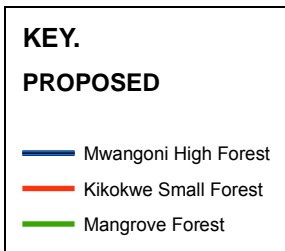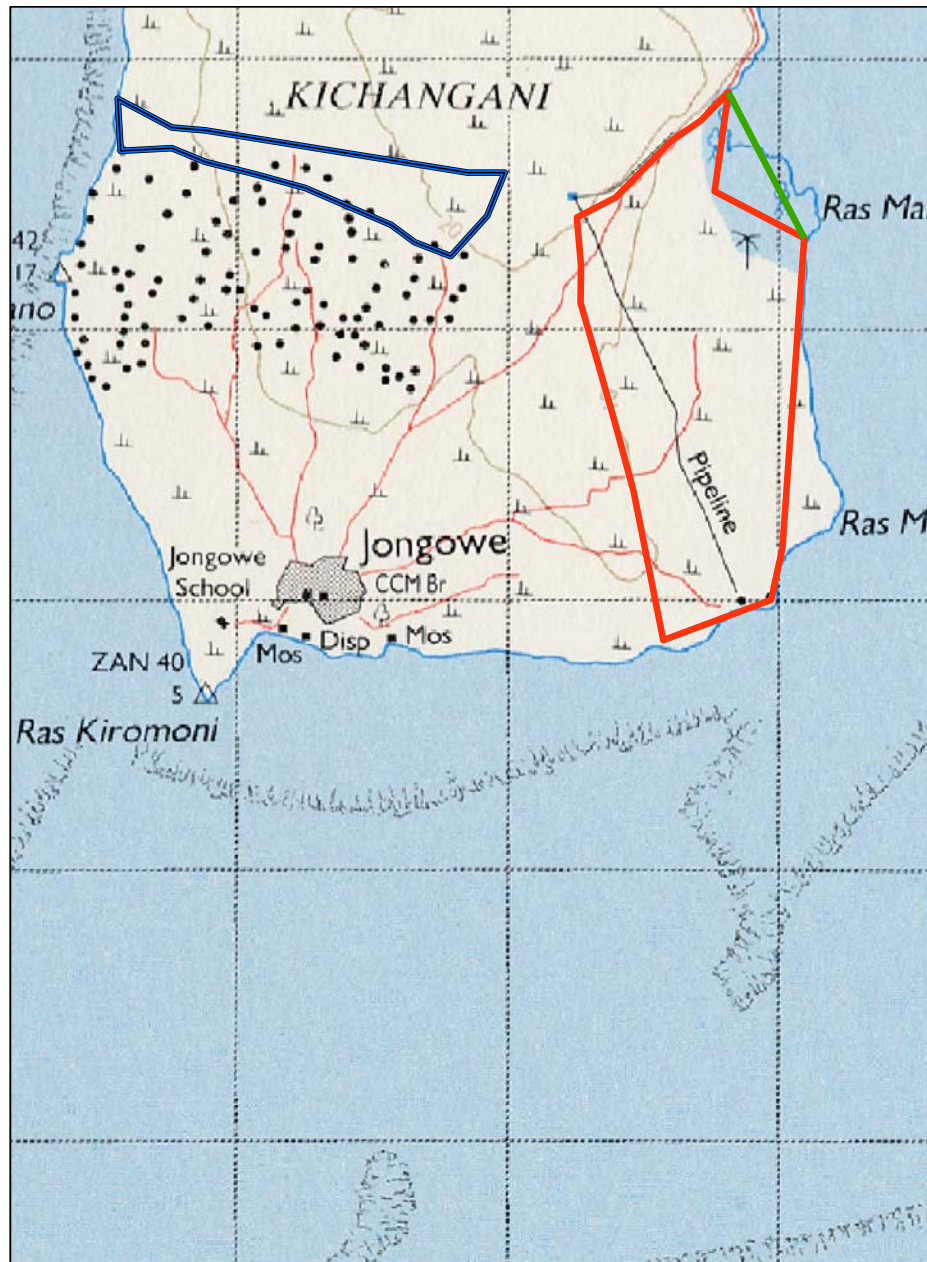
Source: Field Work (2006)

Table 1: Village Forest Products Ranking

No	Type of Forest Product	Score	Ranking
1	Firewood (kuni)	33	1st
2	Withies (fito)	26	2nd
3	Pole (boriti)	24	3rd
3	Pole (Nguzo)	23	4th
5	Tree for traps (Miti ya Madema)	23	5th
6	Herbal medicine (miti ya Madawa)	23	6th
7	Fodder (Malisho)	23	7th
8	Bed legs (Matendegu)	19	8th
9	Honey (asali)	19	9th
10	Boat ribs (Mataruma)	17	10th
11	Handles (mipini)	17	11th
12	Spice trees (miti ya viungo)	15	12th
13	Wild fruits (Matunda Mwitu)	12	13th
14	Wildlife (Wanyamapori)	10	14th
15	Wild rope (Kamba)	9	15th
16	Liwa	7	16th
17	lime (Chokaa)	3	17th
18	Sacred water points (Panga za maji)	3	18th
19	Sacred areas (Sehemu za jadi)	0	19th

*Plate 4: Women exercise voting to decide on the important product for them, while **Men** group follow up ranking during forest product ranking exercise.*

Table 2: Summary of the Species Prioritization Matrix against forest product

Forest Products against tree species	Level of tree species preference	Availability
Firewood (kuni) • Mpepe • Mkwamba • Mtumbika • Mchengelevu • Mlachole • Mchofu • Mbunduki • Mkaaga	Most preferred	Abundant
Fodder (malisho) • Ukoka • Mkwamba	Most preferred	Abundant
Miti ya Madema • Mchofu • Mtarawanda • Mtumbika	Most preferred	Abundant
• Muwazi • Mtapo	Most preferred	Rare/Limited
Miti ya Madawa (herbs) • Mtumbika • Mkwamba • Muyumbuzi • Mnwa • Muwakikali • Mchakuzi • Mpindambavu	Most preferred	Abundant
• Kishinda wakuu • Mpachu • Mcheka na Nyika • Mzimya • Mdimu msitu • Mpapura • Mwango	Most preferred	
Miti ya Mataruma (boat ribs) • Mzimya • Mtunda ngo'mbe • Mkarati • Mkungupwa • Mvururu	Most preferred	Abundant

• Mvunja shoka	Most preferred	Rare/Limited
• Mpilivili		
Miti ya Matendegu		
• Mzimya	Most preferred	Abundant
• Mtopetope		
Mipini (handles)		
• Mtopetope		
• Mfuru	Most preferred	Limited
• Mgongo		
Withies (fito)		
• Mfyodo		
• Mchengelevu	Most preferred	Limited
• Mjoma		
• Mchoko	Most preferred	Abundant
Wanyamapori (wildlife)		
• Paa		
• Kanga		
• Kororo	Most preferred	Limited
• Pelele		
Kamba (rope)		
• Mbibi kuyu		
• Kisisi		
• Mchochoni	Most Preferred	Abundant
• Mfyoo		
• Mwengele		
• Mlimo		
Liwa (Sandalwood)		
• Mliwa	Most Preferred	Limited
• Msiliza		
Chokaa (lime making)		
• Mumbu	Most Preferred	Abundant
• Mzimia		
• Mkole	Most Preferred	Very limited
• Mg'ong'o		

Note: The Scientific names tree species are in presented in appendix 4.

4.2.3 Quantity Villagers' Forest Products Requirements

The PFRA Team used forest product utilization matrix to find the quantity of forest product requirements by village community. Results show that, all village members require various forest products for different purposes and or uses. Firewood is highly required by all households as a major source of cooking and heating energy in the village. The availability of firewood is challenging the future conservation efforts of Jongowe forest. Much effort is needed to ensure the firewood availability at the village so as to safe guard the remnants of

the Jongowe natural forest. The annual households' forest products requirements are shown in the 3 below.

Jongowe forest supports about 90% of all population in providing wood materials for domestic energy, construction poles and materials for dhow construction. Wood resources at this village are of great importance as they produced 100% of total demand for fuel wood and building materials. A part from wood as tangible products from the forest it also provides variety of non-wood products such as medicinal plats, rope, wild fruit and handcraft materials. So far there is no research or study which had been carried out to determine the potential economic value of non-wood forest product in Tumbatu Jongowe.

Table 3: Forest Product Utilization Matrix

Village name	Tumbatu Jongowe	
Number of Households	561	
Forest Product	**Annual household requirement/need**	**No. of households using the product or "all"**
Firewood	3,600 head loads of firewood	All
Trees for trap making (Madema)	600 traps (madema)	20
Herbal medicine	Not measures	All
Trees for boat ribs	480 pieces of logs	12
Bed legs (Matendegu)	60 trees for making bed legs	All
Wild animal	50 wild animals	5
Handle	70 handles	All
Withies	200 loads of withies each with 50 pieces	All
Fodder	Not measures	8

There is huge economic potential of fruits from *Adonsonia digitata* (Baobab tree or Monkey breed) which is now marketable in town. Large quantity of the Baobab fruits is imported from Mainland Tanzania. Effort to utilize this potential should be part of the management and utilization of Jongowe's forest resources

4.3   Vegetation survey/analysis

The forest vegetation of Jongowe Village can be categorized into three major types:
1. High forest of Mwangoni (60 ha)
2. Small forest of Kikokwe (63 ha)
3. Mangrove forest (6)

4.4.1 High forest of Mwangoni

High forest of Mwangoni (60 ha) has conservation values and community has decided to conserve it due to its potentiality. It has secondary forest vegetation, yet endowed with good flora representation. Based on the sample intensity of 1.5% the total area survey is 1 ha with 20 sample plots. Assessment shows that, the forest has 269 trees (2cm to 17cm diameter) per hector. Tree distribution based on the diameter classes is shown in the figure 4 below.

Figure 4: Distribution of Tree based on diameter class/ha in high forest
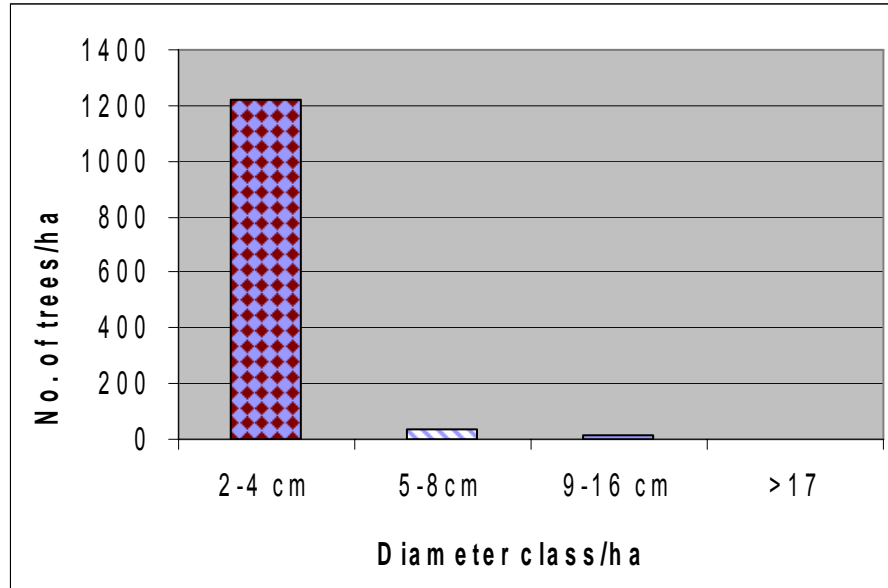
Source: Field work (2006)

The figure 5 above shows very lower number of higher diameter trees, indicating significant wood harvesting in the past and before attempt to conserve the area being initiated. The data also reveals the most wood available in higher forest is small size (i.e. 2-4cm diameter) which can only be used as withies (Fito). Field observation witnesses the remnants of cultivated crops such as Cassava, banana and pigeon piece which also proves the use of the forest for food crops production. Cutting was also observed and estimated that cutting intensity is 209 stems per hector. Conservation efforts shown by the village community is worthwhile and must be supported to ensure the growth of the forest.

Species distribution analysis in high forest shows Mvuvuru/Mviru is relatively well distributed with 37.5% followed by Mfyodo/Haung'ong'wa with 12.3%. Other species narrow distribution ranging from 0.4% to 7%. The figure 5 below represents species distribution in percentage for high forest.

Figure 5: Species Distribution in high forest
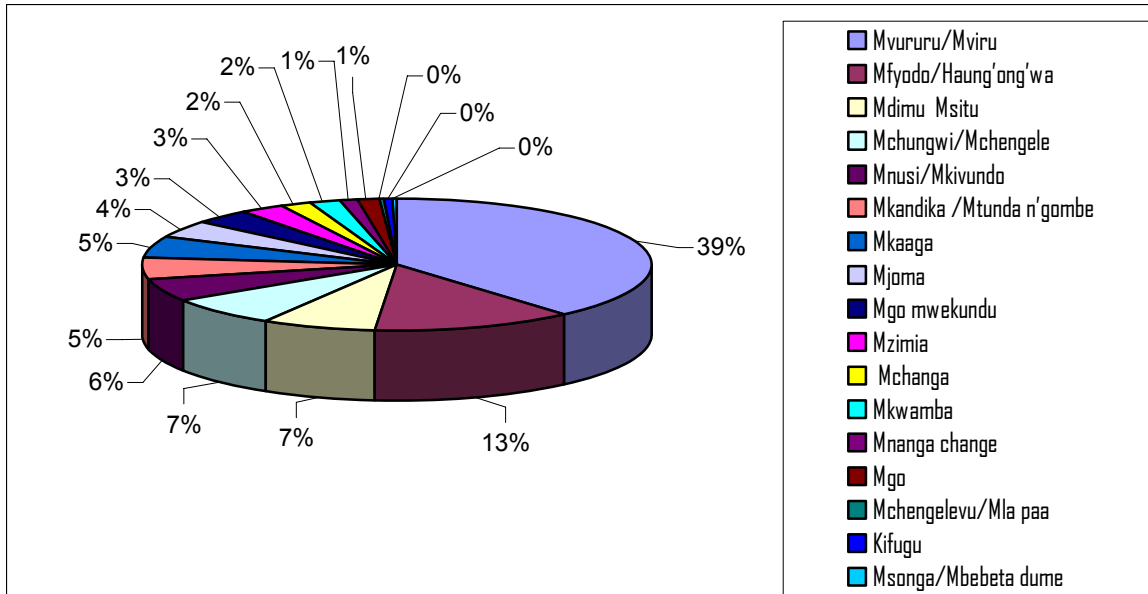
Source: Fieldwork (2006)

4.4.2   Small Forest of Kikokwe

The small forest of Kikokwe area is bordered by high forest by the west, mangrove forest by the east and cultivation area to the south. The forest is less canopy and shifting cultivation experienced in the last ten to twelve years (Mr. Hassan pers. comm. 2006). Other activities, which currently practiced includes grazing, hunting and wood cutting, though the extent and level is relatively small. Figure 5 illustrate species distribution in the high forest of Mwangoni

Based on the sample intensity of 1.5% the total area survey is 1.04 ha with 20 sample plots. Assessment shows that, the forest has 205 trees (2cm to 17cm diameter) per hector. If compared to Mwangoni this forest is less stocked. The cutting intensity in this forest is lower, that is 78 stems per hector.
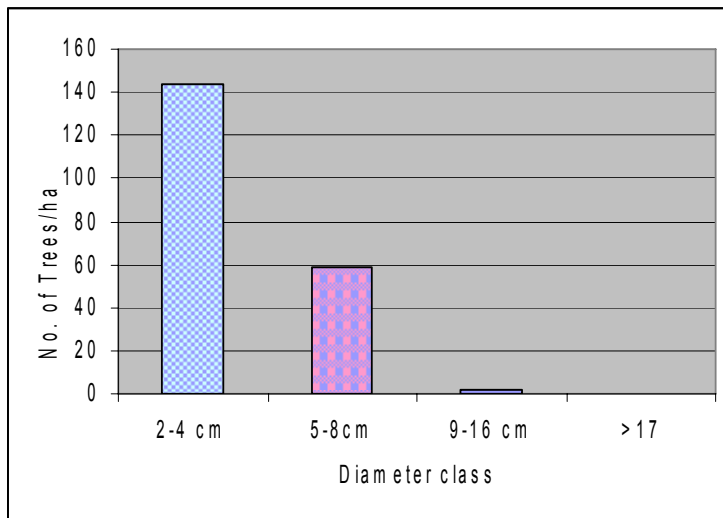
Tree distribution based on the diameter classes as shown in the figure 6 indicating higher number of small sized poles (2 – 4 cm) as in higher forest. As mentioned earlier this could the result of shifting cultivation practiced in the area in the past years.

Figure 6: Distribution of Diameter class in small forest

Source: Field work (2006)

The species distribution in this forest indicates Mkwamba with high distribution of 21.3%, Mkonge with 19% and Mpingaume 7.3 %. Other species in this forest have low distribution as shown in the figure 7 below.

Figure 7: Species Distribution in Small forest of Kikokwe
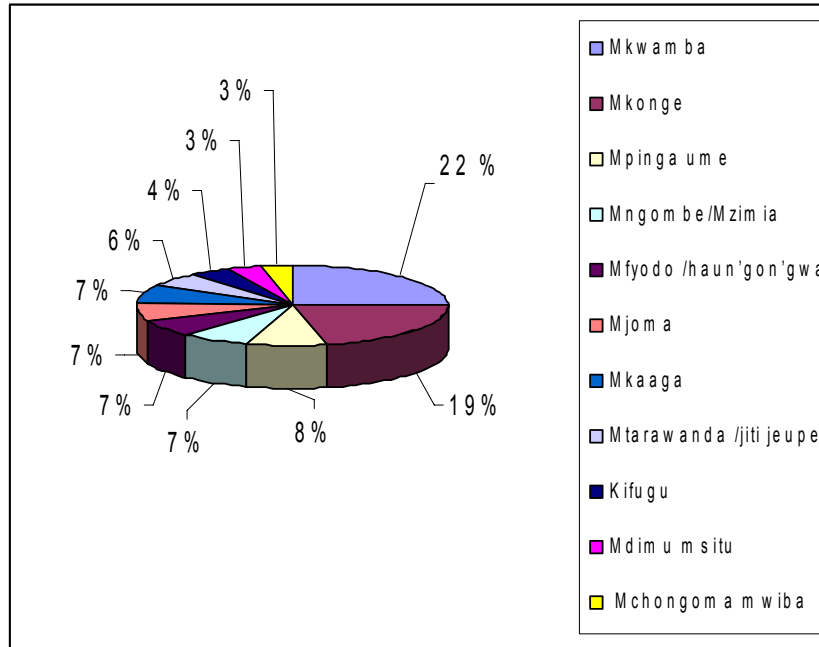
4.4.3 Mangrove Forest

Mangrove area is touched with Small forest of Kikokwe area. This is just a patch of 6 ha east of Kikokwe to Indian Ocean. The area is composed with common mangrove species found in Zanzibar, namely Ceriops tagal (Mkandaa Mwekundu), *Rhizophora stylosa* (Gondi) *Brugiera gymnorhiza* (Mui) and *Sonneratia alba* (Mliana). Based on the sample intensity of 1.5% Mangrove shows being well stocked with 1,500 tree per hector compared to the coral rag forest areas although the diameter range is as them. Diameter distribution in mangrove forest shows that, small sized trees are relatively high as other two coral rag forests (figure 8 below). Both three forest types show low number of big sized trees.
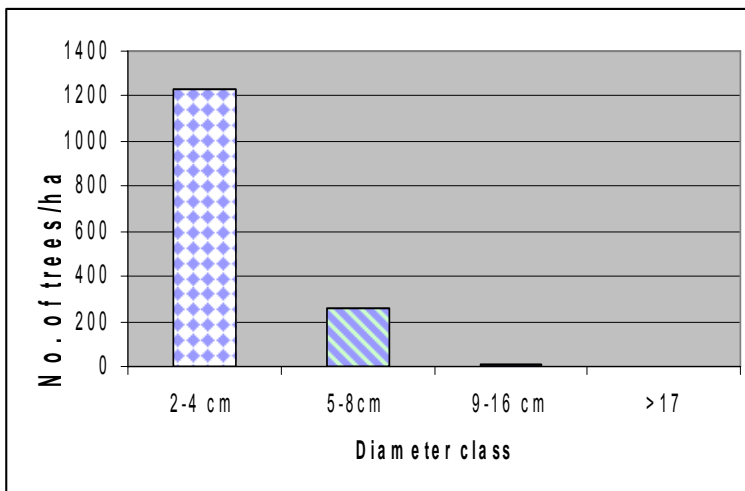
Figure 8: Distribution of Mangrove tree in diameter class

Source: Field work (2006)

The distribution analysis of mangrove species show *Ceriops tagal* (Mkandaa mwekundu) is the most dominant species with 49.3%, Rhizophora spp (Gondi) is the second with 38%. The third is *Brugiera spp* (Mui) with 11.3 and the last is *Sonneratia alba* (Mliana) with only 1.3%. On the uses point of view, Ceripos tagal (Mkandaa mwekundu), is mostly preferred, followed by *Brugiera spp* (Mui) and the *Sonneratia alba* (Mliana). Figure 9 below shows mangrove distribution in percentage. Mangrove planting especially *Ceriops tagal* and *Rhizophora* must be encouraged because its cutting intensity is significant high about 550 stems per hector and do not couple with regeneration capacity. This rate is low compared to Unguja Ukuu mangrove forest which is 770 stems per hectare (Shunula 1990, cited in Tamrini (2001)
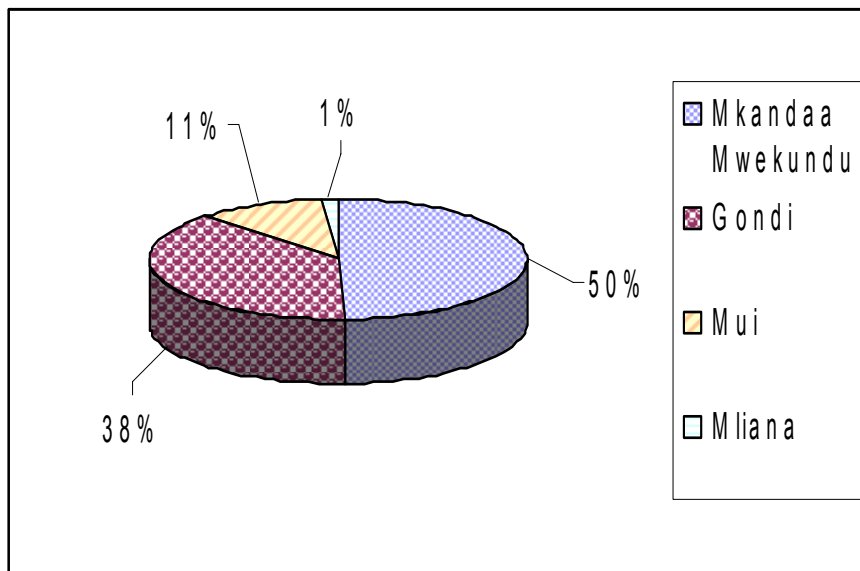
Figure 9: Distribution of Mangrove species in %

Source: Fieldwork (2006)

Generally, it is revealed that, the forest of Tumbatu Jongowe contain some tree species which are semi reared and semi endemic. These include Markhamia zanzibarica (Mtarawanda/Jiti jeupe) and *Vengurus infausta* (Mvuvuru/Mviru) and Mpilivili respectively. The *M. zanzibarica* has been recorded only in Jozani National Park and *V. infausta* only recorded in Uzi Island, Zanzibar. Our grandfathers and mothers used to utilize the *Markhamis spp* (Mtarawanda) in making shoes in addition to traditional medicine.

The species diversity calculations for the three types of forest vegetation show good species richness in Kikokwe forest with species diversity index of 2.6248. The Mwangoni forest is low with species diversity index of 1.9506 and that of mangrove forest as 1.0506 respectively. Table 4 below summarized the results of species diversity and appendix 9 shows the diversity index calculations for each vegetation group.

Table 4: Summarized species diversity values for three vegetation types of Jongowe forest

	Mwangoni Forest (High forest)	Kikokwe Forest (Small forest)	Mangrove	Total
# of plots	20	20	5	45
# of Individuals	206	165	320	691
Shannon Diversity Index (H' = -∑(pi) (lnpi)	1.9506	2.6249	1.0506	

4.5   Faunal Assessment

4.5.1   Avifauna

Bird's assessment was done in four blocks namely; small forest, cultivated land residential areas and offshore. In all four blocks about 25 bird species were identified with 210 individuals recorded. Out of that, 13 species were identified at aquatic (marine) with 89 Individuals and 13 species identified in terrestrial vegetation with 121 individuals and only one species Cattle egret (*Ardeola ibis*) identified in both terrestrial and marine habitats. Table 5 below show the list of bird species identified in aquatic and terrestrial habitats. Species marked with * indicates the migratory birds from Palaearctic while those marked with ** shows the intra-migratory bird species which normally found within Africa and sometimes is considered migratory from Europe and non marked species are considered resident species. The abundance of bird species was more in small forest and cultivated land because of the easy access to food.

Table 5: List of Birds species and their habitat

No	Common Name	Scientific Name	Habitat	
			Aquatic	**Terrestrial**
1.	Bee eater**?	*Merops sp*		✓
2.	White browed coucal	*Centropus superciliosus*		✓
3.	Zanzibar sombre greenbul	*Andropadus importunus*		✓
4.	Red eyed dove	*Streptopelia semitorqata*		✓
5.	Mannikin sp	*Spermestes sp*		✓
6.	Cisticola sp	*Cisticola sp*		✓
7.	Golden weaver	*Ploceus xanthops*		✓
8.	Cattle egret	*Ardeola ibis*	✓	✓
9.	Tropical boubuo	*Laniarius aethiopicus*		✓
10.	Striped swallow	*Hirundo abyssinica*		✓
11.	Green backed heron	*Butorides striatus*	✓	
12.	Whimbrel*	*Numenius phaeopus*	✓	
13.	Common sandpiper*	*Actitis hypoleucos*	✓	
14.	Greenshank*	*Tringa nebularia*	✓	
15.	Little egret	*Egretta garzetta*	✓	
16.	Dimorphic	*Egretta dimorpha*	✓	
17.	Turnstones*	*Arenaria interpres*	✓	

No	Common Name	Scientific Name	Habitat	
			Aquatic	Terrestrial
18.	Grey plover*	*Pluvialis squatarola*	✓	
19	Crab plover*	*Dromas ardeola*	✓	
20.	Grey heron	*Ardea cinerea*	✓	
21.	Mash sandpiper*	*Tringa stagnatilis*	✓	
22.	Starling sp**	*Lamprotornis sp*		✓
23.	Bronze sunbird	*Nectarinia kilimensis*		✓
24.	Scarlet-chested sunbird	*Nectarinia senegalensis*		✓
25.	Lesser crested tern	*Sterna benghalensis*	✓	

4.5.2   Small Mammals and Reptiles

Assessment shows low diversity of small mammals in Tumbatu forest vegetation. Seven small mammals' species were recorded being available in the forest. These are Sykes monkeys, Tree hyrax and Blue duikers. Others are presented in table 5. Blue duiker was found dead in the forest few metres for the transect line. The animal identified to be adult female and at the death scene there was no sing of fighting. The reasons could be a natural death or hunted by snare and found already dead by hunter and left in the forest.

During forest products ranking and preference, it was revealed that, some duikers could be found dead at the trap scene because of the hunters' delay in monitoring his traps.

Plate 5: A dead Blue duiker at the Small Forest of Kikokwe

In a small forest the abundance is quite good than in high forest and could be because of the food availability About 30 points of pallets were seen along the transect line. Tree hyrax was mostly observed through pallets in high forest than in small forest. However during scan search for reptiles along the sea shore one adult male was found dead. It was believed to be in the crevasses of rock close to offshore and failed to timely move out when sea water entering to the crevasses. Only two groups of monkey were identified at the high forest with about 10-15 individuals.

Community at Tumbatu village believed to have high abundance of monkeys in their village and raid crops significantly, although during assessment the team failed to observe them in large numbers. Attempts are underway to reduce the number of black monkeys which is a pest as far as agricultural production is concerned and there is special national wide campaign to control vermin including wild pigs which is not available at Tumbatu village. List of small animals identified during field assessment are shown in table 6. Reptiles which are considered secretive animals were not seen at Tumbatu during field assessment. Table 7 below shows list of mostly known reptiles and other mammals identified by community through individual village member interviews and believed to be found in the forest and marine areas.

Plate 6: A hip of Tree Hyrax pallet (dotted red cycle) under the tree

Table 6: List of Small Mammals Identified during field assessment

S/N	Common Name	Scientific Name	Location of observation
1.	Skye monkey/black	*Cercopithecus mitis albogularies*	Scattered along the farms edges areas and in the forest patches
2.	Tree hyrax	*Dendrohyrax validus nuemanni)*	Scattered in the bush and on the beaches cliff
3.	Sundevall's Blue Duiker	*Cephalophus monticola sundevalli*	Abundant in the bush, especial on the former shift cultivation areas (More pellets were counted in the bush rather than in the forest patches)
4.	House mouse	*Mus musculus*	Common in the residential houses
5.	Bats spp.	*Hipposideros spp*	Common in the local houses and other infrastructure
6.	Black rat	*Rattus rattus*	Scattered in the farms and along the roads between the local houses
7.	Zanzibar Galagos	*Galago senegalensis zanzibaricus*	Common in the farms and residential houses

Table 7: Reptile and Other mammals identified through village members interviews

S/N	Common Name	Habitat	
		Terrestrial	**Marine**
1.	Cobra	✓	
2.	African python	✓	

3.	Twig snake	✓	
4.	Mamba	✓	
5.	Sea Turtle		✓
6.	Trip lizards	✓	
7.	Plated Lizard	✓	
8	Plated Lizard	✓	
9	Dolphin (migratory)		✓

4.5.3   Arthropods

Assessment of arthropod which is the largest phylum of invertebrates was done in three habitats namely; high forest, small forest or bushes and cultivated land. Based on the pit fall traps analysis and sweep netting methods nine taxa groups were identified. These are Lepidoptera (butterflies), arachnida (spider), Orthoptera (grasshoppers), Hymenoptera (bees, wasp), collembera (spring tail), Hemiptera (bugs), Deplopoda (millipeds, centipeds), and Odonata (dragon flies) and Molluscs that comprised of land snail and slugs. The abundance of individual in groups is as shown in figure 10 below. The diversity index of the taxa groups in the study area is 2.19 which indicate good invertebrate groups' richness.

Figure 10: Invertebrate groups found in Tumbatu Vegetation (study area)
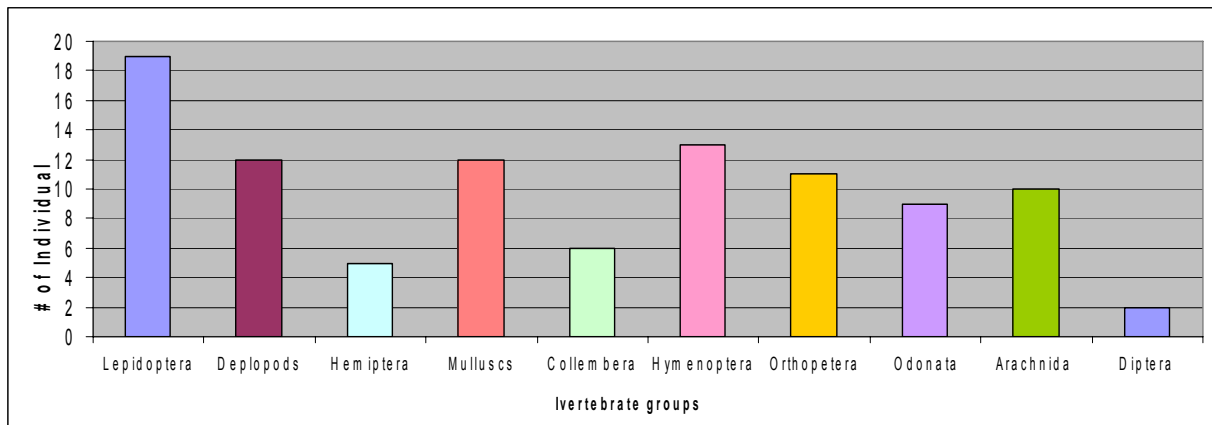
The abundance of small land snail (*Achatina iredalei)* and slug in cultivated land threatened the production of agricultural crops as they are directly damaging the crops. Farmers take considerable measures to reduce their number in farm plots. Piles of collected land snails were found at the edges of farm plots and some being burned. While land snails are considered threats to food production, some of the arthropods like butterflies; bees etc are useful insects especially in pollination process. Study is called upon to investigate the appropriate methods for controlling land snail in farm plots.

The Shannon Weiner Diversity Index (H') was used to find invertebrate groups diversity or richness. Results from pitfall traps and sweep netting show small forest and cultivated land to have high diversity of the invertebrates groups than in high forest as indicated in the table 8 below. Nine taxa groups were identified from the small forest and cultivated land against 6 groups from high forest. Figure 11 below gives illustration of the data. The canopy cover

and nature of the vegetation could be the reason of some groups being not presents for example Mulluscs seem to prefer most in cultivated land and small bushes.

Table 8: Summary results of invertebrates and in relation to vegetation surveyed

	High Forest	Small Forest	Cultivated land	Total
# of invertebrate groups	6	9	9	24
# of Individuals	25	29	45	99
Shannon Diversity Index (H' = -∑(pi) (lnpi)	1.5	2.16	2.07	

Figure 11: Showing number of Invertebrate groups, number of individual and its diversity index in the study area
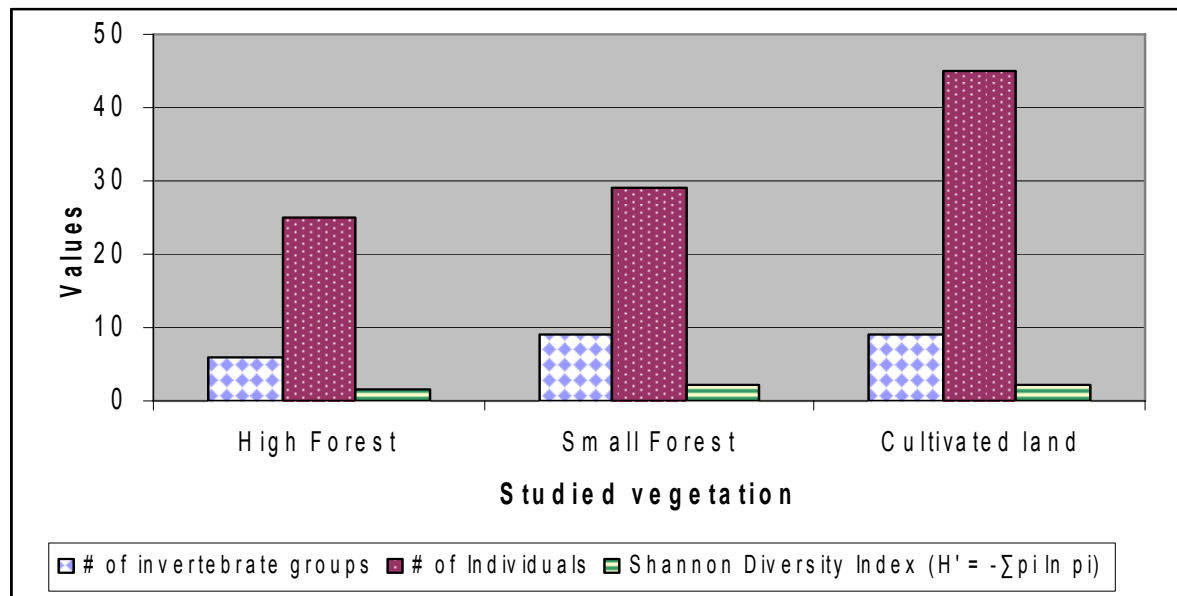
4.6   Community's concerns on forest resources conservation

During the participatory assessment of flora and fauna of Tumbatu Jongowe Village, number of issues was raised by community members related to forest resources conservation in relation to future livelihoods security. Basically, community is aware of the values of forest resource conservation and they welcome the idea, nevertheless, their concerns are categorized into the following majors:

1. The need for wood for their uses

Community at Tumbatu Jongowe depend the existing natural vegetation for collection of fire wood, building materials etc. They are worry if the forest shall be conserved they could get limitation in fetching firewood and other wood materials for their uses. One woman even asked *"How fuel wood could be collected after the forest being reserved".* This is crucial concern for community and must be put into account for future sustainable management of village forest resources. Without clear alternative, conservation efforts are in jeopardy.

2. Crop raiding by Monkeys

Farmers are well concerned with the damage caused by monkeys. Several complaints have been acknowledged up to District level on monkey's destruction on food crops. Community feel that by conserving the forest will mean to provide favorable environment for monkeys and further cops destruction. Appropriate mechanism for vermin control must be established so as to improve food security.

3. Land for cultivation

Shifting cultivation is common farming system employed by most framers at Jongowe village. The existing natural forest is the primary source of land for cultivation. The demand for farm plots is increasing with the decreasing fallow period as a result of low soil fertility and vegetation re-growth. Demarcating large area for village forest reserve will reduce farmer's access to land for crop production. Appropriate farming methods must be introduced to ensure the small land available is efficiently and productively utilized while other forest patches are set aside for conservation purposes.

Plate 7: Cultivation land adjacent to Mwangoni high forest

4. Forest reserve limit

End limit of the forest to be reserved is still unknown to some of the villagers. Some supposed could start at the boundary point with Kichangani Village so as to prevent them from wood cutting and hunting. Other s thought the end of high forest. This needs further discussion with entire community. It is important to know that, what ever the end of the forest reserve could be established, neighbouring village must be informed in advance to avoid resource use conflicts.

4.7   Results from feedback village meeting

A village meeting was called to present the findings of the assessment. The meetings divided
into two sessions, session was for the men and
session two was for the female. Participation was very
good in both sex categories (see the plates). After
presentation delivered by Tamrini, the village people
got chances to contribute and give suggestion and
opinion or demand clarification. Some of the points
highlighted and need clarification includes:

- **Forest to be Reserved:**

As pointed earlier that, Jongowe community was
not sure which forest could be set aside to be their
village forest reserve; and thought someone could
do for them. However, during this presentation,
community is asked to decide themselves on their
village forest reserve. In both sessions, community
decided and agreed the Mwangoni (high forest), part of Kikokwe (small forest) and
Mangrove as being their propose forest reserve, and JEMA should facilitate it though legal
procedures.

- **The ownership of the proposed forest areas**

Community wanted to know if the proposed forest areas are really belong to the Jongowe
people, and if not what measures are taken to avoid conflict with neighboring village.
Through discussion, it was clarified, that, the report will be distributed to different
authorities and other people could give out their opinion on the proposed forest areas.
Additionally, village elder's committee will be established to address their village interest of
establishing forest reserve to other neighboring villages. One of the PFAT members wanted
other village members not to worry, as the area proposed to be forest reserve is within the
Jongowe village and is far from what is considered to be village boundary.

- **Area for tree planting**

The community wanted to know where they will be getting area for tree planting. The
meeting decided that part of Kikokwe forest shall be set aside and being utilized for
establishment of village and groups wood lots that could cater the need for wood supply for
domestic purposes.

4.8   Proposed Forest Resource Development and Conservation Programs for Tumbatu Jongowe Village

4.8.1   Tree planting program

Introduction

The ecological system of Jongowe like other coral rag areas is vulnerable to environmental disturbance due to human population associated with unsustainable resource utilization. Human population is creating an increasing demand on wood for different uses, and where neither there is nor other sources, natural forest must faces all the pressure and ultimately degradation of the environment. Villagers have recognized the higher and increasing local demand of forest products which could not be fulfilled by the remaining natural forest alone. Tree planting program for wood production to substitute natural forest is of primary importance for Jongowe community.

Major issue and underlying problems
- Forest products from the existing forest contribute very little amount of the total annual household demand
- There is no tree nursery to supply seedlings and other planting materials to farmers and other community members to boost wood lots and collecting at Zanzibar town is costly
- A technical package on how to grow and maintain tree is limited to some of farmers.

Justification
- Tree planting could reduce cutting pressure on the few remaining natural vegetation
- Community are curious to see the program is established and are ready to provide helping hand to support the program
- The village has enough water for tree nursery establishment
- Land for tree growing is available
- One of the National Forest Policy objective

Activities and budget

No	Activities	Budget (US$)

1	Public awareness program
	  ▪ Video show
	  ▪ School program
	  ▪ Village meetings
	  ▪ Farmers cross visit
	  ▪ Production of leaflets
		3,500

2	Tree nursery establishment
	  ▪ Procurement of nursery tools and materials
	  ▪ Procurement of seeds
		13,500

3	Training on Nursery management and tree growing	2,000
	Total	**19,000**

4.8.2 Agroforestry Program

Introduction

For decades shifting cultivation has been a phenomenon at Jongowe. Although some areas re practiced with permanent agriculture system, most other areas are under fallow cycle which are not longer enough for the soil to regain its fertility and vegetation growth. In shifting cultivation a slash and burn techniques is frequently used during land preparation, as a result continuous loss of forest cover and decline in soil fertility, consequently low productivity which cause decline of income to the farmers, and food insecurity and malnutrition. Therefore, agro-forestry could be a possible solution to the firstly, for land scarcity but secondly for improving soil fertility and increase productivity.

Major issue and underlying problems
- There is increasing demand of land for crop production
- Poor soil fertility
- Shortage of forest products
- Low productivity of agricultural crops
- Low income earning for farmers
- Increased malnutrition

Justification
- Agroforestry ensures maximum land utilization
- Improve agricultural crops through soil fertility improvement and moisture retention capacity
- Reduce land competition
- Improve food security and income of farmers
- One of the National Forest Policy objective

Activities and budget

No	Activities	Budget (US$)
1	Public awareness program ■ Video show ■ School program ■ Village meetings ■ Farmers cross visit ■ Production of leaflets	3,000
2	Establishment of demonstration plot	4,000
3	Training farmers on best agroforestry practices	1,500
	Total	**8,500**

4.8.3   Beekeeping program

Introduction

Beekeeping is seen as a potentially useful income generating activity for rural communities. Beekeeping has been practiced traditionally in many areas of Zanzibar in both coral and mangrove forest areas. For the purpose of strengthen forest conservation and livelihoods improvement, improved beekeeping practice could be good a mechanism if introduced at the village. A part being a source of food, honey is also considered as potential traditional medicine and its market price is high, about Tanzanian shilling 3,000 for bottle of 700ml.. Currently, some village members are practicing beekeeping but in a more traditional way which does not ensure high production and quality product. The need to improve the practice for better results is appropriate.

Major issue and underlying problems
- There is low community awareness on the economic values of beekeeping practices
- Reduction of bee colonies due to poor honey harvesting techniques shifting cultivation practices

Justification
- There is increasing demand of bee products (honey and wax) for local and international markets
- Potential source of income at village level
- Improve forest resources conservation and management
- Potential source of food and medicine
- Availability of local materials
- Availability of bee colonies that could be managed
- Community willingness to practice the program
- One of National Forest Policy objective

Activities and budget

No	Activities	Budget (US$)
1	Public awareness program ▪ Video show ▪ School program ▪ Village meetings ▪ Farmers cross visit ▪ Production of leaflets	2,500
2	Procurement of beekeeping tools ▪ Local beehives ▪ Modern beehives ▪ Protective gears	5,000
3	Training farmers on best beekeeping practices	2,000
	Total	**9,500**

4.8.4   Development of Village Forest Management Plan

Introduction
In the last decade, awareness to empower community in the management of their forest resources has increased considerably in Tanzania and Zanzibar as well. The move is to ensure communities are effectively participating in the management of their own forest resources and benefits from it. They are considered as local forest managers. Village forest management plan is a mechanism that could ensure smooth development and conservation of forest resources at village level. Through village forest management plan, village forest resources use agreement could be established and act as a village instrument to safeguard and oversee the sustainable utilization of available forest resource and might reduce conflict among community members. Forest resources management agreement is implemented in Zanzibar particularly in the neibouring forest conservation sisters of Jozani-Chwaka Bay National Park, Ngezi–Vumawimbi Nature Forest Reserve and in Villages South of Jozani are now in the process under the Participatory Forest and Wildlife Management Project.

Experience shows that participatory forest management gain communities support when it embarked with microfinance scheme. In a pilot bases the village will establish four pilot saving and credit groups. The success of these groups will be used as a sample to the entire remaining interested group in the islet. The existing saving and credit model adopted in Jozani – Chwaka bay conservation area will be taken as a sample to the development of the scheme. A group of thirty people joined together to form one group and proper mechanism of saving will be used to encourage the communities group to access the savings.

A: Village Forestry Management Plan

i)   Major issue and underlying problems
- No binding mechanism to ensure forest resource development at village level
- Over exploitation of forest resources
- Pressure for agriculture expansion

Justification
- Ensure sustainable forest resource utilization
- Reduce conflicts on resource use among village members and between villages
- Increase forest resources ownership
- Improve participatory forest resource management
- One of National Forest Policy objective

Activities and budget

No	Activities	Budget (US$)
1	Public awareness program ▪ Village meetings ▪ Community cross visit	1,500
2	Participatory Rural Appraisal (PRA) ▪ Forest resource utilization assessment ▪ Development and production of agreed village bylaw	3,500
3	Production of village forest resources management plan	3,000
	Total	**8,000**

B: Saving and Credit Scheme

ii)   **Major issue and underlying problems**

- No binding mechanism to ensure economic improvement in the islet. It believed that the coastal communities do not committed in the culture on saving, but worth if technically introduced
- Local communities were not cultured in saving and credit schemes
- Low income in the local settings

Justification
- Ensure the development of saving and credits schemes
- Establish pilot groups of saving and credits in the islets
- Improvement of communities economic income

Activities and budget

No	Activities	Budget (US$)

1	Public awareness program
	  ▪ Village meetings
	  ▪ Community cross visit
		
		 1,500

2	▪ Production of saving and credit to pilot groups	7,500
3	• Purchase of saving boxes (strong saving boxes)	3,000
4	• Supporting allowance to communities local trainers	3,200
5	• Others training material	1,500
	Total	**16,700**

4.8.5   Study on economic value of non-wood forest products

Introduction

The gathering and trade in traditional medicine and wild fruits is a good example of the economic value of resources available to communities from non-timber forest products. Many rural inhabitants collect certain plants from the forest and plantations for self – medication and as food at home or for sale. These products are invaluable resources that could be utilized on a sustainable manner to satisfy local demand for medicines, food stuffs and to cater for cash income needs. The community has been using non-wood forest products extensively, many of which are likely to offer commercial opportunities for example Monkey bread trees - *Adansonia digitata* (Mbuyu) which are scattered all over the Jongowe village, bur no effort have been made to put its fruits into business venture. It appears that the importance of non-wood forest products has generally been under estimated in relation to local economy and consumption. Therefore study to determine the potential economic values of non-wood forest products is important

Major issues and underlying problems

- Non-wood forest products are considered widely as values less and some community members are not interested in engaging into its business.
- Being at the wild environment, non-wood forest products are considered as a common good and should no is paying attention.

Justification
The study is required to improve understanding on the economic values of non-wood forest products to most of Jongowe community so as they could take part in managing and tape its benefits. There is increasing traditional vendor shops in Zanzibar town and some of its products are harvested from Jongowe forest with little or nor benefits for the community managing the forest. The fruits of *Adansonia digitata* (Monkey Breed) has market potential in many places around Zanzibar and at Jongowe are widely scattered

Activities and budget

No	Activities	Budget (US$)
1	Conduct market survey/analysis of non-wood forest products in Zanzibar town	700
2	Participatory Rural Appraisal (PRA) ▪ Identify potential non-wood forest products at Jongowe forest and residential area	1,500
3	▪ Conduct workshop at Jongowe village to feed back the study outcome.	500
4	Production of study report	300
	Total	**3,000**

5 Conclusion and Recommendation

5.1 Conclusion

The participatory assessment of flora and fauna was done successfully at Tumbatu Jongowe village and assessment team involves professional personal, local hunters, and other village members. Three types of forest vegetation were recognized based on the community understanding namely; High forest of Mwangoni (60ha), Small forest of Kikokwe (69ha) and Mangrove forest (6ha). The Jongowe forest has high conservation potential as they harbor diverse of plants and animals, some of which are considered to be semi rare and semi endemic particularly plats. Assessment recorded 25 bird's species, four mangrove species, eight invertebrates groups, and a good number of plants species some of which have medicinal importance. Monkeys are considered threat to crops production and mechanism to control further damage is necessary.

The demand for firewood is given first priority and natural forest considered to be the primary source. Pressure for land is significant as community practicing shifting cultivation and the reaming forest has been the target.

There was considerable cooperation between the villagers and assessment team throughout the exercise. The assessment has timely done and information explored is useful for future participatory management and conservation of Jongowe forest resources.

5.2 Recommendation
Based on the assessment of flora and fauna at Jongowe village the following recommendation needs further consideration

- It has been revealed that, there is a cute shortage of firewood and other building materials at the village, tree planting program should be initiated so as to increase wood availability at the village reduce pressure to the natural forest

- The current trend of farming system is imposing pressure to the remaining natural forest, yet the low productivity due to poor soil fertility. It is recommended framers be introduced with agrofoorestry practices aiming at improve soil fertility and crops productivity at the same time halting further uses of natural forest.

- Community need their forest to be reserve for future, it is important to put in mind that, any part to be served must be agreed by entire community and neighouring village should be informed so as to reduce resource use conflict.

- The establishment of boundaries between Jongowe Shehia and Kichangani will facilitate the introduction of conservation activities on Tumbatu Island and minimize environmental degradation.

- There is need to conduct more birds inventory during the month of January to assess the migratory and local species and add to the list.

- There is need for JEMA to organize for future detail researches of wildlife species in both aquatic and terrestrial habitats for the purpose of sustainable management and conservation

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▶

Appendix 1: Species Prioritization Matrix

Species Prioritization	1 firewood	2. Withies	3. Pole-Boriti	4. Pole-Nguzo	5. Tree for Traps	6. Herbal Medicine	7. Fodder	8. Bed legs	9. Honey	10. Boat ribs	11. Handles	12. Spices	13. Wild fruits	14. Wildlife	15. Wild rope	16. Liwa	17. Lime making
Mpepe	!!! xxxx	-	..	-	..	-	..	..	..	-	..	-	..	-	..	-	-
Mkwamba	!!! xxxx	-	..	-	..	!!!! xxxx	!!!! xxxx	..	..	-	..	-	..	-	..	-	-
Mtumbika	!!! xxxx	-	..	-	..	!!!! xxxx	..	..	..	!!!! xxx	..	-	..	-	..	-	-
Mchengelevu	!!! xxxx	!!!!! xx	..	..	..	..	..	..	..	-	..	-	..	-	..	-	-
Mlachole	!!! xxxx	-	..	-	..	..	..	..	..	-	..	-	..	-	..	-	-
Mchofu	!!! xxxx	-	..	-	..	..	..	..	..	!!!! xxx	..	-	..	-	..	-	-
Mbundwa	!!! xxxx	-	..	-	-	..	..	..	..	-	..	-	..	-	..	-	-
Mkaaga	!!! xxxx	-	..	-	..	..	..	..	..	-	..	-	..	-	..	-	-
Ukoka	-	-	..	-	..	-	..	!!! xxxx	..	-	..	-	..	-	..	-	-
Mtarawanda	-	-	..	-	..	-	..	..	..	!!!! xxx	..	-	..	-	..	-	-
Muyumbuzi	-	-	..	-	..	!!!! xxxx	..	..	..	-	..	-	..	-	..	-	-
Mnwa	-	-	..	-	..	!!!! xxxx	..	..	..	-	..	-	..	-	..	-	-
Muwakikali	-	-	..	-	..	!!!! xxxx	..	..	..	-	..	-	..	-	..	-	-
Mchakuzi	-	-	..	-	..	!!!! xxxx	..	..	..	-	..	-	..	-	..	-	-
Mpindambavu	-	-	..	-	..	!!!! xxxx	..	..	..	-	..	-	..	-	..	-	-
Mshinda wakuu						!!!! xxxx											

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mpachu						!!!! xxxx										
Mzimiya							!!!! xxx		!!!! xxx							
Ntunda ng'ombe									!!!! xxx							
Mkarati									!!!! xxx							
Mkungupwa									!!!! xxx							
Mvururu									!!!! xxx							
Mtopetope							!!!! xxx			!!!! xxx						
Mfuru										!!!! xxx						
Mng'ong'o										!!!! xxx						
Mfyodo		!!!!! xx														
Mjoma		!!!!! xx														
Paa														!!! xx		
Kanga														!!! xx		
Kororo														!!! xx		
Pelele														!!! xx		
Mbibi kuyu															!!!! xxxx	

Kisisi	..	-	..	..	..	..	-	..	..	..	..	..	..	..	IIII xxxx	..	-
Mchochoni	..	-	..	..	..	..	-	..	..	..	..	..	..	..	IIII xxxx	..	-
Mfyoo	..	-	..	..	..	..	-	..	..	..	..	..	..	..	IIII xxxx	..	-
Mwengele	..	-	..	..	..	..	-	..	..	..	..	..	..	..	IIII xxxx	..	-
Mlimo	..	-	..	..	..	..	-	..	..	..	..	..	..	..	IIII xxxx	..	-
Mliwa	..	-	..	..	..	..	-	..	..	..	..	..	..	..	..	III xxx	-
Msiliza	..	-	..	..	..	..	-	..	..	..	..	..	..	..	..	III xxx	-
Mumbu	..	-	..	..	..	..	-	..	..	..	..	..	..	..	..	..	IIII xx
Mkole	..	-	..	..	..	..	-	..	..	..	..	..	..	..	..	..	IIII xx
Mkole	..	-	..	..	..	..	-	..	..	..	..	..	..	..	..	..	IIII xx
Mn'gong'o	..	-	..	..	..	..	-	..	..	..	..	..	..	..	..	..	IIII xx

Key:

IIII   =   Species preference

xxxxx =   Species availability in the forest

Appendix 2: Form for Vegetation Assessment

Things to do in each plot
1. Measure all trees is a sampled plot
2. Measure dbh – from 2cm and above
3. Identify tree important species (timber, fito, poles, madema, medicine)
4. Note regeneration capacity (seed or coppicing)
5. Note number of cuttings
6. Note signs of animals (pellets, foot mark, feather etc)
7. Note grazing
8. Note other human activities (e.g. Charcoal burning/farming, fire, etc)

Plot No _____   Date of Assessment_____

S/no	Tree Code	Dbh (cm)	Plot Characteristics	Tick/No
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.			• No. of cuttings	
9.				
10.			• Regeneration	
11.				
12.			• Sign of animals	
13.				
14.			• Grazing	
15.				
16.			• Human activities	
17.				
18.				
19.				
20.				

Appendix 3: List of people used in Assessment team

Professional Personnel

1. Ali Mwinyi   - Wildlife Officer

2. Alawi Haji   - Wildlife Officer

3. Said Abdalla fakih   - Ethnobotanist

4. Abbass Juma   - Forest Officer

5. Ali Kassim   - Surveyor

6. Hussein Abdalla   - Surveyor

Local Hunters

1. Kombo Juma Ali

2. Makame Makame Haji

3. Sheha Khamis Sheha

4. Haji Bakari Makame

Other Village Members (JEMA members)

1. Hassan Sharif Hassan

2. Saleh Ali Saleh

3. Othman Hadhir Othman

4. Salim Makame Ali

Appendix 4: List of Common tree species found at Jongowe forest vegetation

No	Scientific Name	Swahili Name
1	Mkwamba	*Fluegis virosa*
2	Mkonge	*Psychutria bibacteatum*
3	Mpinga ume	*Senna petersiana*
4	Mngombe/Mzimia	*Ozoroa obovata*
5	Mfyodo /haun'gon'gwa	*Psychotriamohanii*
6	Mjoma	*Macphersonia grocilis*
7	Mkaaga	*Eugenia capensis*
8	Mtarawanda /jiti jeupe	*Markhamia zanzibarica*
9	Kifugu	*Mystroxylon aethiopicum*
10	Mdimu msitu	*Serigada zanzibariensis*
11	Mchongoma mwiba	*Flacortia sp*
12	Mnanga change	*Allophlus perviuei*
13	Mkono wa samba/Mchonjo	*Todalia asiaica*
14	Msasa	*Ficus exasperate*
15	Mkandika/Mtunda ngombe	*Sideroxylon irneme*
16	Mzimia	*Ozoroa obovata*
17	Mgo mwekundu	*Flactia indica*
18	Mvururu/mviru	*Vengurus infansta*
19	Mchengelevu/Mla paa	*Polyphaeria parviflorarus*
20	Mpesu	*Trema orientalis*
21	Mtumbika /mtundu tundu	*Mollatus opposifolius*
22	Mnusi Mkivundo	*Mytenus mossambicensis*
23	Mchanga	*Un identified*
24	Mgo	*Flacotia indica*
25	Msonga/Mbebeta dume	*Psidia Arabica*
26	Mchungwi/Mchengele	*Rhus natalensis*

Appendix 5: Calculation of Invertebrate groups' Diversity index in High forest

No	Order/Species	No. of Individuals	Proportion of Individual (pi)	Natural Logarithm (lnpi)	pi * lnpi	Shannon Diversity Index H' = -∑pi ln pi
1	Hymenoptera (Wasps, Bees, Red ants	4	0.1600	-1.833	-0.2932	0.29
2	Arachnida (Spider)	2	0.0800	-2.526	-0.2021	0.20
3	Orthoptera (grasshoppers)	3	0.1200	-0.254	-0.0305	0.03
4	Lepidoptera (Butterflies)	5	0.2000	-1.609	-0.3219	0.32
5	Ordonata (dragon flies)	7	0.2800	-1.273	-0.3564	0.36
6	Deplopoda (Millepeds)	4	0.1600	-1.833	-0.2932	0.29
	Total	**25**		**H'**	**-1.50**	**1.50**

Appendix 6: Calculation of Invertebrate group's diversity index in small forest

No	Order/Species	No. of Individuals	Proportion of Individual (pi)	Natural Logarithm (lnpi)	pi * lnpi	Shannon Diversity Index H' = -∑pi ln pi
1	Hymenoptera (Wasps, Bees, Red ants	3	0.1034	-2.2687	-0.2347	0.23
2	Arachnida (Spider)	4	0.1379	-1.9810	-0.2732	0.27
3	Orthoptera (grasshoppers)	3	0.1034	-2.2687	-0.2347	0.23
4	Lepidoptera (Butterflies)	4	0.1379	-1.9810	-0.2732	0.27
5	Diptera (Houseflies)	2	0.0690	-2.6741	-0.1844	0.18
6	Collembera (Springtail)	2	0.0690	-2.6741	-0.1844	0.18
7	Hemiptera (Bugs)	3	0.1034	-2.2687	-0.2347	0.23
8	Deplopoda (Millepeds)	3	0.1034	-2.2687	-0.2347	0.23
	Mulluscs (land snail and slung)	5	0.1724	-1.7579	-0.3031	0.30
	Total	29			-2.16	2.16

Appendix 7: Calculation of Invertebrate group's diversity index in cultivated land

No	Order	No. of Individuals	Proportion of Individual (pi)	pi* lnpi	Shannon Diversity Index H'= -∑pi ln pi
1	Hymenoptera (Wasps, Bees)	6	0.1333	-0.2687	0.2687
2	Arachnida (Spider)	4	0.0889	-0.2151	0.2151
3	Orthoptera (grasshoppers)	5	0.1111	-0.2441	0.2441
4	Lepidoptera (Butterflies)	10	0.2222	-0.3342	0.3342
5	Odonata (dragon flies)	2	0.0444	-0.1384	0.1384
6	Collembera (Springtail)	4	0.0889	-0.2029	0.2029
7	Hemiptera (Bugs)	2	0.0444	-0.1384	0.1384
8	Deplopoda (Millepeds)	5	0.1111	-0.2441	0.2441
	Mulluscs (land snail and slung)	7	0.1556	-0.2895	0.2895
	Total	45		-2.08	2.08

Appendix 8: Diversity Index of Invertebrates groups in Tumbatu Jongowe Vegetation

No	Order	No. of Individuals	Proportion of Individual (pi)	pi* lnpi	Shannon Diversity Index H'= -∑pi ln pi
1	Lepidoptera	19	0.1919	-0.3129	0.3129
2	Deplopods	12	0.1212	-0.2533	0.2533
3	Hemiptera	5	0.0505	-0.1498	0.1498
4	Mulluscs	12	0.1212	-0.2533	0.2533
5	Collembera	6	0.0606	-0.1687	0.1687
6	Hymenoptera	13	0.1313	-0.2639	0.2639
7	Orthopetera	11	0.1111	-0.2419	0.2419
8	Odonata	9	0.0909	-0.2390	0.2390
9	Arachnida	10	0.1010	-0.2295	0.2295
10	Diptera	2	0.0202	-0.0784	0.0784
Total		99		-2.1906	2.19

Appendix 9: Species Diversity Index for three vegetation types of Jongowe Village

A: Mwangoni (High Forest)

No	Tree Species	No. of Individuals	Proportion of Individual (pi)	Natural Logarithm (lnpi)	pi * lnpi	Shannon Diversity Index H' = -∑pi ln pi
1	Mvuvuru/Mviru	101	0.3855	-0.9532	-0.36746	0.3675
2	Mfyodo/Haung'ong'wa	33	0.1260	-2.0715	-0.26091	0.2609
3	Mdimu Msitu	19	0.0725	-2.6242	-0.1903	0.1903
4	Mchungwi/Mchengele	19	0.0725	-2.6242	-0.1903	0.1903
5	Mnusi/Mkivundo	15	0.0573	-2.8595	-0.16371	0.1637
6	Mkandika /Mtunda ngombe	14	0.0534	-2.9299	-0.15656	0.1566
7	Mkaaga	14	0.0534	-2.9299	-0.15656	0.1566
8	Mjoma	11	0.0420	-3.1701	-0.1331	0.1331
9	Mgo mwekundu	9	0.0344	-3.3697	-0.11575	0.1158
10	Mzimiya	8	0.0305	-3.4900	-0.10657	0.1066
11	Mchanga	5	0.0191	-3.9581	-0.07554	0.0755
12	Mkwamba	5	0.0191	-3.9581	-0.07554	0.0755
13	Mnanga change	3	0.0115	-4.4654	-0.05113	0.0511
14	Mgo	3	0.0115	-4.4654	-0.05113	0.0511
15	Mchengelevu/Mla paa	1	0.0038	-5.5728	-0.02127	0.0213
16	Kifugu	1	0.0038	-5.5728	-0.02127	0.0213
17	Msonga/Mbebeta dume	1	0.0038	-5.5728	-0.02127	0.0213
	Total	**262**			-2.1584	2.1584

B: Mangrove forest

No	Tree Species	No. of Individuals	Proportion of Individual (pi)	Natural Logarithm (lnpi)	pi * lnpi	Shannon Diversity Index H' = -∑pi ln pi
	Mkandaa Mwekundu	740	0.4933	-0.7066	-0.3486	0.3486
	Gondi	570	0.3800	-0.9676	-0.3677	0.3677
	Mui	170	0.1133	-2.1777	-0.2468	0.2468
	Mliana	20	0.0133	-4.3200	-0.0576	0.0576
	Total	**1,500**			**-1.0207**	**1.0207**

C: Kikokwe (Small forest)

No	Tree Species	No. of Individuals	Proportion of Individual (pi)	Natural Logarithm (lnpi)	pi * lnpi	Shannon Diversity Index H' = -∑pi ln pi
1	Mkwamba	45	0.2174	-1.5260	-0.3317	0.3317
2	Mkonge	39	0.1884	-1.6692	-0.3145	0.3145
3	Mpinga ume	15	0.0725	-2.6242	-0.1902	0.1902
4	Mngombe/Mzimia	13	0.0628	-2.7678	-0.1738	0.1738
5	Mfyodo /haun'gon'gwa	13	0.0628	-2.7678	-0.1738	0.1738
6	Mjoma	13	0.0628	-2.7678	-0.1738	0.1738
7	Mkaaga	13	0.0628	-2.7678	-0.1738	0.1738
8	Mtarawanda /jiti jeupe	11	0.0531	-2.7678	-0.1471	0.1471
9	Kifugu	8	0.0386	-3.2545	-0.1258	0.1258
10	Mdimu msitu	6	0.0290	-3.5405	-0.1026	0.1026
11	Mchongoma mwiba	6	0.0290	-3.5405	-0.1026	0.1026
12	Mnanga change	4	0.0193	-3.9477	-0.0763	0.0763
13	Mkono wa samba/Mchonjo	4	0.0193	-3.9477	-0.0763	0.0763
14	Msasa	4	0.0193	-3.9477	-0.0763	0.0763
15	Mkandika/Mtunda ngombe	4	0.0193	-3.9477	-0.0763	0.0763
16	Mzimiya	3	0.0145	-4.2336	-0.0614	0.0614
17	Mgo mwekundu	1	0.0048	-5.3391	-0.0258	0.0258
18	Mvururu/mviru	1	0.0048	-5.3391	-0.0258	0.0258
19	Mchengelevu/Mla paa	1	0.0048	-5.3391	-0.0258	0.0258
20	Mpesu	1	0.0048	-5.3391	-0.0258	0.0258
21	Mtumbika /mtundu tundu	1	0.0048	-5.3391	-0.0258	0.0258
22	Mnusi Mkivundo	1	0.0048	-5.3391	-0.0258	0.0258
	Total	**207**			**-2.5310**	**2.5310**