

Management Surveys of the Mangroves of Mkinga District in Mainland Tanzania



Consultancy Report

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This technical report is part of the reports prepared during the course of the project entitle *Restoration of Mangrove Ecosystem in Mkinga District through participatory community approaches*. The conclusions and recommendations given are those considered appropriate at the time of its preparation. They may be modified in the light of further knowledge at subsequent stages of the project.

The opinions expressed in this document are those of the author and do not reflect whatsoever on the part of the RECOMAP, IOC, ENVIROCARE or KMFRI

Foreword and acknowledgement

ENVIROCARE, a Non-Governmental Organization in Tanzania, received funding from RECOMAP to implement a project entitled '*Restoration of Mangrove Ecosystem in Mkinga District through participatory community approaches*'. The project is being implemented in 5 pilot areas located in Mkinga District of mainland Tanzania.

A consultant and his team visited the project area in April 2010 to undertake participatory mapping and training on rehabilitation of degraded mangrove forests in the pilot areas. The total area of mangroves in the pilot area is 3320ha; dominated by *Rhizophora mucronata* and *Ceriops tagal*. These forests are in different degree of degradation. In the course of this Consultancy, more than 1million mangrove trees were replanted in degraded forests.

The consultant wishes to thank ENVIROCARE and RECOMAP national ICZM officer in Tanzania for arranging field trips to Tanzania.

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Abbreviations

ENVIROCARE	Environmental Human Rights Care and Gender Organization
EU	European Union
FEA	Foundation for Environmental Awareness
ICZM	Integrated Coastal Zone Management
IOC	Indian Ocean Commission
IUCN	United Union of Conservation of Nature
KMFRI	Kenya Marine and Fisheries Research Institute
NGO	Non-Governmental Organization
RCU	Regional Coordination Unit, of RECOMAP
RECOMAP	Regional Programme for the Sustainable Management of the Coastal Zones of the Countries of the Indian Ocean
TACOECONT	Tanzania Coastal Environmental Conservation Network
UNEP	United Nations Environment Program

1 Introduction

Under the 2nd Calls for Proposal (CFP2) from RECOMAP, **ENVIROCARE** of Tanzania is implementing a project entitled '*Restoration of Mangrove Ecosystem in Mkinga District through participatory community Approaches*'. The project aims at building local capacity to mitigate the impact of coastal and marine resource depletion through promoting sustainable management of mangroves and alternative livelihoods in Mkinga district of mainland Tanzania.

The immediate objectives of the project are as follows:

- To maintain and improve mangrove ecosystems in Mkinga district through participatory development of joint mangrove management plans
- To enhance the capacity of local communities in the selected villages in Mkinga district to participate fully in planning, implementing and monitoring mangrove forest reserves
- To build capacity of local communities to attain greater awareness on the importance of mangrove forest conservation to their lives through educational and public awareness programmes
- To support alternative means of livelihoods for the target communities through initiation of micro-income generation projects in the mangroves

ENVIROCARE is implementing the project in partnership with Foundation for Environmental Awareness (FEA) and Tanzania Coastal Environmental Conservation Network (TACOECONT). Other partners include Local Government Authority as well as Forest and Beekeeping Division of the Ministry of Tourism, Natural Resources and Environment in Mkinga.

A consultant was recruited to work with the proponents to carry out participatory mapping and conduct training on rehabilitation, conservation and sustainable utilization of mangrove resources in the pilot areas. During the mission, the Consultant and his team visited five project sites in Mkinga District, including: Moa, Jasini-Mahandakini, Kijiru-Ndumbani, Boma-Subutuni and Boma-Kichakamiba villages. The draft report was discussed with the project proponent on 30th May, 2010. Upon in-cooperating amendments from initial draft, a final report was prepared and is discussed below.

1.1 Terms of Reference

According to the terms of reference (ToR) given by ENVIROCARE, the Mangrove Consultant was to:

1. Conduct a participatory mangrove forest surveys within and adjacent to Mkinga District, in the mainland Tanzania
2. Review available ecological baseline data to establish the most appropriate strategies and approaches that could be adopted in order to protect and rehabilitate degraded mangrove forest in the project area;

3. Advise the project proponents on the strategies that could be adopted in order to ensure long-term sustainability of the activities that would be initiated by the project,

The total duration of the consultancy was 21 days spread over the months of April and May 2010. The Consultant and his team visited Tanzania between 20th April and 11th May in order to familiarize with field conditions and discuss with project proponents (Plate 1, Annex. 1). During the mission, the consultant met and was greatly assisted by people from ENVIROCARE, Forest and Beekeeping, FEA, TACOECNT, the local government, community based organization and politicians. A list of persons met during the entire assignment is presented in Annex II. This report is in two parts, Part 1 and 2. Part one covers survey and mapping of the mangroves of the pilot area; while Part 2 details practical aspects of the consultancy including field training and the establishment of demo mangrove plantations.



Plate 1: Part of the Cruise Team.

2 PART 1: Survey of mangroves in Mkinga

2.1 Introduction

Mangroves of mainland Tanzania are estimated to cover 115,500 ha, consisting of 9 species. The common mangrove species in Mkinga district are *Rhizophora mucronata*, *Ceriops tagal* and *Avicennia marina* that occupy more than 70% of the forest formation (Table 1). Mangroves are valuable for their wood and non-wood products to million of people in Tanzania, providing; timber, building poles, fuelwood, charcoal, fishing stakes, local medicine, and animal fodder (Table 1).

Table 1: Mangrove species in Tanzania and their uses

<i>Species name</i>	Local Names (Kiswahili)	Uses
<i>Avicennia marina</i>	Mchu,	Firewood, furniture, fencing posts, low quality charcoal, boat ribs, fodder
<i>Bruguiera gymnorrhiza</i>	msinzi or mshinzi	Charcoal, construction poles, boat paddles, handcart handles, bee hives
<i>Ceriops tagal</i>	Mkandaa	Construction poles, paddles, oars, dyes
<i>Lumnitzera racemosa</i>	mkandaa dume	Medium quality commercial firewood and charcoal
<i>Sonneratia alba</i>	mlilana or mpira	Canoes, boat ribs, paddles, masts, fishing net floats, construction timber, charcoal and firewood
<i>Rhizophora mucronata</i>	mkoko or mkaka	Construction poles, high quality commercial charcoal, dyes, and local medicines
<i>Xylocarpus granatum</i>	Mkomafi	High quality timber for bed construction, window and door frames, charcoal and firewood
<i>Xylocarpus mollucensis</i>	mkomafi dume	Quality timber for construction and furniture, charcoal
<i>Heritiera littoralis</i>	msikundazi or mkungu	Charcoal, fire wood, building wood

According to the 1988/1989 inventory, mangroves in mainland Tanzania are distributed in 10 blocks, stretching from Mtwara in the Tanzania-Mozambique border in the south to Tanga-Muheza in the Kenya-Tanzania border in the north. The largest mangrove areas occur in Rujiji and Kilwa district (Fig. 1.; Table 2). The current project is being implemented in Block 1 covering the Tanga-Muheza area.



Figure 1: Tanzania coastline showing the location of project area.

Table 2: Distribution of mangroves on the administration blocks of mainland Tanzania

Block	District	Area
1	Tanga and Muheza	9,403
2	Pangani	1,756
3	Bagamoyo	5,636
4	Dar es Salaam	2,168
5	Kisarawe	3,858
6	Mafia	3,473
7	Rufiji	53,255
8	Kilwa	22,429
9	Lindi	4,547
10	Mtwara	8,942
	TOTAL	115,467

On a national scale, the coverage of mangrove in mainland Tanzania has not significantly changed over the last 50 yrs (FAO, 2005). On a local scale, however, mangrove forests in mainland Tanzania have been degraded through over-cutting for firewood and building poles, conversion of mangrove areas for other land uses, and pollution. The loss of mangroves coverage in Mkinga district during the last decade is estimated at 20%.

The underlying root causes of mangrove degradation in Mkinga District include;

- The low levels of environmental education which is manifested in the form of inadequate understanding of the functions and values of mangrove ecosystems
- Conversion of mangrove areas for solar salt pans as well as using mangrove wood for boiling water for salt making, firewood, charcoal making, illegal cutting of wood for export into the neighbouring country.
- Limited access to market due to production of low quality and quantities of seaweed and honey
- Deep-seated cultural attitudes, behaviours and practices
- Unsustainable agricultural activities such as up-land poor farming practices resulting into soil erosion and sedimentation in the mangrove resources.

The current consultancy aimed at assessing mangrove forests conditions in Mkinga District of mainland Tanzania; and enhance capacity on sustainable utilization of mangrove resources in the pilot area.

2.2 Survey approach and methodology

The Consultant had intended to update digital mangrove maps of the pilot area developed in 1998/99. According to these maps, the mangroves of Tanga and Muheza districts (Block 1) were mapped into 5 map sheets. The current survey falls under Map sheets 1 and 2. Lack of readily available GIS maps for the area could not allow updating of the maps. Instead a thorough field surveys was conducted to assess forest conditions in the pilot area. Using GPS points and compass, the cruise team visited and surveyed

2.3 Survey results

The current survey has revealed the area of mangroves in the pilot area as 3320ha. This figure is higher than the area given by Muhando (2010); that estimated the mangroves of pilot area as 2240ha. The latter did not include the area of mangroves in Boma-Kichakamiba and Boma-Subutuni which contain substantive cover of mangroves. Most of mangroves in Mkinga district occur in Boma-Subutuni, Jasini and Kigirini-Daluni (Table 3). The major species of mangroves in Mkinga District are *Rhizophora mucronata*, *Ceriops tagal*, *Avicennia marina*, and *Sonneratia alba*. The species, *Bruguiera gymnorhiza*, *Heritiera littoralis*, *Lumnitzera racemosa* and *Xylocarpus granatum* have restricted distribution in Moa and Boma-Subutuni. *Xylocarpus mollucensis*, though not encountered in the 1998/99 survey of the area was found existing as simple stands in Jasini area. The forest is most impacted through harvesting for wood products. The most affected sites are Moa (50%), Jasini (40%) and Boma-Subutuni (40%). Detailed forest characteristics in the pilot areas are described below:

Table 3: Structural parameters for the mangroves of Mkinga District. Number in brackets indicate range.

Parameters	Pilot areas				
	Jasini	Moa	Kigirini	Daluni	Boma-Subutuni
Total Area (ha)	948	501	238	598	1035
Degraded forests (%)	40	50	40	30	20
Tree height (m±SE)	6.19 ± 0.21 (3.0 – 12.0)	6.32 ± 0.18 (2.0 – 13.0)	6.0±0.17 (3.0 – 9.0)	6.92± 0.17 (4.0 – 14.0)	7.03 ± 0.32 (2.0 – 20.0)
Stem diameter (Dbh) cm ± SE	8.01 ± 0.33 (5 – 26.8)	7.61 ± 0.20 (3.3 – 20.0)	6.95 ± 0.20 (5.0 – 14)	8.74 ± 0.44 (5.0 – 38)	9.43 ± 0.52 (5.0 – 36)
Stand density (stems/ha)	2200	1500	1600	2072	1322
Regeneration rate (seedlings/ha)	79701	88531	18775	31965	101766

2.3.1 Jasini pilot area

Jasini pilot area stretches from the Kenya-Tanzania border to Mhandakini. The mangroves of Kendwa, Mahandakini, Jimbo, Kigomeni, and Kiphururu are included in this pilot area. The total area of mangroves in Jasini block has been estimated as 948 ha (Table 3). The forest is dominated *Rhizophora mucronata*, *Ceriops tagal* and *Avicennia marina*. Tree heights in Jasini range from 3.0 – 12.0 m (mean: 6.2 ± 0.2 m) with dbh of 8.0 ± 0.3 (range: 5.0 – 26.8cm) and a stand density of 2200 stems/ha in areas away from salt ponds. Areas close to the salt ponds had stand densities of less than 100 stems/ha,

of mostly scrub *Avicennia* and *Ceriops*. Productive stands in Jasini have relatively high densities of the preferred *Rhizophora* and *Ceriops* species, thus cutters travel long distances from the border country to harvest trees in the area. Overall, 40% of the forest in Jasini is degraded. Reforestation is required in areas close to human settlement in order to transform the degraded forests into uniform stands. The stocking rate of juveniles in Jasini was 79,701 juveniles/ha; dominated by juvenile class 40 – 150 cm in height.

2.3.2 Moa pilot area

This pilot area stretches from Moa village in the south to Mahandakini in the north. The total area of mangroves in Moa is estimated at 501 ha; and includes the forests in Nami, Kijiru Mayomboni, Dumbani and south of Kirui Island. Major mangrove species in Moa are *Rhizophora*, *Ceriops* and *Sonneratia alba* that fringes the sea. Heavy cutting was evident near the village; and the remaining trees on the seaward were coppiced *Sonneratia* ranging in height from 2.0 - 13.0 m (mean: 6.3 ± 0.2 m) with a stem diameter of 7.6 ± 0.2 cm (range: 3.3 – 20 cm). The stand density of mangroves in Moa was 1500 stems per hectare. Heavy erosion of adjacent agricultural field was evident in the area due to removal of the fringing forests. Contiguous blank areas exist in Moa that could be replanted with suitable mangrove species. Natural regeneration in less degraded forests is proceeding well, with juvenile density of 88,531 juveniles/ha (Table 3).

2.3.3 Kigirini Pilot area

Kigirini pilot area extends from Moa to Kigirini settlement; bordering Horo horo – Tanga road. Mangroves in Mwanapaka, as well as Gulio Island are in this pilot area. Bordering Kigirini is rich agricultural fields; where subsistence crops such as maize, cassava and vegetables were found growing during survey period. The estimated mangrove area in Kigirini is 238 ha. The forest is dominated by dwarf *Rhizophora* and stunted *Ceriops* and *Avicennia* on the mainland. Tree heights in Kigirini ranged from 3.0 – 9.0 m (6.0 ± 0.2 m) with a dbh of 7.0 ± 0.2 cm (range: 5.0 – 14.0 cm). The stand density of mangroves in Kigirini was 1600 stems/ha.

2.3.4 Daluni pilot area

Mangroves of Daluni extend from Moa to Daluni village; and include the forests in Gozini Island. The total area of mangroves in Daluni has been estimated as 598ha. The forest is dominated by *R.mucronata* that makes more than 70% of the forest. Other species encountered during this study include *C.tagal*, *S.alba*, *A. marina* as well as stunted bushes of *Lumnitzera racemosa* on the landward. Tree heights in Daluni ranged from 4.0 – 14.0 m (mean: 7.0 ± 0.20 m) with a stem diameter of 8.7 ± 0.4 cm (range: 5.0 – 38.0 cm); and stand density of 2072 stems/ha. Natural regeneration in Daluni was assessed to be adequate in most sites. The average regeneration rate was 31,965 juveniles/ha (Table 3).

2.3.5 Boma Subutuni

Six mangrove species were encountered in Subutuni, dominated by *C. tagal*, *R. mucronata* and *A. marina*. The site is close to a large scale agricultural company. Compared to other sites visited, Subutuni represented un-degraded mangroves. The area is, however, threatened by failing agricultural activities in the farm as witnessed by abandoned sisal plantation and failed crop. Tree height ranged from 2.0 – 20.0m (mean: 7.0 ± 0.3 m) with dbh of 9.43 ± 0.50 cm (range: 5.0 – 36.0 cm). The stand density of trees in Subutuni was 1322 stems/ha. Most areas of Subutuni had adequate natural regeneration as such no reforestation is required at this point. Management plan is, however, required in order to identify zones where future sustainable cutting could be carried out.

When the data was pooled to construct stand tables for the two management blocks; Jasini- Moa and Daluni-Subutuni, coincidentally the two blocks had similar standing densities. In both blocks the stand densities for *Rhizophora* was highest followed by *Ceriops* and *Bruguiera*. As expected for natural stands, the forest in Mkinga district is dominated by small sized poles. More than 80% of the forests in Mkinga had stem diameter of less than 10cm (Table 4).

Table 4: Stand table data (stems/ha) for mangroves forests in (a): Moa- Jasini and (b) Daluni - Subutuni

a. Moa –Jasini											
<i>Diameter class</i>	>7.5	7.5-10	10-12.5	12.5-15	15-17.5	17.5-20	20-25	25-30	TOTAL		
<i>Avicennia</i>	6	0	0	0	6	0	0	0	11		
<i>Bruguiera</i>	72	33	22	6	6	0	6	6	150		
<i>Ceriops</i>	278	56	0	6	0	0	0	0	339		
<i>Rhizophora</i>	678	344	94	67	17	11	6	0	1217		
Total	1033	433	117	78	28	11	11	6	1717		
% total	60.2	25.2	6.8	4.5	1.6	0.6	0.6	0.3			
b. Daluni – Subutuni											
<i>Diameter class</i>	>7.5	7.5-10	10-12.5	12.5-15	15-17.5	17.5-20	20-25	25-30	30-35	35-40	Total
<i>Avicennia</i>	52	10	0	0	0	0	0	0	0	0	62
<i>Bruguiera</i>	57	10	5	0	0	5	0	10	0	5	90
<i>Ceriops</i>	295	90	29	14	5	0	0	10	0	0	443
<i>Rhizophora</i>	471	276	71	33	24	38	24	5	5	0	948
<i>Sonneratia</i>	29	43	0	5	5	5	0	0	0	5	90
<i>Xylocarpus</i>	5	0	0	0	0	0	0	0	0	0	5
Total	910	429	105	52	33	48	24	24	5	10	1638
%total	55.6	26.2	6.4	3.2	2.0	2.9	1.5	1.5	0.3	0.6	

3 PART 2. Capacity building on mangrove reforestation and management

3.1 Introduction

Scientific management of mangroves is a new thing not only in Tanzania but in several parts of the Western Indian Ocean region. For this reason the Consultant conducted practical field sessions on mangrove seed collection, transportation, storage, as well as in the establishment of mangrove nurseries and outplanting. At the end of training sessions, demo plantations to serve as future sample plots were established in Moa, Jasini and Subutuni with the following specific objectives:

1. To facilitate natural regeneration
2. To demonstrate procedures for mangrove plantation establishments and monitoring
3. To produce seedling stock for future reforestation

Other objectives were:

- To transform degraded areas to uniform stands
- To strength the technical capacity of management agencies, NGO, and the community in mangrove restoration and management
- To improve the mangrove environment through conservation and reforestation in order to return multiple-use potentials of the system.

The total number of mangrove propagules and saplings planted in the pilot area was 40,000 (table 5)

3.2 Plantation approach

3.2.1 Site selection and preparation

In selecting pilot areas for planting activities, the following criteria were used:

- Suitability of the environment to support mangrove growing such as; deep substrate, wide tidal range and absence of strong wave and wind actions
- Past history of mangrove existence in the area as witnessed from dead stumps
- Availability of planting materials, both propagules and wildings

Site preparations involved removal of over-wash debris and plastic litter that would otherwise dislodge the planted seedlings as well as prevent natural regeneration. Moa and Jasini had fairly large blank areas for the establishment of demonstration plantation (Plate 3). The two sites are easily accessible by road; and that there is strong

commitment by the local people to support mangrove reforestation. During the April/May season, mangrove seeds were readily available in the area.



Plate 2: Consultant conducting field training on mangrove planting to community members in Moa

3.2.2 Species selection

Based on site suitability and seed availability, the following species were used in establishing demo plantations: *Rhizophora mucronata*, *Ceriops tagal*, and *Avicennia marina*. Community groups in the pilot villages were hired to collect propagules and wildings. Only healthy and mature seeds were used in the plantation and nursery establishment

In *Avicennia*, mature seeds are recognized from their yellowish seed coat (pericarp) and deep-green cotyledons. Seeds were harvested from the mother tree or collected from the ground under tree canopy or on the beach during low tide. In the case of

Rhizophora, and *Ceriops* mature propagules have a yellowish cotyledonary collar. This is the part between the hypocotyls and the fruit.

More than 150 community members from 5 pilot villages were involved in the collection, transportation, establishment of nurseries, and in field transplantation (Table 5). Participants were trained in identifying and selecting mature and healthy seed stocks. After collection, the seeds were inspected for infections, malformations, damage during transport, and stages of maturity. At the initial phase of the project, nearly 40 – 50% of the seeds were discarded as infected, immature or damaged. This, however, decreased to less than 10% discard by the 5th day of collection as participants became acquainted with collecting mature, quality seeds. The sorted *Avicennia* seeds were soaked in seawater for not more than 2 days, and the outer coats removed prior to planting (Plate 4). No treatment was made on *Rhizophora* propagules prior to planting.



Plate 3: *Rhizophora* and *Avicennia* propagules ready for planting. Prior to planting *Avicennia* propagules (in the bucket) were soaked in water for overnight

3.2.3 Nursery establishment

Five nursery sites were selected, one each in Moa, Boma-Kichakamiba, Boma-Subutini, Kijiru and Jasini. Nursery beds of size 6 m, long x 1.2 m, width and x 20 cm, deep were dug out using spades (shovel). Polybags (25 cm x 15 cm) were filled with mangrove soil and then placed side by side inside the beds. One such bed could accommodate 550 bags. Ten beds were constructed each in Moa, Jasini, Boma-Kichakamiba, Boma-Subutini and Kijiru. The distance from one bed to another was 30 cm apart, with a drainage of 20 cm deep all around the bed.

3.2.4 Sowing of seeds

One propagule was sown in each pot by embedding one third of the seed into the soil (Fig. 2). It is difficult for buried *Avicennia* seeds to germinate. A total number of seeds sown in the nurseries were about 20,000.



Figure 3: Method of sowing *Avicennia* seeds. Deeply sown seeds rot, while those shallowly embedded are washed away by tidal action

3.2.5 Field plantation

Trial plantations of *Rhizophora*, *Avicennia*, and *Ceriops* were carried out in Moa, Kijiru, Jasini and Kichakamiba using both broadcast, direct planting, and wildings techniques. A total of 10,000 propagules of *Avicennia* were broadcasted in the bare areas of Jasini and Moa. In addition, 10,000 propagules and wildings of *Rhizophora* were used to demonstrate nursery establishment and outplanting. Direct sowing of *Rhizophora* involves installation of nearly a third of the propagule into the soil at low tide. Planting distance was 1.0 x 1.0 m matrix for propagules and 2.0 x 2.0 m for saplings, giving a stand density of 10,000 propagules/ha and 2,500 saplings/ha respectively.

After demonstration planting, communities were encouraged to replant mangroves in their areas. In the course of the Consultancy more than 1 million mangrove trees were replanted in designated areas (Table 5). The total replanted area was about 150ha.

Table 5: Number of mangrove planted in Mkinga District

Pilot area	Community group	Major threats to mangroves	Planting activities undertaken	Total planted	Approx. area planted as of August 2010 (ha)
Jasini/Mahandakini	Lengo Zinduka	- overcutting, - salt work - encroachment	- Replanting with <i>Ceriops</i> <i>Rhizophora</i> and <i>Avicennia</i>	122,000	30
Ndumbani/Kijiru	Muomba Mungu	- overcutting, - encroachment - sedimentation	Replanting with <i>Ceriops</i> <i>Rhizophora</i> and <i>Avicennia</i>	237,000	24
Moa – Nashukuru	Nashukuru Ufukwe	- overcutting - sedimentation	- Replanting with <i>C. tagal</i> , <i>R. mucronata</i> and <i>A. marina</i>	243,000	24
Boma Kichakamiba	Mwanzo Mgumu	- overcutting, - encroachment - sedimentation	Replanting with <i>Ceriops</i> <i>Rhizophora</i> and <i>Avicennia</i>	252,000	25
Boma Subutuni	Gamoyoni Boma Boma ndani			245,000	49
Total				1,099,000	152

4 Conclusion

Mangrove forests in Mkinga district are not pristine. These forests suffer different level of degradation, ranging from conversions to other land uses to removal of wood productions. Forests close to human settlement in Moa, Mahandakini, Jasini, Boma-subutuni and Boma-kichakamiba have been selectively harvested to remove desired pole sizes for building. The most affected species are *Rhizophora*, *Ceriops*, and *Bruguiera*. Long term selective practices have tendency to shift superior mangroves of *Rhizophora* to inferior stands of *Ceriops tagal* (Kairo et al 2002). Restocking of degraded areas through actual reforestation as well as introducing rotational management is recommended. In the course of the current project more than 1M trees were planted in 152ha of degraded forests (Table 5).

Tanzania was the first country in Africa to develop management plans for her mangroves. The plans were developed in 1991, but no information exist of their effectiveness in the management of mangroves in Tanzania. A review of these plans is

recommended. A first step in the review would be to conduct a thorough study to determine extraction levels of mangrove resources and their sustainability. This will be followed by inventory of mangrove wood resources as well as determination of cover change.

There is no growth data that exists on mangroves of Tanzania. However, based on the studies in Kenya; we can draw conclusion of yields from replanted forests. A 12 years old replanted *Rhizophora* plantation in Kenya have been estimated to containing a stand density of 1486 stems/ha and biomass of 106.7t/ha (Kairo et al., 2008). Since same species of mangroves occur in Kenya as in the pilot area it is possible to expect similar yield from replanted forests in Tanzania. A monitoring plan is recommended to follow-up recovery processes of the replanted areas. The following vegetation data should be taken during monitoring:

1. Increment in height (sample of 30 per plantation)
2. Diameter of the first internode (30)
3. Number of leaves (30)
4. Branching (30)
5. Germination (sprouting) percentage (all)
6. Survival rate (all)

In order to monitor environmental changes influencing mangroves, simple indicators that can be understood by local communities could be developed and adopted in all mangrove areas, for example:

- number of damaged trees (high = negative indicator)
- flowering and fruiting on mangrove trees (high = positive indicator)
- abundance and diversity of mangrove fauna e.g. birds (high = positive indicator)
- soil stability (high erosion rate = negative indicator)
- Crab abundance and diversity (high = positive indicator).

5. References

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6. Annexes

Annex 1: Itinerary (April 2010)

- April 18: Mangrove consultant arrives in Moa
- April 19-20 Consultative meetings and discussion with project personnel, including: Abdalla (Programme Officer, Envirocare); Dr Sabia FEA and Ndongo (Executive Director, TACEOCONT).
- April 21-27 Survey of Moa, Boma-Subutuni, Boma-Kichakamiba, Jasini, Kijiru, Kigirini and Daluni mangroves and establishment of nurseries

Annex 2: List of Persons Contacted

1. Abdallah Ramadhani– *Project Officer, Envirocare*
2. Daniel Sabai - *Program Officer, FEA*
3. Nzori Ndongo – *Director, TACOECNT*
4. Yusuphu Kajia – *Natural Resource Officer, Department of Forestry and Beekeeping*
5. Ibrahim Kwisha - *Chairman, Boma-Subutuni*
6. Hasani Sifa – *Chairman, Boma Kichakamiba*
7. Kipitu Mussa – *Secretary, Boma Kichakamiba*

Village	Name	Role In The Group
Jasini-Mahandakini Village	Asha Selemani	Farmer
	Fatuma Ali	Farmer
	Hussein Omari	Farmer
	Musa Mbaruku	Fisherman
	Shauri Shali	Fisherman
	Hamadi Shariff	Fisherman
Kijiru - Ndumbani Village	Rehema Jumaa	Farmer
	Salimu Seif	Farmer
	Saumu Mwihaji	Farmer
	Ali Hamza	Farmer
	Kabari Dole	Farmer
Boma Subutuni	Athumani Faki	Farmer
	Hassani Ibrahimu	Farmer
	Zabuja Gunda	Farmer
	Agawi Ramartan	Farmer
	Mwanzaina Saumu	Member
Moa	Masika Sifa	Member
	Twaibu Hassani	Farmer
	Mwawingu Rashidi	Farmer
	Mohamedi Jumaa	Farmer
	Haruni Ngori	Farmer
	Shauri Mohamadi	Farmer
	Saidi Omari	Farmer
Mohamadi Azizi	Farmer	