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KEY FOREST GAPS FOR IMPROVED LANDSCAPE PLANNING AND RESTORATION IN THE EAST USAMBARA MOUNTAINS



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SUMMARY

Background

East Usambara rain forests are famous because they are among the world's tropical rain forests with a rich biodiversity, including many unique plant and animal species. However, the forests have been undergoing serious degradation due to commercial logging, supply of building materials, bush fires and land clearing for cultivation.

The consequences of extensive deforestation are serious soil erosion, disappearance of unique plant and animal species and drying of water sources. Other problems are unreliable rainfall due to climatic changes, reduced soil productivity leading to poor yields, which contributes to hunger and poverty.

Poor cultivation on steep slopes, encroachment of river tributaries has led to poor recharge of main Sigi River with negative implication to the water supply for domestic uses in the countryside and Tanga City.

Realising the importance of conserving the East Usambara forests as a World heritage sites, plus other Catchment forests in the country, the government of Tanzania made several policy changes favouring involvement of local communities in forest protection, sustainable management and restoration. Several projects are on board exploring ways to make use of this government policy.

The World Wide Fund for nature (WWF) and Tanzania Forest Conservation Group (TFCG) are conducting forest landscape restoration project that aims to test community based forest management, joint forest management, land use planning, agroforestry schemes and fire management at the landscape scale within the East Usambara Mountains. The WWF Tanzania commissioned ARI-Mlingano to conduct a participatory and multidisciplinary baseline study on detailed information on land use pattern in key Forest Reserve gaps using GIS and rural participatory appraisal tools.

This report presents the results of the work conducted to collect detailed field information on the land use pattern in the key gaps between existing forest reserves in the lowland of East Usambara. This information will enable introduction of appropriate landscape management to enhance the restoration of forests and forest gaps and sustainably improve the livelihoods of the local communities. The study was conducted from 1st September to 30th October 2005 by a multi-disciplinary team of 5 people from ARI- Mlingano and Muheza District Council.

Activities carried out included focused surveys, interviews, village council discussions and GIS mapping by walking along selected forest boundaries and delineation of different land use types in respective forest gaps.

Land use types in the gaps

Results show that a major land use in the villages and the forest gaps between the Forest Reserves is cultivation. There is however subdivision of gap land uses types using percentage tree cover, steep slopes and or rockiness. There are 11 polygons of land use types in Nilo-Semdoe forests gap as shown by Figure 2. There are 6 land use types in Segoma - Manga forests gap (Figure 11) and there are 3 land use types in Kwamngumi/Segoma - Semdoe

forests gap. Although there are similarities, their geographical location and position on the landscape make them slightly different.

Main crops grown in Nilo-Semdoe gap are maize, beans, cassava and banana in the intercropping system. Also there are tree crops such, mango and cashew nut. The gap is unique in that still grown big fields of cardamom. The field are known as cardamom forests. There are 63 ha in the gap planted with cardamom. The gap also has Mzungi Forests Reserve owned by the village.

Segoma –Manga forests gap has 6 land use types. These are BL1, BL2 and FL1 through FL3. The FL1 through FL3 form a major chunk of fallow land about 477 ha not touched or with small scattered fields in FL2 and FL3. BL1 and BL2 are famous for maize and beans. Other crops grown include various legumes, tree crop such as mangoes, cashew nut, jack tree and coconut.

Kwamngumi –Semdoe forests gap has 3 land use types which are BL3, BL4 and FF. The total gap area is 518 ha, whereby BL3 occupying over 71% of the entire gap. Except for FF which is a long period fallow, both BL3 and BL4 grow maize, beans, and cassava. Other crops are mangoes, cashew nut and coconut

In general, major agricultural production constraints in the studied gaps are inadequate extension service, low yields, low prices and inadequate inputs that constitute unsustainable land use. The low yields are due to low soil fertility due to continuous cultivation, soil erosion and use of poor yielding crop cultivars. Poor yields are also caused by poor agronomic practices, a common practice in the area

How the forest gaps evolved

All forest gaps evolved in a similar manner. There were immigrants coming from Lushoto district seeking assistance for food. Upon arrival, they were asked to settle and shown the public land to establish their fields and settlements. Some other people joined them in the late 1990s from Kuze, Kizerui and Kambai villages to acquire land for cultivation. Another big group joined the gap cultivators in the 1990s from Nilo forests, Kwechawa and Semdoe to allow for expansion of Forest Reserves of Nilo, Semdoe and Kwamngumi. There were also people who established fields from the closed Sikh Saw Mills land after the prohibition of forests harvesting in all catchment forests in early 1980s.

Development bottlenecks in villages bordering the gaps

Development bottlenecks mentioned by farmers are inadequate markets, poor infrastructure (roads, classes, and dispensaries), diseases, and inadequate financial capital.

Coping mechanisms to development bottlenecks in general were use of collective action to make or repair roads to and out of villages; to acquire high yielding crop cultivars and improved breeds of livestock and chicken. Small enterprise such as mending was proposed at Segoma village by women.

Conclusions

Due to a wide data coverage collected in the field and discussions held with farmers, this study concludes that. It is important however to note that there are conclusions and relevant recommendations under specific land use types in the main text.

1. Rapid population growth will in a near future add pressure to the forests in the area, widen the existing forest gaps and therefore prevent sustainable forests connectivity. This was evident from the expanding and newly established farms in the gaps and shortening of fallow periods is also attributed to population pressure.
2. The studied villages obtain relatively poor crop yields due a chain of factors among them include continuous cultivation (nutrient mining), poor agronomic practices and use of poor yielding cultivars.
3. Soil erosion is widespread and serious because most of the study area fields are on steep slopes about 70⁰ (degree) but cultivated without any soil conservation measures.
4. There are natural trees in Nilo-Semdoe, Manga-Segoma and Segoma and Semdoe forests gaps which make it possible and easy for secondary natural forests re-establishment in the area.
5. There is a serious threat of drying up of rivers tributaries which are catchments for Sigi River. Water shortage due to drying up of Sigi River will negatively affect the potential growth of Tanga City in future and in particular it will jeopardize possibilities for industrialisation.
6. Communities in the study area are not familiar with by laws (such as Forest Acts), governing land and natural resources management. Farmers' works on their fields cutting down trees like Mvule (*Milicia excelsa*).
7. Establishment of villages' forests and woodlots will in future reduce dependence of Forest Reserves for wood supply in nearby communities.

Recommendations

Following the conclusions derived from the field visits, there are also several recommendations.

- 1) It is recommended to determine land use planning in the villages at the Forest Reserves gaps, to facilitate sustainable land use by putting a suitable use at right landscape.
- 2) Immediate steps should be taken by Muheza Forestry Department/district Council and other stakeholders in order to establish and gazette public lands around Semdoe and Manga Forests Reserves to prevent immigrants from taking advantage of this general land to ensure that they are placed under sound management.

- 3) It was found that hamlets in the key gaps were divided into three villages around the fact that deprives ownership any particular village hence making any intervention difficult. It is recommended that to facilitate the project success, a village status should be given to the hamlets.
- 4) Recommended to introduce soil conservation measures and sound agronomic practices (use of certified seeds, planting across slopes, and recommended specific crop spacing) use of fertilisers and manures to improve soil fertility. Agroforestry techniques are advisable in areas with less than 50% tree cover but well guided by agroforestry to avoid over shadow to crops.
- 5) Improved livestock production by introducing or improving dairy cattle stock and improving standards of husbandry for the existing local breeds including controlling diseases.
- 6) Farmers indicated poor infrastructure, inadequate agricultural knowledge and inadequate financial capital which call for the whole spectra of farmers' empowerment. For example farmers should be facilitated to establish credit facilities, trained on sustainable agricultural practices (use of certified seeds, pesticides/botanical) and facilitated to obtain extension officer based in the village.
- 7) Empowerment of the community on environment should include formulation of by laws that should govern use and management of water sources, soils, and trees in farmers' fields. For example establishment of village environmental committees (VECs) that oversee implementation of by laws that safeguard sustainable use of natural resources and also acts as doorway of outsiders in communities in the gaps.
- 8) Introduce and promote training farmers on trees as crops and therefore encourage establishment of commercial woodlots timber, fuelwood and building materials in future
- 9) To secure forests from bush fires training of fire hazards should be carried in villages around forests (leaders and farmers). Also there should be wide forest buffer around the villages.
- 10) Segoma village has no legality on the land they own as it belongs to the SHUWIMU lease, which was the business arm of Muheza District Council. Consultation and negotiation with Muheza District Council should be initiated and supported to clarify on the way forward.
- 11) The Forests gap between Kwamungumi and Semdoe is owned by three (3) villages. There are three hamlets that belong to Kizerui, Kambai and Kuze Kibago villages respectively which pose some difficulties in land ownership or certification under Village Forest Reserves (VFRs) land use plan endorsement and By laws formulation and enforcement.

1.0 INTRODUCTION

East Usambara (EU) Mountains forms part of Eastern Arc Mountains in Tanzania. The EU is famous for their tropical rain forests which are rich biodiversity, having unique plant and animal species (Masayanika, 1995). These forests however have been over-harvested for different purposes ranging from commercial logging, wood supplies and agriculture purposes (NEMC, 1995). Other reasons for degradation of EU forests are reckless bush fires from slash and burn land preparation practices that are common in the area. The intensity of forests clearing in the EU areas has been high since independence in 1961 because of political relaxation and poor understanding of environmental degradation local communities. For example the East Usambara, forests were reduced from 100,000ha in 1940s to 23,000 ha in 1990s (OY FINNAGRO AB, 1993). Land clearing for agriculture has been accelerated by the ever growing population struggling to obtain land for farming. Additional problem is poor tillage practices which normally results to poor yields therefore people clear for land to compensate small returns obtained.

The consequences of extensive deforestation are serious soil erosion (NEMC, 1995), disappearance of plant species and drying of water sources. Other problems are unreliable rainfall due to climatic changes (Agrawala et al. 2003), reduced soil productivity leading to poor yields, which results to hungers and poverty (Reinhard *et al.*, 1987; Shenkalwa, 1989; Masayanyika, 1995), affecting negatively not only the livelihood of the communities around forest areas but other down stream who also depend these Mountains for their survival.

Realising the importance of conserving the world heritage forests, the government of Tanzania made several policy changes that are now in operation. The changes call for involvement of local communities in forest protection, sustainable management and restoration. Following these policy changes several projects are exploring ways to improve the prospect for both conservation of globally important forest resources and also improve the livelihood of nearby communities. The World Wide Fund for Nature (WWF) and Tanzania Forest Conservation Group (TFCG) are carrying out forest landscape restoration projects that aim to test community based forest management, land use planning, and fire management at the scale of single landscape within the East Usambara.

However, there are no detailed baseline information to help monitor participatory forests management arrangement and maps that show land uses in key gaps between *Segoma and Manga, Nilo and Semdoe and Semdoe and Segoma* the various forest reserves in the lowland of East Usambara. This hinders the design of locally appropriate and acceptable project interventions that aim at reducing the size of the gaps i.e. cultivated areas between forests by encouraging natural forests rejuvenation.

This report presents results of field visits in Kuze kibago, Segoma and Kizerui villages and the hamlets in respective villages forming key forest gaps. The field work was conducted between 20th September and 11th October 2005 and in February from 12 to 17, 2006 to obtain the baseline information for planning for the community based forest management that ease rejuvenation of natural forests while improving the livelihood of the communities. It was done as consultancy work for WWF by ARI-Mlingano and team of subject specialists from Muheza district council.

2.0 OBJECTIVES OF THE STUDY

The overall objective of the study was to collect detailed field information on the land use pattern in the key gaps between existing forest reserves in the lowland of East Usambara so that appropriate landscape management can be introduced to enhance the restoration of forests and sustainably improve livelihood of the local communities around. Specific objectives were:

1. To collect field level data and map the key forests gaps which identifies current land uses
2. Determine the boundaries of remaining forest habitat, and the areas that can be restored,
3. Establish potential corridors between reserved areas

3.0 TERMS OF REFERENCE

The terms of reference of the reported work is attached as appendix 1. However, the deliverables were:

1. Final set of consolidated and clear hard copy maps showing indicative land use distribution for Segoma, Kizerui and Kuze Kibago and adjacent forests in the three key gaps. The maps will indicate the land uses outlined above as well as including: title, north arrow, coordinates and relevant annotations.
2. Copies of digital photographs taken from defined (GPS) viewpoints showing the condition of the landscape and the degree of forest connectivity.
3. Short report including introduction outlining the objectives of the work, methodology, detailed description of activities that were undertaken, main findings, outcomes of discussions with each of the three villages in terms of changes in land use and their thoughts on tree planting in the area.

4.0 STUDY AREA

The study covered three villages bordering four forest reserves. The villages are Kuze Kibago which is bordering Nilo and Segoma forests reserves, Segoma village, bordering Segoma and Manga forests reserves and Kizerui which is bordering Nilo and Semdoe forests reserves. The centres of interest for forests restoration are the gaps between Segoma and Semdoe, Segoma and Manga and Nilo and Segoma. See Figure 1.

5.0 APPROACH

5.1 COMPOSITION OF THE TEAM

The field work was done by a team of staff from ARI-Mlingano and Muheza District council. It include experts on Soil and water conservation and GIS, forest management, land survey and community development. The team composed of:-

1. Edward Lyawere District Forest Officer (DFO), Muheza District,
2. Joel L. Meliyo Land and Water Management and GIS Consultant (Team leader)
3. Joseph D. Mbogoni Land and Water Management and GIS Consultant
4. Paul C. Shembilu Land Surveyor, Muheza District,
5. Ms Vije Mfaume Community Development officer, Muheza District.

5.2 BASE MAP PREPARATION,

Prior to field work, base maps were prepared for forests, listed in the terms of reference by digitising hard copies of maps for 1996, and 2002. The land use/land cover background was of countrywide coverage of 1996.

5.3 LITERATURE REVIEW AND QUESTIONNAIRE PREPARATION

Literature was broadly consulted to be accustomed to the study area. The coverage was through grey literature, surfing (Eastern Arc) where a substantial coverage of East Usambaras was found. The team also prepared questionnaires that were used to guide discussion with farmers. The questionnaires were discussed pre-tested before they were communicated to farmers to see to it that the information required could be collected without difficulties. The phase was concluded by short listing of required materials and/or equipment. The collection included: Global Positioning System (Hand GPS, Magellan with an error of 3-5 metres), Canon digital camera 3X less, and 3 topographic sheets of 1:50000.

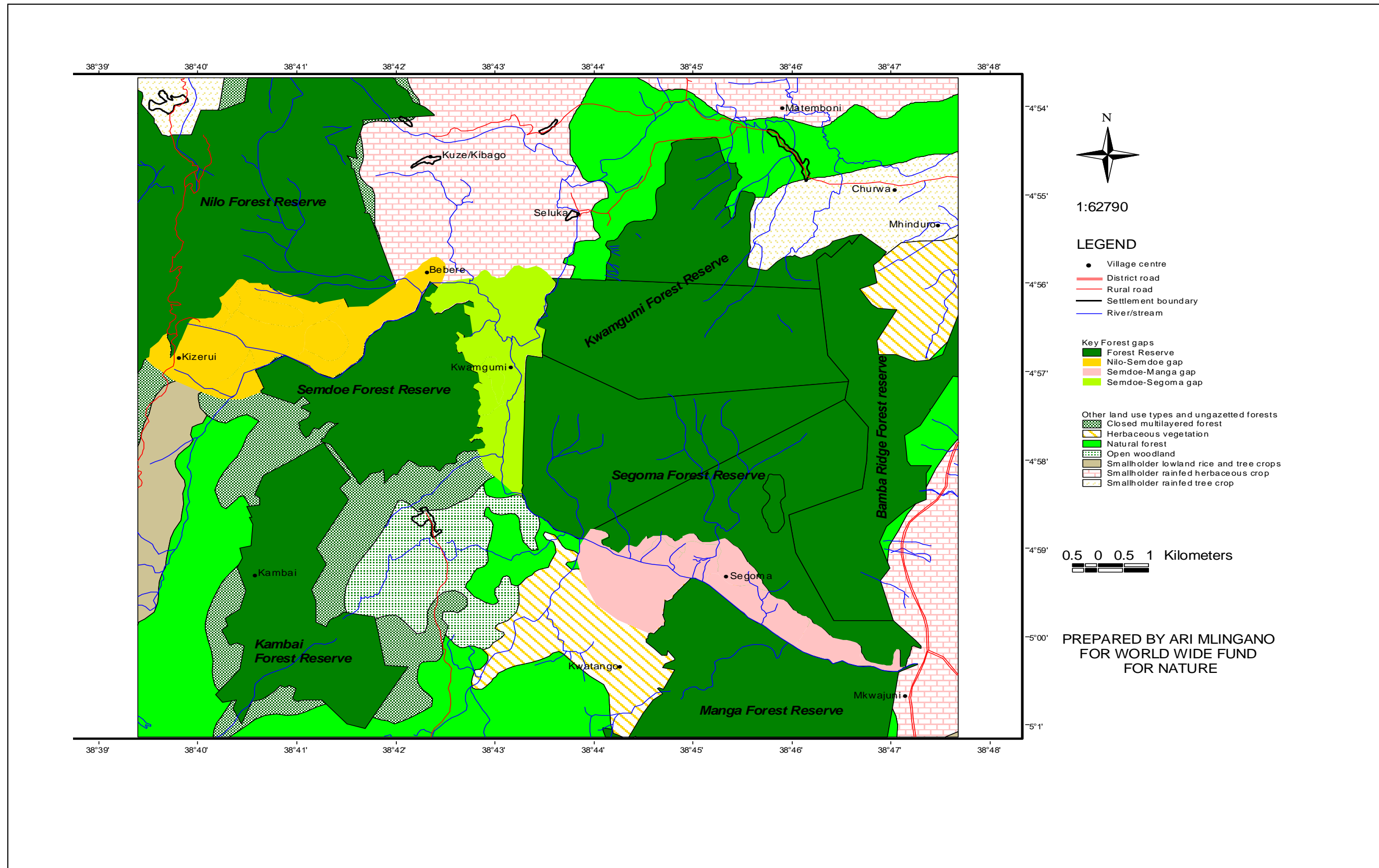


Figure 1: East Usambara key forest gaps and major land use/land cover for landscape restoration

5.4 FIELD DATA COLLECTION

5.4.1 Focused PRA

Data collection involved two stages firstly intensive review of secondary data and focused PRA (group discussions, household survey and field visits). The secondary data review acquainted the team with the study area and guided formulation of questionnaires for group discussion. In the villages, focused group discussions constituting village government, hamlets leaders and farmers were done. Focused PRA tool was conducted using tools such as absolute ranking, historical trends, and seasonal calendar. General information on issues such as major economic and labour demanding enterprises in the village was investigated.

The group discussions also assessed activities related to human settlement, immigration, agriculture, tree planting, livestock rearing and problems hampering development in the communities. The discussions were first done with the bigger (general) village community and later zoomed village councils, then different age groups and sex (gender). Historical trends were also covered during the group discussions.

5.4.2 GIS mapping

The mapping involved taking GPS readings at every corner along the forest boundaries, and grazing areas found within the hamlets. It also involved mapping of land use types in the gaps, trying to gap the differences between similar land utilization by considering percentage of tree cover. The farmers and area foresters with adequate knowledge on the boundaries guided the mapping. Attribute data being quantitative or qualitative were also recorded.

5.4.3 Along transect interviews

Special interviews were conducted with people met along transect. Important information collected during these interviews included how they came to the area, their original areas, water resources issues at present compared several years back. Old persons who settled in the area since 1920 were also interviewed, as well as youth who came in 1990s. Historical accounts of natural resources use and management was covered by asking about obvious changes like river flows, rainfall reliability and crops yields that all farmers would know about.

6.0 FINDINGS

6.1 GEOGRAPHICAL INFORMATION SYSTEMS (GIS) MAPPING

There are 3 maps indicating respective forest gaps and the different land uses.

Map 1 Nil - Semdoe forests reserves gap and its land use types,

Map 3 shows Segoma - Manga Forest reserves gap, and

Map 3 shows Semdoe - Kwamngumi forest reserves gap.

The different maps are found at respective sub sections.

6.2 PHYSICAL VISIT TO VILLAGES AND FARMERS' DISCUSSION

6.2.1 Kizerui Village

6.2.1.1 Geographical Setting

Kizerui village is a natural village that started in 1960s as a hamlet of Zirai composed mainly of people from Lushoto. It is located in Amani division in Muheza district. It was registered in 2000 after detaching from Zirai. It borders Kuze Kibago and Nilo Forest in the north through west, Zirai village to the south and Segoma forest and Kambai village to the east. It is located nearly on the top of a ridge lying north-east close to the boundary between Muheza and Korogwe district. The top of the ridge is the highest point which divides the two watershed areas, pouring water into Sigi River in the east and to Pangani River in the west.

6.2.1.2 Physical Environment (Topography)

Kizerui village lies almost on the top of the ridge at a highly dissected portion of East Usambara Mountains that extend north-east to Kuze Kibago. The village has a longer boundary with Nilo forest than other neighbouring villages. Bebere hamlet (sometimes called Kombora) forms part of the Nilo-Semdoe gap that has very steep slopes than the rest of three villages included in the study. The transect route from Kombora headquarter settlement to the Semdoe river at the corner and boundary between Semdoe forests shows the relief intensity of about 450 meters which is very steep.

The landform, soils and crops grown are similar to those of Kuze Kibago except for Cardamom which is still a dominant crop in Kizerui.

6.2.1.3 Demography

There are 426 households in Kizerui with a population of 2059 people. There are 1052 and 1007 men and women respectively. The general household size is 5 to 7 persons. Majority of population belong to the Sambaa while there are few Wambugu. It is also important to note that the majority or all the residents originated from Lushoto district due to the problem of landlessness.

6.2.1.4 Land Tenure

Land ownership in the whole of Usambara which is dominated by Wasambaa ethnic group is dominantly traditional and is controlled by traditional laws, passing land from one generation to another through inheritance. This is equally the case in Kizerui village. The majority of the villagers own between 3 and 7 acres of land. Landless people are directed by the village government to open up new piece of land at the general land which is the *gap between Nilo and Semdoe forests*.

6.2.1.4.1 Crop production in Kizerui and the Gap

Cultivation in Kizerui like other villages in the study area is characterized by mixed cropping. The community intercrop maize, cassava, beans, bananas and tree crops in the same piece of land. However, there are small portions of monocropping where legumes are grown. It is important to note that in Kizerui, cardamom cultivation is still very important and according to informers every household in the hamlet close to Nilo Forest own at least one acre of cardamom. The cardamom fields could easily be identified because they are forest like from a distance. Cultivation again is a major land use type in Bebere the gap between Semdoe and Nilo at the border between Kuze kibago and Kizerui which is somewhat closed than the rest of the village. Yield levels in Bebere ranges from 0.8 to 1.2t/ha for maize, other leguminous crops are lower than 1t/ha. There is a significant tree cutting operation going on to secure land for cultivation. There are also big surface stones that are indicators of widespread soil erosion, a common phenomenon in steep slopes in the area. The common land use is maize-beans intercrop, planted in fields already having banana and other tree crops at establishment stage. Tree crops included in the farming system are guava, mango, and cashew. There are also fruits such as papaya. Other crops grown are maize and legumes: beans and green gram and cow pea along the slope.

6.2.1.4.2 Methods of cultivation and bush fires

Slash and burn is more less a traditional way of land preparation in the entire study area. The reason is large amounts of grass that need to be removed before sowing and the fact that a major means of cultivation is the hand hoe. Crop residues such as maize and bean residues are burnt and so are shrubs and trees. This is attributed to forest fire incidences in the area.

6.2.1.4.3 Constraints to crops production

Several problems were mentioned by farmers that prohibit practicing improved agriculture. The problems identified were:

- Inadequate extension services,
- Poor accessibility of the market,
- Poor infrastructure (roads, bridges),
- Poor soil fertility,
- Low crop prices,
- Accelerated soil erosion,
- Poor cultivars, that have low productivity,
- Pests and diseases, and
- Inadequate capital for supplying necessary needed agricultural inputs.

6.2.1.5 Means to Sustainable Natural Resources Management

During the interview, it was learned that people were not regretting that their farms were taken to allow for Nilo Forest expansion. The expansion has created understanding on the forests importance to climate and water sources sustenance. The farmers interviewed associated forest re-growth with the current water availability and rainfall reliability that has improved. Following the discussions farmers proposed activities that when addressed could ensure sustainable natural resources management in the village to include:

1. Tree planting to open areas and on farms,
2. To avoid doing harvesting or getting into Natural Catchments Forest,
3. Promoting the use fertilizers (using organic and inorganic sources of nutrients),
4. Abandon use of bush fire for land preparation,
5. Improving land management (land conservation) by use of conservation measures to reduce and control soil erosion,
6. They should be provided with extension services, and
7. Promised to adopt new technologies provided geared to improve productivity.

The communities indicated that bottlenecks to sustainable natural resource management are brought about by:-

- Inadequate knowledge among farmers,
- inadequate understanding and poor enforcement of bylaws meant to protect natural resources in the village, and
- Inadequate capital.

6.2.2 Nilo -Semdoe Forest Reserves Gap

6.2.2.1 Description of the gap

The gap between Nilo and Semdoe forests (Figure 2) comprises three villages which are Kuze Kibago, Kambai and Kizerui. There are three hamlets in the gap namely Kombora in the Mountain, Bebere lower down, and Magati bordering Semdoe forest reserve to the north forming a gap between Semdoe and Kwamngumu forest reserves. The boundaries between three hamlets are the rivers. River Sigi is dividing the two Magatis while River Lusanga is dividing Bebere and Seluka hamlets in Kizerui and Kuze Kibago villages respectively.

6.2.2.2 How the gap evolved and its status

According to the historical trend of the village, the first settlements in the gaps started 1994 following a severe drought that forced some people in Lushoto district to move and join their close relatives or fellow tribesmen in East Usambara seeking for relief food and employment. When they arrived, the gap was an ungazetted forest area. The nearby village governments and/or relatives allocated forest land to the immigrants to establish their fields.

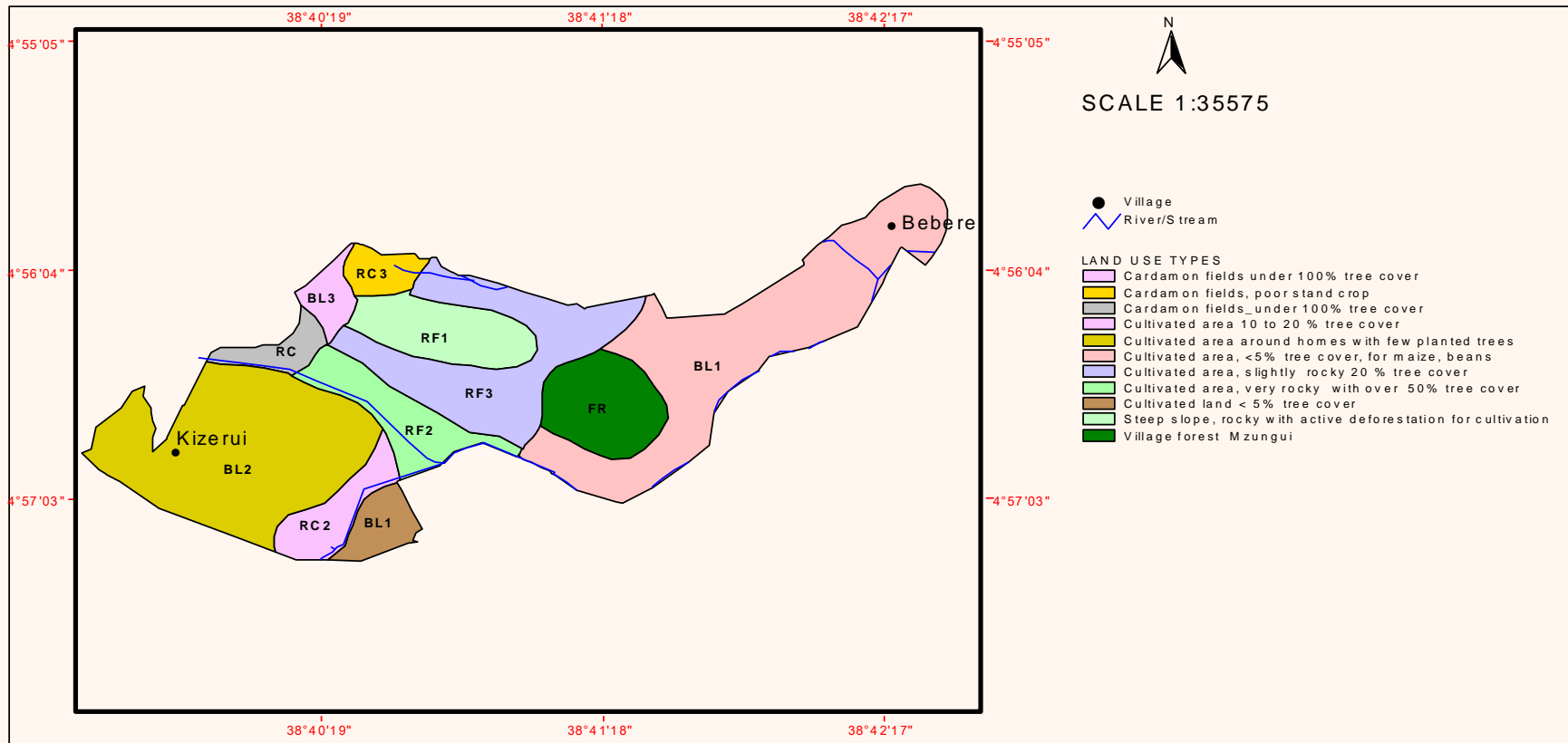


Figure 2: Nilo-Semdoe forests gap, current land use types

Another group of residents in the gap was the people whose fields were taken up for Nilo forest reserve expansion and restoration by the Catchment Forests Project in 1990s. People who were growing cardamom in Semdoe forest were expelled, and established themselves within the gap. There were also immigrants from Kwechawa village who were expelled to allow for Kwamgumi and Segoma Forests Reserves expansion.

The immigrated farmers cleared forestland to establish land for cultivation as its now with small remnants of natural trees (See Figure 2 land use types BL1 and BL2), while some parts of the gap to the west have few remaining tree (RF1 through RF3) as indicated in Figure 2. The field work indicated that the gap has sparse settlement. Kombora hamlet has 35 households, while Bebere (Kizerui village portion) and Magati (Kambai village portion) had 32 and 47 households respectively. The findings further show that Magati (Kuze Kibago) hamlet has 50 households.

6.2.2.3. Land use types in the forests gap

Major land use types are presented in Figure 2 and Table 1. The results show that the dominant land use types are BL1, BL2 BL3, and FR. Other includes RC, RC2 and RC3. There is also a category of land use RF1, RF2 and RF3. The paragraphs below give a detail description of these land use types and their inherent problems.

6.2.2.3.1 Land use BL1 (199 ha; (29%)):

The acronym is Bare land 1, referring to the dominant cultivated area in the gap with less than 5% tree cover (Figure 2 and Table 1). The land use type is located at the lower ladder of the gap. It is in two hamlets of Bebere and Magati. The area is famous for cultivation of maize, beans, banana, cassava and cow peas (Figure 3) and livestock keeping (Figure 4).



Figure 3: Mixed cropping in BL1 Bebere hamlet near Nilo forest reserve

Agricultural problems in land use BL1

Major problems include:-

1. Poor agronomic practices, therefore poor yields
2. Rampant soil erosion in steep slopes cultivated without conservation measures
3. Distant markets and hence poor crop prices
4. Pests and diseases
5. Inadequate use of agricultural inputs hence low yields
6. Most of the natural trees have been slashed and the remaining few are burned. There are obvious signs that in few years these people will be dependent on forest reserves for fuel wood.
7. Animals keeping with poor yields or milk and meat.

Recommendations for problems at land use BL1

- It was observed with concern the absence of agricultural field officers in the area. It is recommended that for the project to change the community there should be a link between the project and community. Hence, there should be field officer to facilitate field activities.
- Farmers at all levels require sensitization (training workshops) to create awareness on soils as a store for crop nutrients that need to be managed well for sustainable release for the longer time. They will be able to manage residues that are at present burned.
- To correct soil erosion and soil fertility, it is recommended use of integrated nutrient management in its broad sense (agroforestry technologies, cover crops and integrating with farm yard manures). These could be part of WWF-Tz supported project activities.
- Due to rampant soil erosion in particular steep areas, soil conservation should be introduced in a user friendly manner that will encourage farmers to conserve their land.
- Linking farmers with market will enable them to improve their livelihood in particular with cash crops such *beans and vegetables*. Improving their sales will improve their purchasing power for agricultural inputs.



Figure 4 Livestock grazing in BL1 in Bebere hamlet near Nilo Forest reserve

6.2.2.3.2 Land use BL2 (168 ha (24%))

The land use BL2 (Figure 2, Table 1) comprises 24% of the entire Nilo_Semdoe forests gap. It is cultivated near Kombara hamlet residential area. The natural trees have been cleared such that there is little (0-2%) tree cover. Geographically, the area is a summit and shoulder of the ridge one of the systems of ridges forming East Usambara Mountains covered by Nilo Forest reserve. The area is characterized by very steep slopes, forming one of the difficult terrains in the EU forest reserves. Crops grown in the area include maize, beans, banana and cow peas and vegetables such as tomatoes, okra, are also cultivated. Other crops include sugar cane and tree crops such as guava.

Agricultural problems

1. Poor infrastructure,
2. Inadequate market access due to the distance to urban and sub-urban areas,
3. Soil erosion due to steep slopes,
4. Human diseases (coughing, diarrhoea) which could be attributed poor hygiene and unclean water,
5. Inadequate skills and extension services,
6. Poor crop production,
7. Poor agronomic practices hence poor yields
8. No use of agricultural inputs (they do not buy seeds nor fertilisers, and
9. Dependence on few food and cash crops

Table 1: Land use types in Nilo-Semdoe forest gaps

CODE	Description	Area (ha)	Proportion (%)
BL1	Cultivated area, with less 5% tree cover for maize and beans	199	29
BL2	Cultivated area around homes with few planted trees	168	24
BL3	Cultivated area 10 to 20 tree cover	15	2
FR	Village Forest Mzungui	52	7
RC	Cardamom fields under 100% tree cover	17	2
RC2	Cardamom fields under 100% tree cover	30	4
RC3	Cardamom fields, poor stand crop	16	2
RF1	Steep slope, rocky with active deforestation for cultivation	49	7
RF2	Cultivated area, very rock with 50% tree cover	44	6
RF3	Cultivated area, slightly rocky with 20% tree cover	102	15

Recommendation for Land use BL2

1. Inaccessibility of markets, hospital and schools was difficult because of the poor infrastructure and very difficult terrain. It is therefore recommended that opening a road that join Kizerui and Kuze villages will be a break through to these people. It will enable them market their produce and motivate them to conserve environment.
2. Sensitise farmers on agronomic practices and integrated soil fertility management (training workshops), use of integrated soil fertility measures for restoration of soil fertility and such use of agroforestry techniques, farm yard manure and green manure (cover crops) by conducting demonstration in farmers' fields.
3. Sensitise and train farmers about soil conservation practices to reduce soil loss by accelerated soil erosion.

4. Sensitise farmers to plant tree crop (multipurpose trees) (*Grevillea spp.*, *Gliricida*, *Raufolevia cofra etc*) which are useful for timber and fuelwood in order to reduce dependence of natural forests in future and prevent the remnants from being harvested for different uses.
5. Sensitise farmers on tree planting for purpose and in particular tree crops such as *Avocado and pears* because they grow well under that ecological environment and its money generating business.

6.2.2.3.3 Land use BL3 (15 ha (2%))

The unit is generally situated at the summit of the ridge in a system of ridges, almost at the middle of the Nilo – Semdoe forests gap. It occupies 15 ha about 2 % of the gap land area. The area is characterized by relatively steep slopes and, with tree cover between 10 and 20%. It has scattered household also known as Kombora hamlet. Crops grown in the unit include maize, beans and banana. There are scattered cardamom fields. The land use type is mostly similar to other BLs only the degree of tree cover that is different.

Agricultural problems

Similar problems to those outlined in BL2.

Recommendation for Land use type BL3

Same as those recommended for BL2 except, tree planting need to consider tree density to avoid too much shade for annual crops like maize which is not an understorey crop.

6.2.2.3.4 Land Use RC and RC2 (47 ha (6%))

Land use types under RC series indicate cardamom fields. The fields are described as cardamom forests with 100% tree cover for RC and RC2 (Table 1). The difference between the two cardamom fields is only the location (Figure 2). The land use type occupies 17 and 30 ha for RC and RC2 respectively which is a total of 6% in the entire gap. The cardamom crop is well established (Figure 5) but farmers complain of low yields probably because of poor soil fertility considering cardamom as heavy feeder for potassium (K) and phosphorus (P).



Figure 5 Cardamom fields in Nilo-Semdoe forests gap (left), cardamom fruits (insert right)

Agricultural problems

Agricultural problems RC and RC2 land use types are similar to other land use types. These include:

- Poor crop prices where business men go in the village and collect cardamom at low prices.
- Areas planted with cardamom are small; because the fields formerly used to grow cardamom had been taken by government in 1990s for forests reserves expansion.
- There are poor yields because there are no new areas which are normally planted because the crop is the heavy feeder for K and P.

Recommendation for land use type RC and RC2

The type of land use is appropriate for multiple reasons.

- It is recommended that, cardamom planting as a land use types on steep slope areas, should be encouraged because the practice protects natural trees that give shade to the cardamom crop as well as soil from soil erosion.
- It is recommended that demonstrations plots with farmers should be established to develop participatory soil fertility management packages for cardamom that will improve yield levels without destroying forests.
- It is recommended that to reduce market pressure for farmers, they should be facilitated to form associations to empower them in bargain of crop prices.

6.2.2.3.5 Land use RF1 (49 ha (7%))

The unit is located at the central part of the gap. It is rocky with steep slopes and still undergoing land clearing to secure land for cultivation. Figure 6 shows banana plants together with remnants of trees (logs) that were cut and burned to allow for cultivation. Crops grow in the land use are maize, beans and banana.



Figure 6 Newly opened field in land use RF1

Agricultural problems

- 1) Poor agronomic practices
- 2) Few alternative crops (Farmers mention a narrow list of crops grown)
- 3) Market inaccessibility and poor prices
- 4) Poor infrastructure,
- 5) Soil erosion due to steep slopes which are cultivated without land conservation measures.
- 6) Inadequate use of agricultural inputs

Recommendations for Land use RF1

- Introduce more alternative crops such as cinnamon, cloves, black pepper, and macadamia nut. These crops grow in such an environment, though field verification may be necessary.
- Improving marketing of produces from this land use type will require similar efforts as other units above.
- The remaining natural trees should not be cut, instead pruning of shady branches would provide enough light for understorey crops.
- Encourage agroforestry fruits and tree planting.

6.2.2.3.6 Land use RF2 (44 ha (6%))

The land use type is characterized by being along the river course, rocky with isolated pockets of soils (Figure 2). RF2 occupy 6% of the entire gap with up to 50% tree cover. Crops grown in the units are maize, beans, banana, cassava and vegetables for domestic consumption. The popular vegetable types include tomatoes and okra.

Agricultural problems

- Soil erosion
- Poor agronomic practices (common to other land blocks).

Recommendations to Land use RF2

Similar to RF1 above

6.2.2.3.7 Land use RF3 (102 ha (15%))

It is an extensive land use type occupying about 102 ha (15%) situated at almost the central part of the gap. It is characterized by 20% tree cover, steep slopes and the crops grown are maize, beans, banana and cassava. Other crops include sugar cane, cow peas and vegetables.

Agricultural problems

They are the same as those explained under RF1 and RF2 above.

Recommendations for land use RF3

They are the same as those in RF1, RF2 and BL3 above.

6.2.2.3.8 *Land Use RF (52 (7%))*

The land use type represents undisturbed natural vegetation which is Mzungui forest reserve that belongs to Kizerui village. The forest is rich in natural tree species such as Albizia spp, Kaya spp, kapok, Mvule and Mkuzu.



Figure 7: Status of some parts of Nilo-Semdoe forests reserve gap showing Mzungui forest (Hill to the right) and scattered residential and three land use types in RF2, RF3 and RF1

General recommendations for Nilo-Semdoe forests reserve gap

For sustainable natural resource management in the units delineated it is recommended that there should be organized efforts for:-

- Tree planting where tree cover is less than 50%.
- Establish community based conservation of the natural catchments i.e. establishment of village forests.
- Improve yields from farmers fields through use of fertilizers (both organic and inorganic sources of nutrients)
- Intensive sensitization about negative effects of bush fires to the environments forests and water sources should be carried out and establish monitoring committees from among the village/communities.

- Land conservation through use of contours and other physical structures to stop soil erosion should be advocated, starting with intensive training and exchange visits for farmers to expose them to different areas where soils have been conserved.
- Facilitate agricultural extension staff to provide their services in the villages. These should include preparing and making farmers understand and adhere to relevant advices from extension staffs.
- Develop by laws and organize farmers in groups that can be empowered through credit facilities to avail them with capital

6.2.3 Segoma Village

6.2.3.1 Geographical Setting

Segoma village is located in a narrow ridge surrounded by an abandoned Shirika la Uchumi la Wilaya ya Muheza (SHUWIMU) estates, in the lowland of East Usambara Mountains. It also forms an important part of Sigi River Watershed, and an important corridor for forest restoration. The village is in Mhinduro ward, Maramba division. SHUWIMU estate was for bitter oranges production but was abandoned due to stagnated economies in the 1990s. The estate now serves as an agricultural land for Segoma village residents. Historical trend shows that people started settling there in 1969, and it was registered as a village in 1975 during the popular villagilisation operation. SHUWIMU estate is bordered by Manga forest reserve in the south, sisal estate in east and Segoma forest reserve in the north east and Kwamgumi forest reserve in the north. There is general land in the west. The village has only one hamlet.

6.2.3.2 Physical Environment (Physiography)

Segoma village is located in the SHUWIMU bitter orange estate occupying a small ridge at the eastern part of the estate (Figure 11). The village is surrounded by several isolated Mountains collectively forming the East Usambara Mountains. It is a foot-slope of Bamba ridge found in the north. Therefore, the village though on the ridge, is basically on the complex Mountains foot-slopes.

The village as well as the estate is characterized by deep soils except on steep slopes areas near the river or hills. The top soils are dark red with red sub soils of medium to poor soil fertility. These soils are generally not fertile but, fertility status has been improved by the long fallow period.

6.2.3.3 Demography

The village has 120 households and a population of 573 people. There are 193, 201 and 179 men, women and children respectively. The village also has 12 and 30 men and women respectively with disabilities. Most of the people in the village came from abandoned Lanzoni sisal estate. The main economic activities are agriculture and petty business. They also depend on illegal forest harvesting of timber, building materials and climbers locally known as *godogodo* for export (Figure 8).

6.2.3.4 Land Tenure

The village was established on the ridge of SHUWIMU probably because the area was not cultivated due to the difficulty to mechanise field operations. Therefore, the people who were redundant because of various factors including age, deteriorated sisal estates following declined sisal prices in the world market in 1970s found themselves establishing homes on the ridge. Since then, people in Segoma are banking on SHUWIMU estate for crop production, although they well know that their village has no mandate on the land they cultivate.

Land ownership assessment shows that few people have land up to 2 acres, while the majority have only 0.5 of an acre. Regardless of this small acreage owned, there is no land pressure in the village because the SHUWIMU unexploited land is available for use. Segoma residents also mention laziness as one of the factors that made many people in the village to have this small area while there is SHUWIMU land around. It is important to note that 60% of the abandoned SHUWIMU estates have turned into a secondary forest.



Figure 8: Forests climbers' godogodo at Segoma village ready for export

6.2.3.5 Crop production in Segoma

Segoma village is characterized by bushy land (Figure 10) with isolated cultivated areas of 3 to 6 acres. The food crops grown in the village are maize, cassava, bananas, beans, cow pea, yams, green gram, and ground nut while the cash crop is mainly coconut. However, it was learnt that many other crops such as beans, banana cassava etcetera were also sold when there was surplus. Most crops are intercropped and there is no clear land use plan for the village. Yields levels for maize ranges from 0.8 to 1.2 t/ha while most of the listed legumes yields are

less than 1 t/ha which are generally low. The optimal yield levels for maize in the study area zone ranges from 4.5 to 8 t/ha depending on varieties and other inputs used signifying those farmers' yields levels are far too low.

6.2.3.6 Methods of land preparation and bush fires

Land preparation is mostly slash and burn and cultivation using hand hoe, and it's done seasonally. The practice is being fuelled by enormous grass and weed which grows fast following intermittent rains, and use of hand hoe in all field operations.

During field surveys there was substantiation of slash and burn practice and fires crossing into Manga forest reserve (Figure 9). It was also reported by farmers that hunting has been a source of bush fires.



Figure 9: Bush fires originating from land clearing process or hunting

6.2.3.7 Crop Production Constraints

Interviewees, men and women in Segoma village identified constrains for crop production in Segoma village to be:

1. Presence of vermin,
2. inadequate extension services, and
3. Shortage of land.
4. Poor yielding cultivars,
5. Traditional cultivation methods,
6. Use of hand hoe, and

7. Laziness of the community as far as agriculture is concern.

Field observation indicated poor agronomic practices; poor crop stands, and poorly managed fields.

6.2.3.8 Grazing areas

Grazing as a type of land use is none existent in Segoma simply because livestock do not form an important economic enterprise. Generally, in the whole village there are very few people with goats and sheep hence no areas were marked for grazing purposes. Another reason is the fact that the village is surrounded by SHUWIMU estate which serves as the grazing land for those few individuals with livestock.

However, it came up during discussion with farmers that among proposed means of alleviating poverty was the introduction of dairy cows and goats, as mentioned by both groups of men and women.

6.2.3.9 Forestry and tree planting

Segoma village people are not planting trees apart from those around homesteads for shade and fruits. This could be attributed to insecurity of land tenure. There are efforts to plant trees being carried out by TFCG throughout Mhinduro ward, Segoma village included. These efforts involve training on tree nursery establishment for business and for farmers' own seedlings requirements. At present tree planting is limited.

6.2.4 Segoma – Manga Forest reserves gap

6.2.4.1 Description of the gap

The gap between Manga and Segoma Forest reserves (Figure 11) is occupied by SHUWIMU estate. The estate was abandoned long time ago such that in some areas, it is difficult to distinguish between the forest and the estate except for the presence of some bitter orange plants that have overgrown to size of forest trees. In the middle of "SHUWIMU forest" there are isolated cultivated fields. However, most of the gap is a closed forest. It is also important to note that about 800 ha of SHUWIMU estate were taken up by Forest department to expand Segoma forest reserve since 1990s. This has reduced the forest gap and contributes to the fact that forests connectivity can easily be achieved, provided there is a political will and support.



Figure 10: Recently regenerated thick forest at SHUWIMU estate

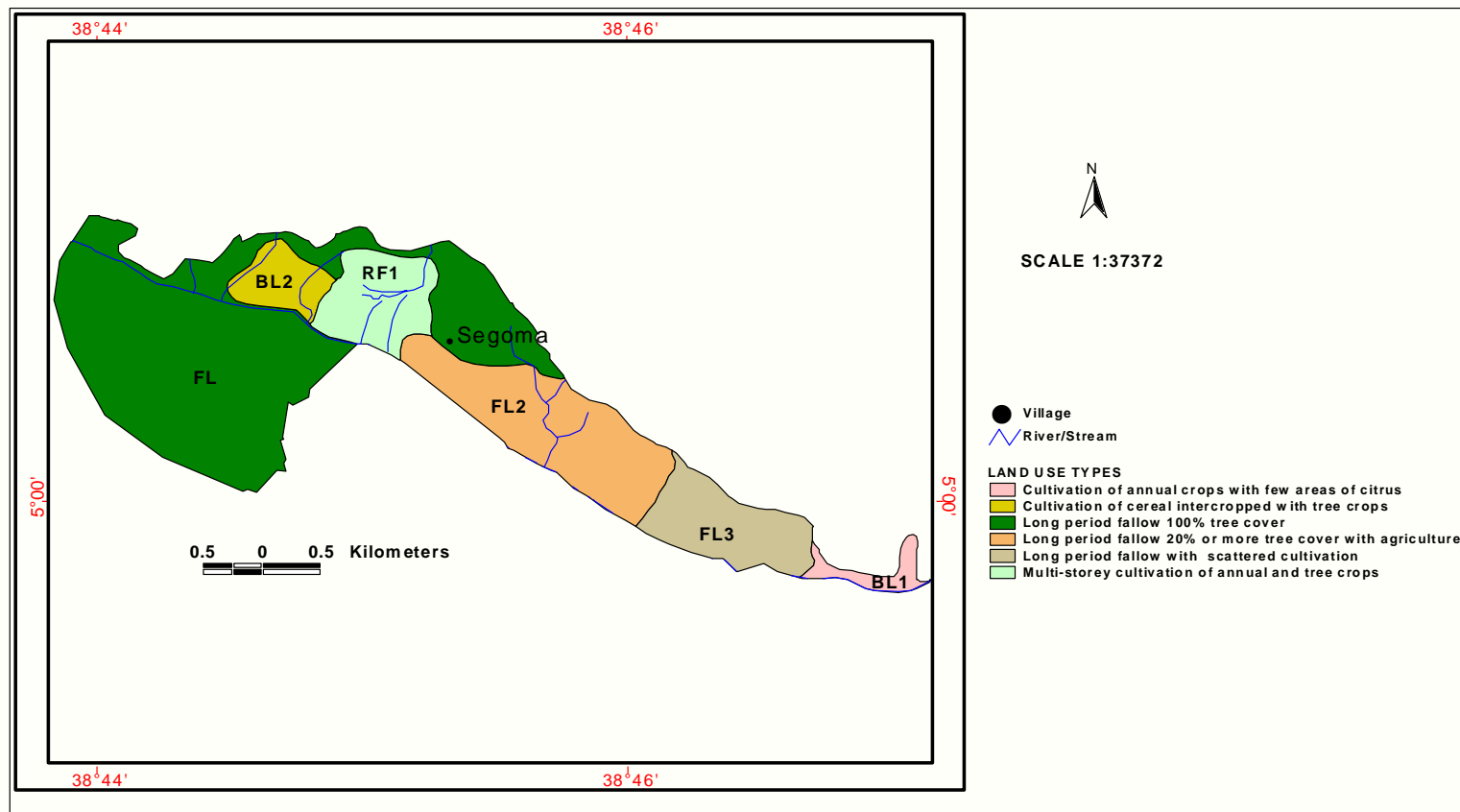


Figure 11: Land use types in Segoma-Manga forests gaps

6.2.4.2 How the gap evolved and its status

The gap between Segoma and Manga forests reserves started when few individuals who retired from Lanzoni and other nearby sisal estates and closed Sikh sawmills came to settle at ridge of SHUWIMU estate that was not cultivated. Other people who wanted to have more land came from nearby villages. It is important to note that while SHUWIMU was operational, the areas surrounding it were under the general land, and therefore, village governments around could allocate land, to landless people who came to register as villagers.

The status of the gap today indicates that there are isolated cultivated fields in SHUWIMU estate. The field sizes range from 3 to 6 acres at one place. There are also indications of immediate regeneration (Figure 10) where cultivation has stopped.

6.2.4.3. Land use types in Segoma - Manga forests gap

Figure 11 and Table 2 present findings of mapping land use types Segoma – Manga forests gap. There are five distinguishable land use types. These are BL1, BL2 FL1, FL2, FL3 and RF1. The gap however is dominated by regenerated of forest of the abandoned SHUWIMU bitter orange estate.

Table 2: Summary of land use types in Segoma-Manga forest reserve gap

CODE	Description	Area (ha)	Proportion (%)
BL1	Cultivation of annual crops with few areas of citrus	13	2
BL2	Cultivation of cereals intercropped with tree crops	27	5
FL1	Long period fallow 100% tree cover	318	55
FL2	Long period fallow 20%, or more tree cover with agriculture	109	19
FL3	Long period fallow with scattered cultivation	60	10
RF1	Multi-storey cultivation of annual and tree crops	52	9

6.2.4.3.1 Land use BL1 (13 ha (2%))

The unit is characterized by annual crops cultivation, intercropped with citrus. The area has been cleared of tree cover. It occupies 13 ha (2%) of the entire gap (Figure 11). It is located in the eastern part of the gap near Muheza - Maramba road. The mode of land preparation is slash and burn and hand hoe cultivation. Crops grown in the units include maize, cow pea, pigeon pea and citrus. Other crops are banana and coconut. It has been reported that yield levels are comparatively high ranging from 0.8 to 1.2 t/ha for maize, but less for beans. This has been attributed long period fallow.

Agricultural problems

- Use of hand hoe was among major problems because of vigorous weeds. This prevents farmers from cultivating large pieces of land; hence most of them own less than 2 acres.
- Inadequate use of agricultural inputs (improved seeds, pesticides, fertilisers etc)
- Lack of land ownership

- Lack of extension services
- Poor agronomic practices

Recommendations for land use BL1 (Segoma – Manga forests gap)

1. There should be extension staff in the village.
2. Efforts should be geared towards reduction of hand hoe (drudgery) by introduction of draft animal (animal power).
3. Extension staff should train farmers on sound agronomic practices such as use of high yielding seeds, spacing etc.
4. Although soil fertility management was not mentioned, it is recommended that farmers should be acquainted with dynamics of soil fertility and management for sustainable use.

6.2.4.3.2 *Land use BL2 (27 ha (5%))*

The land use type is characterized by cultivation of scattered cereal crops intercropped with tree crops such as mangoes and coconut. It is 27 ha big with a proportion of 5% of the entire gap (Figure 11, Table 2). The unit forms the most important agricultural area in Segoma village. Crops grown are maize, beans, cow peas, banana, cassava, sugar cane and various fruits.

Agricultural problems

- 1) Poor agronomic practices,
- 2) Inadequate capital,
- 3) Poor markets due to people growing similar types of crops that do not find external markets,
- 4) Use of hand hoe,
- 5) Inadequate skills and extension services,
- 6) Dependence on few crops as cash crops,
- 7) Insecure land tenure that make up a big problem in the village

Recommendations for land use BL2

- 1) There should be an extension work to address agronomic issues in the village,
- 2) Organise groups/associations of farmers and prepare them for credit facilities,
- 3) Market of produce should be done in groups through bargain, and should have market information before selling the crops,
- 4) Sensitization should be done on use of animal drawn implements that reduce workload especially to women and children
- 5) High value crops should be planted to avail capital to farmers. Demonstrations should be done in groups. Vegetable cultivation gives better income than annual crops.
- 6) Diversification of crops should be attempted by introduction of new crops in the area such as high yielding *cashew nut, cocoa, black paper and cloves*.
- 7) Introduce soil conservation measures to farmers as a prerequisite for improved farming and soil management,
- 8) There should be follow up missions to find out legal status of Segoma village Muheza district Council as well as the position of the district on the ownership of the SHUWIMU estate. This should include providing legal ownership for villagers.

6.2.4.3.3 Land uses FL1, FL2 and FL3 (477 ha (84%))

The land use types are long period fallows. FL1 comprises 318 ha while FL2 and FL3 are 109 and 60 ha respectively (Figure 11, 12 and Table 2). FL1 has been a bush while FL2 and FL3 are slightly open because of some farming activities going at limited scale. The whole fallow is 477 hectares forming a proportion of 84% of the land in the gap. It is also important to note that the gap boundary to the west is in the forests in the general land that is not gazetted.



Figure 12: Long period fallow (FL2) in Segoma-Manga forests gap

Recommendation for land use FL1, FL2 and FL3

The land use is basically vegetation cover. It is the SHUWIMU abandoned estate that has regenerated into forest in many areas.

- 1) It is recommended that if farmers are to cultivate, the areas to cultivate should be FL2 and FL3 and leave FL undisturbed,
- 2) Stop the use of field fire cleaning which has been a source of forests destruction in the area,
- 3) Prepare by laws and ensure their enforcement to curb illegal harvesting and bush fires.
- 4) There should be clear boundaries between areas cultivated and those left out to form forests.
- 5) Recommended that all *general land* in the west of the gap should be claimed for gazetting to prevent encroachment from neighbouring Kambai and Kwatango villages.

6.2.4.3.4 *Land use RF1 (52 ha (9%))*

It is a multi-storey cultivation system where annual and tree crops are intercropped. Crops grown are maize, beans, banana, cow peas, green gram and sugar cane. Tree crops include mangoes, jack fruit, coconut and oil palm. This area is mostly occupied by an individual of Arab decent. He has also planted woodlot consisting of teaks (*Tectona grandis*) that are at the harvesting age.

Agricultural problems

- The system is tree dominated therefore annual crops have low yields.
- Poor agronomic practices (for both annual and perennials).
- Poor soil management.

Recommendations for land use RF1

- There should be a balance between annual and perennial crops for maximum harvest of both
- Introduce integrated soil fertility management skills (cover crops, manures and composts of crop residues)
- Carry out sensitisation on how to grow woodlots for sale and how to market wood crops.

6.2.5 Kuze Kibago Village

6.2.5.1 Geographical Setting

Kuze Kibago village is located in Mhinduro ward, Maramba division in a newly formed Mkinga district. It borders Bosha village in the north, Kwamtili estate and Segoma forest in the east, Kambai village and Kizerui in south and south-east and Nilo forest reserve to the west (Figure 1). The village has 10 hamlets which are Kibago (A), Kibago (B), Mabanda, Seluka Kwamtili, and Kwesangazi. Others are Magati (at the gap), Antakai, Miongwe, and Feza. It is a natural village that started long before colonial period on top of a highly productive Mountain given the name “Kuze” locally meaning a good land. It is important to note that Kuze Kibago is one of several villages that make Sigi River watershed. Sustainable flow of the river therefore depends on the recharge of the river tributaries.

The old people explained reasons that made them live in mountains tops. They said it was to avoid fierce wild animals like lions, elephants and buffalos as the lower part of the village that was the animal corridor walking either side during certain periods of the years. The second reason was hiding from wars from different tribes, and colonial rulers. Later, however, people settled a bit lower to mountain shoulder because their number increased such that the mountain top could not support them. The village was registered as Kuze Kibago in 1976 following the villagisation operation of 1975 in the country.

6.2.5.2 Physical Environment (Topography)

Kuze Kibago village lies at a highly dissected portion of East Usambara Mountains with two mountains tops of Kuze and Mkweya. It is situated at shoulders of two hills that are highly dissected to form broad ridges with relief intensity of 200 metres and very steep slopes of up to 70° (140%). Transect from the grazing area through Mkweya traverses across 10 draining

lines showed that 7 out of 10 streams that were permanent streams during the 1970s through 1980s have dried. The remaining 3 have little water and with signs also to dry up.

The area of the village that borders Nilo forest had very steep slopes over 140% therefore soils that are disturbed during land preparation move down the slope by gravity (Figure 13).



Figure 13: Soil movement by gravity due to steep slope at Miongwe in farmers' fields, Kuze kibago village

Soils

Four types of soils were observed along transect.

- Black clayey soil, sticky and plastic and it is mostly found in valley bottoms. Crops grown on the type of soil are sugarcane, maize and beans. The soil covers few areas except in Magati where in the whole hamlet the soil is dominant.
- Dark brown clayey soil, with comparatively good fertility status and therefore bears relatively good yields in good rainfall years. The soil found mostly on sloping lands, but also can be found in valley bottoms in the forest gaps. Due to their position on the landscape the soils are easily erodible by rainwater and crip with gravity when disturbed or cultivated without conservation measures (Figure 12).
- Red clayey soil widely spread than other types and it's located in sloping lands. It is comparatively poor in fertility and dries more quickly after the rains have stopped.

- Soils characterized by having shallow depth and gravelly. It is located in very steep slopes and therefore highly erodible. The soils stores little water and therefore dry quickly after last rains. Due to the shallow depth, the soil is not suitable for most crops.

6.2.5.3 Demography

There are 595 households in Kuze Kibago with a population of 3,256 people. There are 1202, 1056 and 998 men, women and children respectively. There are 126 disabled people in the village, 64 being men and 62 women, mostly due to old age and chronic disabilities and diseases. The general household size is 4 to 7 persons.

The implications or consequences of present high population will be small farm sizes of less than 1.5 ha for most households in just few years to come. This cannot provide enough food or income for a household of about 7 persons unless there is intensification coupled with use of industrial chemicals (fertilisers, pesticides and insecticides). Other consequences include encroachment of the nearby forest reserves for hunting, illegal logging and charcoal burning to support their lives.

6.2.5.4 Land Tenure

Land tenure or ownership in the Village is traditional and is controlled by clans. There are few, people or clans that own big chunks of about 70 acres of the land in the village. The majority of the villagers however have about 2 to 5 acres. Therefore, the landless people hire land from those with excess land at a cost between Tsh 5,000/= and 7,000/= per acre. It was also observed that normally the land hiring people are given areas that are degraded because of continuous cultivation while land owners cultivating virgin areas which produce more crops. Also, it has been reported that young people acquire land by inheritance or given by parents and additional land is bought or people move to public lands for example newly opened villages like the forests gaps under study. Therefore, there are five ways of acquiring land in the village, which are:

1. Allocation by parents or clan,
2. Inheritance,
3. Buying,
4. Hiring by paying between 5000 and 7000 per growing season per acre, and
5. Allocation by village government where public land is available.

6.2.5.4.1 Land tenure and women farmers

The land tenure as far as women are concerned is still oppressive. The study indicated that in Sambiaa tribe or ethnic group women do not inherit land from the parents, but inherit from the deceased husbands. However women could buy their own fields when they have resources. So, traditionally, women are given pieces of land to cultivate their crops of choice, but do not own or have mandate to sell or hire freely as men do.

6.2.5.5 Crop production in Kuze Kibago

Cultivation of land for crop production is the dominant form of land use. It occupies 80% of the total land of the village, 20% occupied by grazing and rocks which are not suitable for agricultural activities. Cultivation in the area is characterized as mixed cropping. The

community intercrop maize, cassava, beans, bananas and even tree crops in the same piece of land. About 100 % of the village practices intercropping of maize and beans or other legumes. Tree crops include cashew nuts, coconuts and mangoes mostly planted close to homesteads. There are also few fields intercropped with other crops. Sugar canes are planted in wet areas while cardamom is planted under shaded areas such as water streams and closed woody areas. Cardamom is not that important in Kuze Kibago except for few families.

There are grazing areas in Kuze Kibago in every hamlet. The areas are characterized by rockiness and no productive areas are allocated for grazing of livestock, sheep and goats. However, the number of animals kept is small. The extent of these grazing areas was not immediately known.

There are land use plans in the village, where few areas have been planned for communal forests in every hamlet of Kuze Kibago. Tree nursery groups and training are going on being facilitated by TFCG. A network of nursery groups have started and they meet on agreed dates and plan for tree planting efforts in the whole of Mhinduro ward.

6.2.5.6 Methods of cultivation and bush fires

Throughout the village land preparation is slash and burn, and flat cultivation along slopes. Crop residues such as maize and beans residues are burnt. The reasons for rampant burning of residues include use of hand hoe which is drudgery especially when dealing with large amount of weeds (grasses) that are difficult to work on and also inadequate knowledge about the negative effects of burning on soil productivity.

Although there was evidence of burning (Figure 14) in Kuze Kibago, the team did not observe any evidence of bush fires in Nilo Forest reserves, which suggest there is clear understanding that bush fires are illegal and it also shows there is popular support of forest protection involving environment committee in the village.

The situation is different in the forest gap to the side bordering Semdoe in Magati hamlet (Kambai village) where forest boundary is highly encroached and there is evidence of trees destroyed by fires in the eastern corner.

6.2.5.7 Crop Production in Kuze Kibago village

There are several crops grown in the village. Field observation indicates poor agronomic practices, poor crop stands, and poorly managed crops in general. However, yields levels for maize range from 3 to 5 bags of 100 kg per acre in the old upland hamlets. Banana and cassava fields are poorly maintained resulting to poor yields. Farmers' list of crops grown and field observation indicates that major crops are:

Maize

- Used for food and cash
- Used for local brewing
- Used as cash crop, when there is surplus

Cassava

- Important for food security as available in the year round.
- It is utilized raw and can be cooked in different ways such as stiff porridge.

- It's different parts have different uses e.g. leaves serve as green vegetables
- Drought tolerant and grow relatively well in poor soils

Bananas

- Important as food and cash crop and available year round
- Have multiple types of consumption,

Beans

- It matures early hence serve to check hunger.
- Serves as food utilized in various ways in combination with cereal crops.
- Beans leaves used as green vegetables.
- It is a cash crop
- Used in rotation in order to restore soil fertility.



Figure 14: Land preparation, slash and burn at Mabanda – Kuze Kibago, behind Nilo Forest reserve

6.2.5.8 Constraints to crops production

Farmers were able to list different constraints hindering crop production in the village. There were also slight differences between gender groups as listed in Table 3. However, it is important to note that farmers could not relate low yields with poor tillage practices, use of poor yielding cultivars and or even link soil fertility with rampant soil erosion and continuous cultivation. Although they know that continuous cultivation for five (5) seasons leads to reduced yields and normally corrected by people with big pieces of land practicing shifting cultivation. Farmers also listed a number of constraints (Table 3) and their coping strategies (Table 4). It was noted that women could not pin point that they lack or had inadequate extension services but rather said they had inadequate knowledge of how to conserve their

soils. This showed that women in the village are not aware that there are people supposed to work in villages training farmers on appropriate agronomic technologies.

It was observed that men and women put forward the same list of crops and bottlenecks and also coping strategies. Therefore, mechanisms that are geared to remove agricultural bottlenecks will apply equally between men and women.

Table 3: Bottlenecks to crop production listed by different household categories

Crops production bottlenecks	Gender	
	Men	Women
Inadequate knowledge	√	√
Poor soil fertility	√	√
Vines (wild animals)	√	√
Pests and diseases	√	√
Shortage of markets	√	√
Poor infrastructures	√	√
Inadequate extension and research services,	√	-
Lack or small capital	√	√
Lack of inputs (seeds etc)	√	-
Unreliability of seasons	√	√
Land scarcity	√	√
Poor soil conservation	√	√
Low crop prices	√	√

There were several farmers concerns as to why they could not conserve their fields' soil fertility, these included:

- Inadequate knowledge on different soil and water conservation,
- Uncontrolled burning of fields
- Insecure land tenure such as hiring and borrowing.

6.2.5.9 Livestock holdings and production

Livestock constitute an important part of agro-pastoral farming system found in the study area. There are about 200 cattle in the village, 300 goats and sheep. From the data goats and sheep are the dominant livestock. However, livestock keeping in particular cattle is mostly by few households and there are no improved dairy cows. Regardless of the small number the livestock cattle, sheep and goats are an important source of income and source of pride and status in the community. Ownership of animals is mostly by men and women own chicken.

Table 4: List of coping strategies to crop production constraints by gender

Constraints	Strategies	
	Men	Women
Decrease in soil fertility	Fallowing Crop rotation Mixing cereals and legumes	Fallowing Crop rotation Mixing cereals and legumes
Market shortage	Selling at home to middlemen Carrying crops to Maramba by heads	Selling at home to middlemen Carrying crops to Maramba by heads
Wild animals	Use of local traps Avoiding areas of high incidences Scaring	Use of local traps Avoiding areas of high incidences Scaring
Inadequate farmland	Hiring Intercropping	Hiring Intercropping
Inadequate extension services	Haphazard agriculture	-
Unreliable rain seasons	Planting crops tolerant to drought and planting every rainy season	Planting crops tolerant to drought and planting every rainy season
Small capital	-Unregistered money contribution (kibati) - Should be given affordable loans -Dairy cows	-Unregistered money contribution (kibati) - Introduce dairy cows -Keep local chicken
Soil erosion	None	None-

The Zebu breed is the type of cattle commonly kept in area. They produce relatively low milk and meat but they withstand environmental stress better than exotic breeds, in addition to surviving on rough grazing and very steep slopes.

6.2.6 Grazing areas

Grazing is not such an important form of land use but is next in importance to cultivation, covering about 20% of the total land area in Kuze Kibago. Most of the grazing areas are those that are not suitable for cultivation, characterized by very steep slopes and rocky areas (Figure 15). The dominant grass species in these areas are star grass, *Cynodon dactylon*, Elephant grass (*Pennisetum purpureum*) and many legumes.

6.2.6.1. Livestock production constraints

The main constraints facing animal production is low yielding breeds, inadequate funds to buy and keep cattle and diseases, although these are not so prevalent. The people in the gaps also keep animals. Figure 6 was taken at Bebere Kizerui village at the boundary between the village and Nilo forest. The animals were feeding at the boundary. During the study period

there were no fodder problems but during the dry season, it is envisaged that livestock could be feeding deep in the forest. At present there are few animals in the villages, but if the number increases, there are possibilities of animals encroaching forests in future.



Figure 15: Grazing area at Mabanda hamlet Kuze Kibago

6.2.7 Forestry and tree planting

There are no efforts going as regards to tree planting except for tree crops such as mangoes and coconut planted near homesteads. However, farmers explained that there are areas which have been earmarked for village or hamlet woodlots establishment under TFCG, which started training of farmers in Mhinduro ward about nursery establishment and management. Traditional tree planting is confined to fruit trees such as cashew nut, coconut and citrus fruits.

6.2.8 Kwamngumi/Segoma – Semdoe Forest reserves gap

6.2.8.1 Description of the gap

The gap between Kwamngumi/Segoma - Semdoe is made by hamlets of three villages which are Kuze kibago, Kizerui and Kambai villages. It is called by several names depending on the village of origin of individuals. It named Seluka and sometimes Bebere by people from Kuze village and Magati by those individuals from Kambai village. River Sigi divides the two Magatis hamlets while physical feature separate Seluka. The gap (Figure 17) is broader in the west and narrow in the east where it borders Segoma forest. The gap is characterized to be rolling (Figures 16 and 18) with hills characterized by steep slopes. Most of the gap has scattered fields and also few closed fallow areas particularly away from the mother villages.

It is also important to note that 10 years fallow in these areas with high rainfall makes the landscape to have forest look (Figure 16).

6.2.8.2 How the gap evolved and its status

An account of how the gap between Kwamngumi/Segoma and Semdoe has evolved is not different from that of Nilo_Semdoe forests gap. Initially its landless people expelled from Kwechawa and Semdoe due to forests expansion in 1990s who were the first people to settle. Then there were immigrants to from Lushoto district and later people who bought land from the first settlers.



Figure 16: Kwamngumi/Segoma – Semdoe forests gap showing landscape, and effect of bush fires and hand hoe land preparation

6.2.8.3. Land use types in Segoma - Manga forests gap

Figure 18 presents different land use types in the gap. There are three major land use types, based on percentage of tree coverage. The land use types are BL3, BL4 and FF. The gap in total comprises 518 ha. Crops grown are maize, beans, cassava and banana. Other crops are sugar cane, vegetables such as paprika, tomatoes and cabbage. Tree crops include mangoes, cashew nut and coconut.

Mode of land preparation is slash and burn and then hand hoe (Figure 16). The gap has incidences of bush fires every other season according to the forest field officer for Kwamngumi.

6.2.8.3.1 Land use BL3 (367 ha (71%))

Land use BL3 forms a major part of the gap with 367 ha. It is characterized by cultivation and tree cover that ranges between 10 and 20%. The unit is famous for maize, cassava, beans, banana and sugar cane. Tree crops are cashew nut, mangoes and coconut.

Agricultural problems

- From Figure 16 above hand hoe is major problems
- Poor agronomic practices

- Soil erosion (farmers cultivate along the slope)
- Nutrients mining (farmers do not apply fertilisers)
- Low use of agricultural inputs (agrochemicals, seeds etc)
- Land preparation by slash and burn (environmental harmful practice)

Recommendations for land use BL3

1. Sensitize farmers about use of animal power as alternative to hand hoe.
2. Introduce concepts of sustainable soil conservation and management (integrated soil fertility management, agroforestry use for soil fertility and better management of crop residues instead of burning to improve soil moisture storage, nutrient levels etc.)
3. Sensitize farmers about negative effects accruing from use of fire to clear fields to soil organic matter, forests around and soil moisture storage
4. Encourage farmers on use of agricultural inputs for improved yields (example certified seeds, fertilisers and pesticides for quality and quantity yields)

6.2.8.3.2 Land use BL4 (130 ha (25%))

Figure 17 present land use LB4 that occupies 130 ha, 25% of the forests gap. It is characterized by cultivation and tree cover less than 10%. The landscape in the area is gently undulating to rolling with slopes up to 45% (Figure 18). Crops grown in gap include maize, banana, sugar cane and beans

Agricultural problems

- Use of hand hoe is major the problem,
- Poor agronomic practices (poorly maintained fields),
- Nutrients mining (farmers do not apply fertilisers),
- Low use of agricultural inputs (agrochemicals, seeds etc), and
- Land preparation by slash and burn (environmental harmful practice)

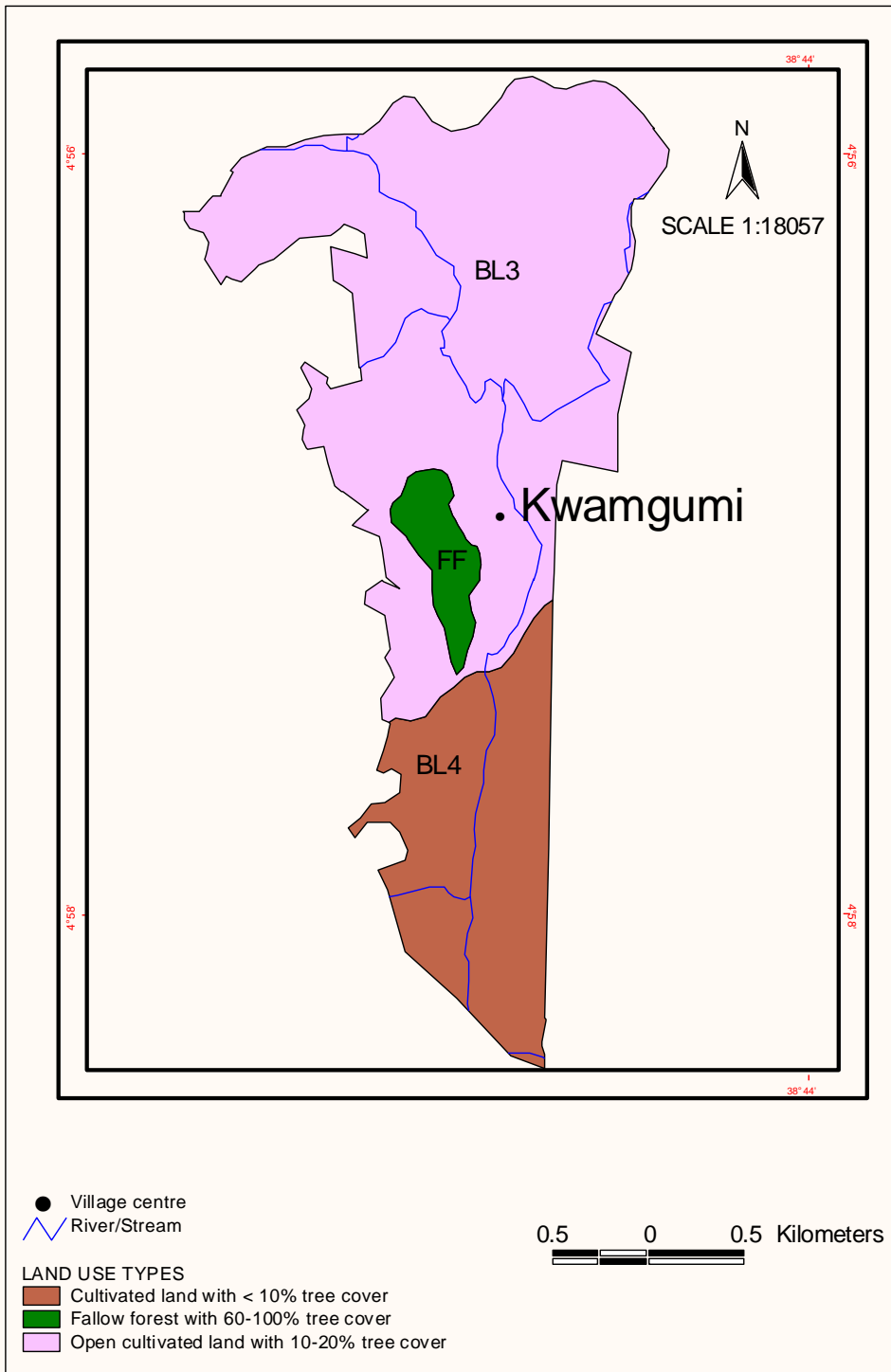


Figure 17: Kwamngumi/Segoma – Semdoe forests gap, land use types



Figure 18: Poorly maintained fields of maize and banana in Land use LB3 in Kwamngumi – Semdoe forests gap. Far behind is Segoma forest reserve.

Recommendations for land use LB4
Same as LB3 above.

6.2.8.3.3 *Land use FF (21 ha (4%))*

Land use FF denotes long time fallows hence has mature natural trees such Mvule, Albizia spp, Ficus spp etc. It is a small unit of 21 hectares about 4% of the entire gap, which is suited to be a village forest or woodlot. It is said to belong to an individual.

Recommendation for land use FF

- To negotiate with owner in order to avail the to the village government for use as woodlot or village forest or have the area managed as private forest reserve.

7.0 GENERAL HISTORICAL TRENDS IN NATURAL RESOURCES DEGRADATION IN THE STUDY AREA

Historical relationships among different components of the natural resource base are summarized by Figure 19 and Table 5. Information on natural resources degradation with time was collected through the entire walk and elders discussions. The process was important because it enabled farmers to gauge what might have been the situation of selected natural resources since the first people settled in the area and the level of farmers' perception to forests degradation. The historical analysis also assisted farmers to perceive the present and probably predict the future. The gauging of the past was done by comparing what looked so obvious to farmers for easy drawing of conclusions. The interviewees collectively agreed that there were changes from good to bad as they could remember; there were no changes that were good as far as natural resources management was concerned. Arbitrary two periods were set, the good years being between independence 1961 and 1980s and deterioration of most natural resources began during the 1980s. It was also agreed that the main cause for deterioration was commercial logging and sawmills established by colonial rulers, population increase, and poor tillage practices among others.

Table 5: Historical trends of key natural resources management issues

Event	Time in Years	
	1960-1980s	1990-2000
Rainfall availability and reliability	Good	Not good
Number of rivers/streams	Many	few
Water levels in the rivers/streams	More water	Less water
Bush fires	No bush fires	Frequent fires
Size of land owned by individuals	More than enough	Not enough
Crops yield levels	Enough yields	Not enough
Land scarcity	No	Yes
Tree planting	Not needed	Few planted
Soil fertility status in steep slopes	Very good	Not good
Soil fertility status in valley bottoms	Very good	Slightly good
Soil erosion status in hilly steep slopes	Not much	Much
Natural forests harvesting – logging	Too much harvested	No harvesting
Follow up on Central GoT laws	Strict	Not strict
Presence of livestock kept	Many	Few
Youth depending more on employment than cultivation	Not many	Many
Variety of wild animals	Many	few

Generally, the trend indicates that degradation of natural resources such as water sources, land and soil erosion, soil fertility etc were increasing with time and with the proportional increase of the consequences such as reduced yields, reduced water levels and increased pests and diseases. Therefore, there is a direct relationship between natural resources degradation and increased use that accrues from increased population.

During the colonial rule in 1954 Nilo forest was gazetted. However, most of the areas were bushy and forests. During that time there were traditional beliefs, which to a great extent governed the way natural resources were managed and utilized. There were abundant water resources such as springs, streams and rivers well covered by vegetation. Farmers practiced slash and burn cultivation to secure lands for planting crops and practiced zero tillage. The colonial government made laws that were meant to protect natural resources. For example farmers who cultivated on steep slopes without any conservation measures were sentenced to jail for 3 months. Also, there was an order that all un-conserved steep slopes should be planted with banana. There was strict enforcement of the government laws on natural resources management.

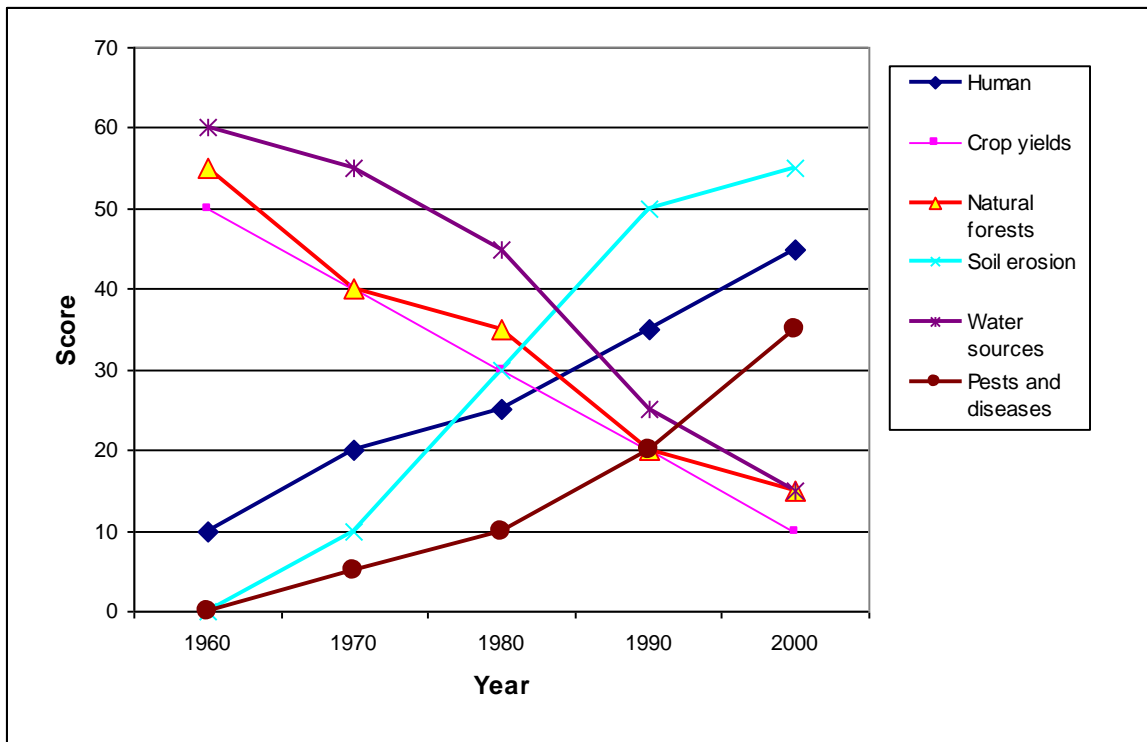


Figure 19: Historical trends and interactions of population and natural resources in the study area

During struggle for independence, farmers were asked to support the struggle for independence with a promise that the enforcement of the law on conservation structures and penalties will be lifted immediately after independence. After independence in 1961 through 1970s there was a notable population increase and general relaxation of by laws enforcement as local chiefdoms were abolished. This period experienced a lot of changes in natural resources management (NRM). There was indiscriminate forest clearing to open new land for cultivation and rampant abuse of water sources, the streams and rivers. During the same period cultivation on slope lands and by laws on cultivation close to water resources were not adhered to, leading to the current state of degradation. Most practises such as ridging and terracing were abandoned and replaced with flat cultivation including the steep slopes.

During the 1980 through 2000s there was rapid and tremendous increase in population. There was also an increase in uncontrolled tree cutting, wild fires and cultivation close to water

resources, increases in vegetable cultivation on valleys, free grazing and non use of soil and water conservation measures, leading to further natural resources degradation (Figure 19). The consequences of poor enforcement of by-laws that governed natural resources were depletion of water sources, reduced soil productivity and rampant soil erosion, indicated by drying of water springs, increased seasonal availability of waters from some springs leading to low levels of water flows in streams and rivers (Figure 19).

Research works report that forest clearing between 1954 and 1978 was rampant where 50% East Usambaras forests were cleared, while much of the remaining is in various stages of degradation (Rodgers and Homewood 1982; Newmark 1998). This suggests disappearance of forests if strong measures are not taken. It also implies that the idea of forest connectivity will rescue substantial forest cover in the East Usambara and in Nilo which is second after Amani for diverse biodiversity.

7.1 ENVIRONMENTAL DEGRADATION AND FARMERS' PERCEPTION

7.1.1 Deforestation, soil erosion and drying out of water sources

The consequences of environmental degradation in the study area are obvious (Figure 19). Forest and woodland areas were cleared for cultivation. This resulted in encroachments of forests that were not gazetted like Semdoe, and all areas found in the three gaps earmarked under this study. Pressure for more land further squeezed forests and cultivation to very steep slopes and very fragile areas, causing drying of water sources. For example, in transect which had 10 streams in 1970s, 7 of them dried completely indicating they have become seasonal discharging water during the rain season only.

Considering the fact that the study area is the watershed to Sigi River, which is the main source of water to the country side to the Indian Ocean and Tanga City, it pose threat that if the situation is not going to improve in the near future, it will negatively affect water supply in the city affecting domestic and industrial water supply which in turn will be expensive to avail water from alternative sources.

At global levels, the study area is among the areas with unique plants and animals. As population increases, settlements will grow and the demands for fuel wood and other wood materials will increase which still exert pressure to these globally important forests.

Meanwhile continued crop production without proper conservation to the ever-eroding soil will accelerate erosion leaving behind unproductive sub-soils and gullies that are not productive.

The general public perceive responsible for the recent environment degradation that they described as drying out water sources, reduced yields and stony fields. People locally say the 'stones are growing' indicating considerable soil erosion.

The government was also answerable by politicising environmental issues and the general relaxation in the enforcement of by laws. The farmers asked themselves a question that, if water ceases to flow, how are they going to survive? The analysis prompted the elders at Kuze Kibago who knew well the situation before, to vow that, they will start to enforce the water sources protection by laws without fear of being seen as bad people or bewitched because they said “there is death always.

7.1.2 Use of land resources

The soil is the substrate used for agricultural production to sustain the food and other materials needs. The way the soil is used to produce food is one of the underlying causes of environmental degradation. The initial clearing of forest cover to get access to more fertile soil exposes the soil to the forces of rain drops and runoff responsible for erosion particularly on very steep slopes. Farmers explained that in old days, they used well planned shifting cultivation whereby the exhausted areas are left to rest as fallow for restoration of soil fertility. Unfortunately, the situation has now changed due to increased population so the land is cultivated continuously. The results have been declined soil fertility manifested by reduced yields.

Cultivation on steep slopes, including mountain up-slopes, without any physical conservation measures, has also contributed tremendously to accelerated soil erosion and reduced infiltration which account for reduced river recharges manifested as reduced river flows. In earlier years as farmers could remember, there were regulations governing the use of such slopes, either through completed protection or the use of terraces. Farmers are well aware of the contribution of tree cutting and soil erosion to environmental degradation.

The farmers could very well describe and gauge reduced water flow by mentioning that it was not possible for children to cross most of the river tributaries in 1970s and even grown up would take off shoes, but today 2000s, children cross rivers without parents’ helps and also one could cross a river from one side to the other without taking off shoes. Soil erosion was gauged by the growing size of boulders and stones as the soil are being eroding from fields that had no stones when they were being opened.

7.1.3 The population increase

The high rate of population increase, due to both natural birth and immigration exerts undue pressure on the already deteriorating resources in the study area. The rapid expansion of cultivation and the dwindling forest cover at the gaps have been associated with rapid resettlement of immigrants from Lushoto, Kwechawa, Semdoe and other areas. There is also a rapid increase in households as the statistics show that when Kizerui village started in the year 1990s there were 200 households, but in 2005 there are 426 households which is an increase of 226 households in less than 20 years. The situation is the same throughout the studied villages.

This rapidly expanding population led to potential land being taken over for cultivation within the three gaps. Now there is no more available land in the area apart from further encroachment around water sources and on mountain tops which are marginal and unsuitable for cultivation. Two villages (Kuze Kibago and Kizerui) and farmers at the Kwamgumi and Semdoe forests gap recognize the contribution of the population pressures to environmental degradation.

7.1.4 Unreliability of rainfall onsets and increased drought

Although rainfall records indicate that East Usambara is within the high rainfall area that receives up to 2000 mm per annum, there are recent significant fluctuations as indicated by farmers. The frequency of drought and unreliability of onset days seems to be increasing. For example there used to be four seasons but now there are two which are not reliable. The onset of the last season was confusing because rains started late than expected therefore reduced yields because they also ended earlier. The increased frequency of drought could be linked to the global degradation of environment affecting most of Sub-Saharan Africa and the World.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

Due to a wide data coverage collected in the field and discussions held with farmers, this study have several conclusions to make. It is important however to note that there are conclusions and relevant recommendations under specific land use types in the main text.

1. Rapid population growth will in a near future add pressure to the forests in the area, widen the existing forest gaps and therefore prevent sustainable forests connectivity. This was evident from the expanding and newly established farms in the gaps and shortening of fallow periods is also attributed to population pressure.
2. The studied villages obtain relatively poor crop yields due a chain of factors among them include continuous cultivation (nutrient mining), poor agronomic practices and use of poor yielding cultivars.
3. Soil erosion is widespread and serious because most of the study area fields are on steep slopes about 70⁰ (degree) but cultivated without any soil conservation measures.
4. There are natural trees in Nilo-Semdoe, Manga-Segoma and Segoma and Semdoe forests gaps which make it possible and easy for secondary natural forests re-establishment in the area.
5. There is a serious threat of drying up of rivers tributaries which are catchments for Sigi River. Water shortage due to drying up of Sigi River will negatively affect the potential growth of Tanga City in future and in particular it will jeopardize possibilities for industrialisation.

6. Communities in the study area are not familiar with by laws (such as Forest Acts), governing land and natural resources management. Farmers' works on their fields cutting down trees like Mvule (*Milicia excelsa*).
7. Establishment of villages' forests and woodlots will in future reduce dependence of Forest Reserves for wood supply in nearby communities.

8.2 RECOMMENDATIONS

Following the conclusions derived from the field visits, there are also several recommendations.

1. It is recommended to determine land use planning in the villages at the Forest Reserves gaps, to facilitate sustainable land use by putting a suitable use at right landscape.
2. Immediate steps should be taken by Muheza Forestry Department/district Council and other stakeholders in order to establish and gazette public lands around Semdoe and Manga Forests Reserves to prevent immigrants from taking advantage of this general land to ensure that they are placed under sound management.
3. It was found that hamlets in the key gaps were divided into three villages around the fact that deprives ownership any particular village hence making any intervention difficult. It is recommended that to facilitate the project success, a village status should be given to the hamlets.
4. Recommended to introduce soil conservation measures and sound agronomic practices (use of certified seeds, planting across slopes, and recommended specific crop spacing) use of fertilisers and manures to improve soil fertility. Agroforestry techniques are advisable in areas with less than 50% tree cover but well guided by agroforestry to avoid over shadow to crops.
5. Improved livestock production by introducing or improving dairy cattle stock and improving standards of husbandry for the existing local breeds including controlling diseases.
6. Farmers indicated poor infrastructure, inadequate agricultural knowledge and inadequate financial capital which call for the whole spectra of farmers' empowerment. For example farmers should be facilitated to establish credit facilities, trained on sustainable agricultural practices (use of certified seeds, pesticides/botanical) and facilitated to obtain extension officer based in the village.
7. Empowerment of the community on environment should include formulation of by laws that should govern use and management of water sources, soils, and trees in farmers' fields. For example establishment of village environmental committees

(VECs) that oversee implementation of by laws that safeguard sustainable use of natural resources and also acts as doorway of outsiders in communities in the gaps.

8. Introduce and promote training farmers on trees as crops and therefore encourage establishment of commercial woodlots timber, fuelwood and building materials in future. This should include facilitating individuals with large chunks of land to establish and manage private forest reserves.
9. To secure forests from bush fires training of fire hazards should be carried in villages around forests (leaders and farmers). Also there should be wide forest buffer around the villages.
10. Segoma village has no legality on the land they own as it belongs to the SHUWIMU lease, which was the business arm of Muheza District Council. Consultation and negotiation with Muheza District Council should be initiated and supported to clarify on the way forward.
11. The Forests gap between Kwamungumi and Semdoe is owned by three (3) villages. There are three hamlets that belong to Kizerui, Kambai and Kuze Kibago villages respectively which pose some difficulties in land ownership or certification under Village Forest Reserves (VFRs) land use plan endorsement and by laws formulation and enforcement.

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10.0 APPENDICES

Appendix 1 1: *Terms of References*

Proposed work

The consultants will undertake the following tasks

1. Obtain 50,000 topographic maps of the area (Map Sales, Lands Dept, Dar)
2. Obtain relevant boundary maps of forest reserves (FBD Dar)
3. Physically visit 3 villages (Kizerui, Segoma and Kuze Kibago) in the gaps between key Forest Reserves: gap between Semdoe and Nilo; Semdoe and Segoma; Segoma and Manga;
4. Discuss with the villages and document how the current land uses distribution in the gaps have evolved and their perceived limitations to agriculture and trees and options for increasing tree cover in the 3 key gaps;
5. From viewpoints, roughly mark on topographical maps current land uses in the villages and adjacent forest reserves; land use categories will include remaining natural forest, plantations, rocky areas, streams and streamline forest, boundaries of village forest reserves, houses, large scale recent fires, areas under agriculture (existing and/or abandoned and annotated to indicate crops grown), wood lots / agroforestry or other planted trees.
6. Ground truth the rough landuse map with GPS, walking down streamlines, and other potential corridors to verify if and where forest remains;
7. Take series of digital photographs of the landscapes from defined (GPS) viewpoints so that future monitoring of changes can be undertaken.
8. Produce final maps of the land uses within the gaps between the different forest reserves.
9. Produce a report documenting the activities undertaken and the results of the work.
10. Attend a stakeholders' workshop in late 2005.

Deliverables

The consultant is expected to provide the following:

- 1) Final set of consolidated and clear hard copy maps showing indicative land use distribution for Segoma, Kizerui and Kuze Kibago and adjacent forests in the three key gaps. The maps will indicate the land uses outlined above as well as including: title, north arrow, coordinates and relevant annotations.
- 2) Copies of digital photographs taken from defined (GPS) viewpoints showing the condition of the landscape and the degree of forest connectivity.
- 3) Short report including introduction outlining the objectives of the work, methodology including a detailed description of the activities that were undertaken (including when, where and by whom), main findings including outcomes of discussions with each of the three villages in terms of changes in land use and their thoughts on tree planting in the gaps (in separate sections for each village), conclusions, limitations and recommendations.

Appendix 1 2: Definition of steep slopes

What Is a Steep Slope?

A steep slope sensitive area is a slope, which both inclines 40% or more and has a vertical rise of 3.1 meters or more. The “top” and “toe” of a slope is defined as the point where the inclination changes from more than 40% to less than 40% at the top and bottom of a slope, respectively.

How is a Steep Slope Delineated?

A slope is delineated on property by determining if and where the ground rises 3.1 meters or more along 8.1 meters of horizontal distance. The sides of the slope are also determined as part of the delineation. Slope inclination is measured as a percentage; that is, the vertical rise divided by the horizontal distance, then multiplied by 100. For example, a 100% slope has one unit of vertical rise for each unit of horizontal distance. A 40% slope has 4 units of vertical rise for each 10 units of horizontal distance. Slopes are sometimes measured in degrees, but there is difficulty in converting between the degrees and percent. A 100% slope is equivalent to 45 degrees, but a 40% slope is roughly equivalent to 22 degrees. Several instruments can measure slope inclination. A “clinometer”, can quickly and accurately determine inclination in both percentages and degrees.

Appendix 1 3: Itinerary

Field work started with ARI_Mlingano team alone. It was later joined by Muheza team after a meeting held at Muheza by ARI-Mlingano team and Isaac Malugu from WWF-Tanzania. The chart below summarizes the schedule of field work.

Date	Description
12.9.2005-18.9.2005	ARI-Mlingano team was preparing basemaps to completion, Also formulated questionnaire, pre-tested
Monday 20.9.2005	ARI-Mlingano team went Muheza district HQ, meet Land use people and Mr E. Lyawere. The expressed the work and asked for any support that would be required, night at ARI-Mlingano.
Tuesday 21.9.2005	ARI-Mlingano team left for Maramba for field work, meet P. Mbaganga of TFCG, promised to assist whatever needed that was available, talked in mobile phone with Isaac Malugu and agreed to include Muheza district council personnel in the team. Agreed to meet at Muheza next morning. Night at Maramba.
Wednesday 22.9.2005	Mlingano team (Joel, Mbogoni, meets with Isaac Malugu at district HQ Hotel and had lunch. Later Muti and P. Mbaganga joined us, talked about need for involving district people in the team. Meet Mhando who assisted in identification of people to be the team. Informed Lyawere who agreed to convey message to the rests.
Friday 23.9.2005	Processed payments at ARI-Mlingano, for the Muheza team. Money was collected at the evening. Agreed to travel to Maramba on 25.9.05.
Sunday 25.9.2005	Left for Maramba after meeting and performed logistical support with Muheza team at Muheza. Lunch at Ambassador Hotel Muheza. After accommodation meet P. Mbaganga at Hotel who made introduction of Mhinduro executive officer to the team. Night at Maramba.
26.9.2005-2.10.2005	Daily Visits to Kuze Kibago, holding meeting with village councillors, farmers representative and transect walk for ground truthing along Nilo and Semdoe; Segoma and Semdoe forests boundaries
3.10.2005 – 4.10.2005	Daily visits to Segoma village for similar mission as above. The travelled to Amani via Muheza for Kizerui field work
4.10.2005 – 11.10.2005	Daily visits to Kizerui village for similar mission as above. On the last day travelled to Muheza
12.10.2005--	Report writing