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ENVIRONMENTAL CONSULTING SERVICES

SIERRA LEONE

Environmental and Social Impact Assessment Report on Plantation Forestry in the Yoni Chiefdom Tonkalili District.

Prepared for Miro Forestry Company Sierra Leone Limited

MIRO FORESTRY COMPANY

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1.0 INTRODUCTION

The Sierra Leonean Environmental Protection Agency (EPA-SL) is the competent authority that will consider and decide on the application for an environmental and social impact assessment License.

As mentioned above, the Miro Forestry Company has contracted the Environmental Consulting Services to assess the potential environmental and social impacts of their forestry project activities within fifteen villages in the Yoni Bana Chiefdom of the Tonkolili District.

In accordance with the requirements of the Environment Protection Agency Act of 2008 and its amendments in 2010, these are some of the requirements that any company be it small or large scale Company Should follow in line with international standards, which are generally used to define compliance with both National and international Principles.

The requirements of relevant sector-specific environmental, health and safety (EH&S) guidelines produced by the World Bank Group (for Agroforestry Project for instance), have been in cooperated in the assessment. Relevant national legislation of Sierra Leone, together with the requirements of any international agreements to which Sierra Leone is a State Party to, has been included in this studies. Where the various international and in-country requirements and guidelines do not agree, ECS has conducted the assessment in accordance with the Sierra Leone principles and international requirements.

Based on the EPA-SL act of 2008, under Schedule two (2) of the said act, this Agroforestry project falls into section (e) of Schedule 1 of the Act: industrial activities such as (e.g. Agroforestry project/heavy mineral mining, wood processing plants, power plants, cement plants, refinery agro-industries), and therefore requires an Environmental Impact Assessment License. These accords with the IFC's environmental and social screening criteria, in terms of which the project is, classified as a Category A project – that is, project with potential significant adverse social and/or environmental impacts that are diverse, irreversible or unprecedented and requires an Environment and Social Impact Assessment (ESIA).

The consulting team has ensure that all parties involved within the project areas are aware that the assessment is not solely focused on the biophysical environment, but includes social and economic considerations, which has led to the production of this comprehensive and complete ESIA document for Miro Forestry Sierra Leone limited.

The ESIA has not only identified and evaluated significance of environmental impacts, but also suggest ways to mitigate any negative impacts and optimize positive impacts.

1.2 Overview of the Agroforestry Industry in Sub Saharan Africa

Many of the coastal West African nations are currently experiencing booming economic growth, with Ghana having GDP growth in 2011 of 15%, second in the world that year barring only Qatar, and Sierra Leone with GDP growth in 2012 and 2013 of 15.2% and 17% respectively. The World Bank predict GDP growth of 7.4% and 14.1% for Ghana and Sierra Leone respectively in 2014, with the average over the last 10 years being 7.5% and 8.2% respectively. Cote d'Ivoire, Liberia and Nigeria are also enjoying periods of economic expansion – in these countries in 2013, annual GDP growth was 8.7%, 7.9% and 6.7% respectively.

West Africa's population is also growing rapidly. Since 2000, average population growth per Annum was 2.5% in Ghana, 3.0% in Sierra Leone and 2.6% in Nigeria. Population growth, economic development and, particularly in Ghana and Nigeria, the development of a middle class and the resultant increase in the consumption of luxury goods and construction materials for housing are all factors driving a buoyant and growing demand for commodities, including industrial timber.

Against this backdrop, West Africa as a region has suffered heavy deforestation as a result of population increase driving agricultural expansion and the conversion of forest lands to agricultural use. In Ghana, the situation is dire. In Ghana 45 years ago a person could travel

between Accra and Kumasi almost entirely under forest canopy, now there is almost no part of the journey through forest, the majority of the area now being savannah. Ghana lost a staggering 25% of its forest cover between 1990 and 2005, and if current deforestation rates continue, the country will have no surviving forest cover in 20 years. In Sierra Leone the rate of deforestation is less drastic but still of major concern, and there are bans on the export of roundwood timber from both countries.

The West African timber industry, traditionally based on the export of high value exotic African hardwoods such as mahoganies, ebony and redwoods to consumers around the world, is now in rapid and steady decline. On behalf of an investor in the Company, Pöyry Consulting conducted detailed surveys on the West African market and determined that "forest resources are under enormous pressure, which is reflected in both a steady decline in sawnwood/plywood production over the past five years, and a common concern amongst industry stakeholders over depleted availability of raw material supply going forward". Of all major sawmillers interviewed in Kumasi, Ghana (one of the major sawmilling hubs of the entire West African region) 81% stated that the availability of sawlogs was decreasing rapidly (the remainder stating that it was decreasing slowly).

Timber prices are rising as stocks dwindle and mills must transport their timber from increasingly distant sources. Whilst this situation poses a significant challenge for national forestry bodies and international groups tasked with ensuring the sustainable management of natural forests, it nevertheless presents a very attractive market in which to be operating sustainable forest plantations.

1.2.1 Timber Imports Necessary to Meet Demand

Currently Africa imports 50% of its industrial wood demand. For the above reasons this is forecast to increase to 75% by 2030 for example, Ghana's demand for sawnwood alone is forecast to double from approximately 500,000m3 currently to 1.0-1.2m m3 by 2035.

Currently industrial wood demand in Africa is approximately 75m m3 per annum, equating to approximately 5% of global industrial wood demand. In addition to this a further 625m m3 is consumed for fuel wood, which accounts for over 90% of domestic energy consumption, making Africa the biggest consumer of timber globally.

As a result of this demand, much of the supply to demand gap is necessarily filled by unsustainable harvesting. Africa is currently losing an estimated 3.4m hectares of forest per annum, an area larger than Belgium. The main drivers for forest loss are conversion of forest lands to agricultural use, and the use of forests to produce fuel wood for energy and cooking. While West Africa's population continues to grow at a rapid pace, these factors will remain.

Against this backdrop, recent surveys by forest experts indicate that industrial forest plantations in Africa cover only 4m to 5m hectares split evenly between private and government ownership. Of these, about 1.3m hectares, or 20% to 25% of this total, represent Africa's highest quality industrial plantations, located in South Africa from which the majority of fibre is exported as pulp and wood chips. Of the remaining plantations more than 60% are deemed fair to poor quality.

In relation to this, Global Environment Fund estimates the total annual production from Africa's plantations to be about 46m m3, of which approximately 40%, or 18m m3, is harvested in South Africa. 11m m3 of wood harvested from South African plantations is processed and exported as pulp andwood chips. Thus, the remaining 35m m3 meets less than one half of the 75m m3 current demand for industrial wood in Africa, which is growing at more than 7% annually. This shortfall in industrial wood demand in Africa can only be reduced domestically (without imports) by the establishment of new plantations and/or the increase in productivity of existing plantations. These are estimated to be growing as follows: 2% per annum from productivity improvements - forecast to grow at 2% annually with improved material and silviculture standards (more than 60% of these African plantations are only deemed fair to poor quality).1% per annum from growth in plantations - forecast to

grow at 1% annually due to difficulties in establishing greenfield plantations, financing, land tenure, infrastructure, team and capacity building. As a result of the above trends the 40m m3 shortfall in demand for industrial timber in Africa is set to continue increasing at rate of approximately 4% annually (assuming domestic plantations are sustainably maintained).

This environmental impact assessment takes cognizance of the Sierra Leone Environment Protection Agency Act of 2008 and its 2010 Amendments, the Forestry Act of (1988), and Forestry Regulations (1990) all projects major Agricultural Projects are mandated to carry out an Environmental and Social Impact Assessment (ESIA). In its desire to operate within the laws of the country, Miro Forestry Company has commissioned this ESIA study for their agroforestry Project within the Tonkolili District in Sierra Leone.

The purpose of the ESIA is to ensure that:

- relevant environmental issues are assessed appropriately;
- Potential environmental impacts, associated with the implementation of the Miro forestry Project as conditioned by the proposed working conditions), are identified, together with appropriate mitigation measures.
- Interested parties are given the opportunity to address any relevant issues during the field studies.

This ESIA seeks to present the proposals and the results of specialist assessments in a clear and unbiased manner and has been produced to accompany the application referred to above. The study was guided by:

- Part III, Section 17 of the Environmental Protection Act, 2000
- Environmental Impact Assessment Procedures Document (EPD 2004).
- National Legislation, regulations, standards and guidelines a project of this nature will be expected to abide by.

- TOR which was developed and agreed between the contractor (Miro forestry Sierra Leone Ltd) and the consulting Firm.
- General best practice guidance as regard Agroforestry project Implementation was also made used off.

The ESIA study was conducted during the month of April, 2014.

1.3 Methodology

A multi-disciplinary team of Sierra Leoneans such as Ecologist, Soil Analyst, Water Resource Management Specialist, Public Health Specialist, Foresters, Agriculturalist, Conservationist, Natural Resources Planners and Environmentalists were commissioned to undertake this study. Information provided in this report was purely based on the following main sources:

a) Experience in working with rural people in Tonkalili District.
b) Secondary data culled from relevant documents in appropriate institutions
c) Various studies on past Agroforestry projects implementation within Tonkalili district and elsewhere in the country.
d) Information from other allied sectors or disciplines and from recent inventory and field reports.

A number of impacts were identified as part of the study and these have been elaborated herein. The significant potential issues and issues that emerged were:

- The potential for dust pollution during the dry season and its consequential impacts on the health of the project beneficiaries'.
- Increase in solid waste.
- Impact on the biodiversity(plants, animals, birds etc)
- Impact of Fertilizers on Ground water
- Decrease in soil fertility, structure and salinity.
- Potential for wild fire and
- Possible effects on water quality of streams and rivers around the project areas

These, along with other impacts are outlined and a number of actions have been identified to mitigate the potential significant adverse impacts for the implementation of this project.

The EIA Team, having analyzed the project and its impacts is of the view that the baseline conditions of the bio-physical environment are not expected to be influenced in a significant way from the activities of the project. The design layout, sitting and technology to be employed will ensure that there are minimal impacts to the environment should the project be implemented. However, as part of the study mitigation actions have been identified for impacts which have the potential to be significant.

Once there is compliance on the part of Miro forestry Sierra Leone Ltd and other key stakeholders and oversight by the regulatory institutions (MAFFS), this project can provide positive benefits for the Tonkalili district people and the Government of Sierra Leone thereby making a meaningful contribution to Sierra Leone's peace and security process

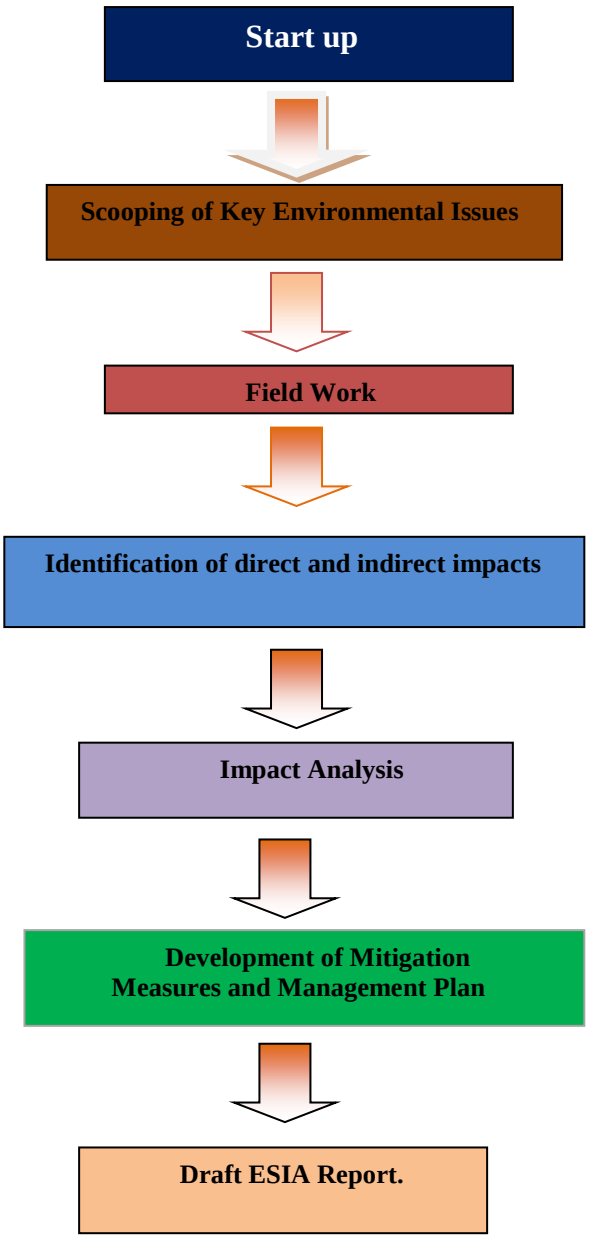
Table 1 Showind the Coordinates of MFC (SL) Ltd BLOCK A (NORTH)

Name	Latitude	Longitude
A1	8.504137	-12.342389
A2	8.516333	-12.285191
A3	8.516333	-12.286619
A4	8.471006	-12.255070
A5	8.469350	-12.255081
A6	8.423096	-12.293890
A7	8.462296	-12.343158

BLOCK B (SOUTH)

Name	Latitude	Longitude
B1	8.482249	-12.180118
B2	8.435783	-12.244671
B3	8.400231	-12.346030
B4	8.394901	-12.341975
B5	8.318926	-12.248933
B6	8.348682	-12.214394
B7	8.388785	-12.190563

Figure 1: Schematic Layout of Research Methodology



2.0 PROJECT BACKGROUND & DESCRIPTION

2.1 Background of the Project Implementation.

The Miro Forestry Company project area is a total of 20,980 hectares leased from the traditional landholders and ratified by the Government. The Company secured this land in late December 2011 and, with limited expenditure, has planted a total of 131 hectares of eucalyptus and a small trial of acacia mangium.

The land lease is 50 years duration, renewable at the Company's option for two further periods of 21 years plus 7 year thereafter (thus 99 years in total). A benefit sharing arrangement is attached to the lease providing 5% of net profit payable into a community development fund, on which management committee the Company sits alongside a limited number of local leaders, certain council members and the district member of parliament. The land lease is US$2/ha/annum, however the Company is also starting to pay a further $10.50/ha/annum for land actively worked by the Company and on which it has established plantations. This additional fee is paid directly to the individual landholders with whom the Company signs separate acknowledgement agreements sitting under the principal lease. This additional fee recognises the Company's active use of the land, further builds local protection of the Company's standing timber, and respects the Government of Sierra Leone's per hectare lease mandate for agricultural land of US$12.50/he/annum.

The Yoni Plantation is located adjacent to the fully metalled main highway heading East from Freetown and Port Loko into the provinces. This road network provides access to Freetown and the major port sites of Sierra Leone within 100 miles.

The plantation is nearest to Yonibana a small town, marginally beyond Mile 91, aptly named being 91 miles outside of Freetown.

The land on which the Company is establishing plantations is largely flat with a fair proportion of low lying swampy land, which often sits underwater during the rainy season and therefore not suitable for tree plantations. Almost all subsistence agriculture takes place in the swamps with rice and yam grown in protruding mounds, being the staple crops. As a result, the higher lying land on which the Company establishes plantations is otherwise

predominantly unused. This pattern allows for an efficient patchwork of established commercial forests and food production.

There is very limited tree cover over the entire area, save for sporadic sacred groves near villages, the entire area having suffered heavily from slash and burn agriculture and charcoal production for local consumption as well as sale into Freetown and Bo. For these reasons, and originally to profit from high value indigenous hardwood sales, Sierra Leone has suffered some of the worst deforestation in West Africa, many estimating it to be over 90% within the last 100 years. The Company is therefore establishing sustainable plantations on degraded lands, covered predominantly by grasses and occasionally low level bush.

2.2 Objectives of the Project.

Miro Company proposes to implement their foresty projects with the following objectives:

i. To help rebuild the economy, political and social lives of the communities in their operational areas and the associated provision of social services to the remote and often neglected rural communities.
ii. To help reduce rural-urban migration through employment opportunities and to make communities more attractive to youths and the unemployed
iii. Improved health care systems with the project Communities.

2.3 Eligibility Criteria

The project is registered with the Ministry of Agriculture Forestry and Food Security, the Income Tax Department of National Revenue Authority and the Ministry of Finance, Development and Economic Planning.

2.4 Miro Forestry Company (SL) Ltd Profile.

Miro Forestry Company ("MFC" or the "Company", which includes subsidiaries where the context implies) is a green-field, profit-oriented forestry group operating in West

Africa to supply sustainable value-added timber products to local and regional markets. MFC is primarily growing fast-rotation eucalyptus for the production of transmission Poles and wood based panels for the local and regional market as well as wood chips for pulp and biomass. The Company is also growing a proportion of teak for high-value Sawn timber export. The Company directly employees over 330 people, predominantly in rural West Africa, and by the end of 2013 had planted 1,095 hectares, or 1.5m trees Within the Company's commercial plantations, MFC operates two plantations in West Africa in Ghana ("Boumfoum" plantation) and Sierra Leone ("Yoni" plantation) totaling Over 30,000 hectares of forestry land. The Company was established in late 2010 and is a private Cayman Island exempted limited liability Company, now with over 25 Shareholders

As at 31st December 2013 MFCL was owned by 24 shareholders including individual investors and family offices. The top two shareholders accounted for 64.40% of the share Capital and the top five for 83.48%. Directors and management held 17.95% of the share capital.

MFCL is registered in the Cayman Islands with registration number WK-240939 and its registered office address at c/o Walkers Corporate Services Limited, Walker House, 87 Mary Street, George Town, Grand Cayman KY1-9005, Cayman Islands.

MFC is registered in Ghana with registration number CA-71,087 and registered office address at 1st Floor Teachers Hall Complex, Education Loop (Off Barnes Road), Adabraka, Accra, P. O. Box 1632, Accra, and Republic of Ghana.

As at year-end 2013 NMFC had two shareholders, MFCL and the National Interests Company Limited ("NICOL"), with MFCL holding 75.26% of issued ordinary shares with Over USD 3m of shareholder loans to be converted into shares, following which MFCL will hold not less than 85% of the issued share capital of NMFC.

MFSL is registered in Sierra Leone with registration number 984/2011 and registered office Address at c/o B&J Partners Solicitors, 2nd Floor, No. 16 Wilberforce Street, Freetown, and

Republic of Sierra Leone. As at year-end 2013 MFSL had two shareholders, MFCL and Agri International Consultants Corporation (AGRI). Pursuant to share issuance documentation Filed by MFSL, MFCL holds 90.2% of the issued ordinary share capital of MFSL.

2.5 MIRO FORESTRY COMPANY ORGANISATIONAL CHART

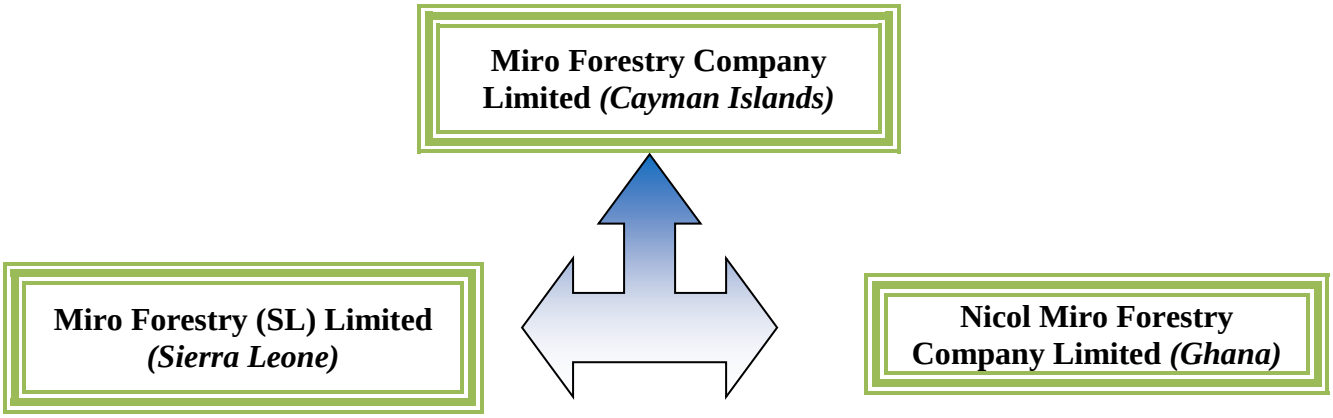


Figure 2: Showing the Organisational Chat of MFC (SL) Ltd.

2.6 Production.

The Miro Forestry (SL) Ltd would specify its range of output based on the availability Of land that is available for the implementation of their Agroforestry project.

2.7 Geographic Location of the Project Area

Mile 91 gets it name from the fact that it is exactly 91 kilometers away from Freetown, the capital city of Sierra Leone. Mile 91 is vital in bridging the rest of the country to Freetown. The diverse population is 87,627 roughly people comprised of small numbers of all the tribes of the country.

Those living in the Mile 91 Community are generally poor with income generating activities primarily consisting of subsistence gardening (e.g. farming), small businesses, and petty trading. Due to its strategic location at the crossroads of Sierra, the Mile 91 Community was frequently attacked by rebels during the civil war who burned homes and

killed residents indiscriminately. Families, fleeing their homes in panic, were separated from their children. Even though the war has ended, the many orphans and extreme poverty left by the war at Mile 91 present a large challenge.

Table2: Population Distribution by the Chiefdom Boarding the Miro Project Areas.

Chiefdom Name	Total Chiefdom Population	Total Male Population by Chiefdom	Total Female Population by Chiefdom
Yoni	87,627	40461	47,166

Source 2004 Population and Housing Census

2.7.1 Project Layout and Activities

At the time of this ESIA studies, Detailed Design and Project Operational Plan were available. Based on information from Miro Forestry Company, and the consulting team' knowledge and experience with projects of this nature, the project is expected to be undertaken in two phases with the following activities:

2.7.2 A project flow diagram for typical agricultural activities.

2.7.3 Nursery Establishment

- Access road
- Base camp
- Site clearing - under brushing & clear felling
- Biomass management & disposal
- Earthworks, drainage & irrigation
- Planting and maintenance of seedlings

2.7.4 Site Preparation

- Access road
- Base camp

- Utilities provision
- Site clearing - under brushing & clear felling
- Biomass management & disposal
- Earthworks, drainage, infrastructure
- Cover crop establishment

2.7.5 Field Establishment

- Field lining & holing
- Final culling
- Transplanting

2.7. 6 Maintenance & Harvesting

- Fertilizer application
- Use of control agro-chemicals
- General field upkeep
- Harvesting
- Transportation of Farm products

2.7.8 Replanting Abandonment

- Nursery establishment
- Removal of old palm trees
- Evacuation of plantation staff & workers
- Biomass management & disposal
- Removal of equipment, machinery& structures
- Field lining and holing
- Site restoration/ Rehabilitation
- Transplanting of mature seedlings
- Maintenance & field upkeep
- Harvesting & transportation

2.8 Project Benefits

2.8.1 Economic Benefits

The project is expected to provide incomes to more than five hundred People (500) there by contributing to their improved standard of living within the Tonkalili District, especially the Yoni chiefdom in Sierra Leone. On a wider scale, the Project is expected to bring economic benefits to the economy of Sierra Leone in the form Of foreign currency, thereby encouraging the Miro Forestry company to plant more Tree crops for sale in the European market.

2.8.2 Social Benefits

An employment opportunity has been provided for a number of persons within the Miro project areas in the Yoni Chiefdom. Preference has been given to skilled/knowledge persons living within the area and in close proximity of Miro project areas.

2.8.3 Training

Training will be ongoing in the Project Communities by qualified trainers from Miro Company (SL) Ltd.

3.0 Institutional and Legal Frame Work

3.1 Introduction to the Legal Frame Work

The Miro Forestry (SL) Ltd Project would be influenced by several policies, laws and regulations specific to areas of environmental management and rehabilitation. Principally, the Environmental Protection Agency (EPA-SL) Act 2008 and its 2010 amendment require an Environmental impacts Assessment for projects that would have a significant impact on the environment. Agroforestry activities are listed in the First Schedule of the Environmental Protection Agency (EPA-SL) Act 2008 and its 2010 amendment as requiring an Environmental impacts Assessment. As such there is a statutory requirement for conducting an ESIA for this project.

Similarly, provisions in a number of national legislations and their regulations also have relevance to the development and implementation of this project. An overview of all such legal instruments and the competent authorities vested with the mandate to implement these instruments is provided in this section.

3.2 National Legislation

Legislation governing environmental issues is found as Acts and regulations of the various government line ministries or institutions. Such legislation includes:

- The Environment Protection Agency Act of 2008.
- The forestry Act-1998
- Forestry regulations-1989
- The ministry of fisheries acts of 1994.
- Ministry of energy.
- Ministry of Water Resources
- Ministry of agriculture forestry and food security.

- Ministry of Lands Country planning and the environment.
- The wild life and forestry policy of 2010.

These documents are available locally, and can be obtained from the institutions to which the Acts refer, for consultation by potential users of the land, whose activities may have an effect on the environment.

3.3 The Environment Protection Agency Act – 2008 and its Amendment in 2010.

The Act which was signed as a legal document in September 2008 and amended in July 2010 established the Agency. Following the enactment of this Act, a National Environment Protection Board was established within the Environment Protection Agency. The Board facilitates coordination, cooperation and collaboration among Government Ministries, local authorities and other governmental agencies, in all areas relating to environmental protection. The Department, subject to the Act, also coordinates environmentally related activities and acts as the focal point of national and international environmental matters, relating to Sierra Leone.

3.3.1 Project Activities Requiring an EIA

According to this Act an Environmental and Social Impact Assessment Report (ESIA) is demanded for certain types of project activities. The contents of assessment must be contained in a report that should be submitted to the Executive Chairman of the Department. A potential mining company, INGOs, NGOs or projects, are required to carry out an ESIA, and after which they are mandated to commence their operations, by the issue of an ESIA license, on approval of the submitted ESIA report. The Board may also disapprove of the issue of an ESIA license if it envisages that the company's or NGOs activities would have a significance adverse effect on the environment and the communities.

Projects requiring an ESIA are those, as given in the first schedule of the Act, whose activities involve or include the following with respect to mining:

- Exploitation of hydraulic resources (e.g. dams drainage and irrigation projects, water basin development and water supply).
- Infrastructure (e.g. roads, bridges, airports, habours, transmission lines, pipelines and railways).
- Industrial Activities (e.g. metallurgical plants, wood processing plants, chemical plants, Major Agricultural Projects,power plants, petro-chemical plants and refinery).
- Extractive industries (e.g. mining, quarrying, extraction of sand, gravel, salt, peat, oil and gas).
- Waste management and disposal (e.g. sewage systems and treatment plants, landfills, treatment of plants for household and hazardous waste).
- Housing construction and development schemes.

3.3.2 Establishment of Environmental Standards

Subject to this Act, regulations are also made, as given in section 34, to establish national environmental standards, pertaining to the following parameters:

- Water quality
- Effluent limitations
- Air quality
- Waste
- Atmospheric protection
- Ozone protection
- Noise control
- Pesticide residues
- Odour

The introduction of any internationally banned chemicals or substances into Sierra Leone is prohibited, as well as the discharge of any hazardous and toxic substances into the air, soil, land and water of Sierra Leone. Failure to comply with this regulation is an offence, and the defaulting company or NGO is liable on conviction, to a fine not exceeding Le2, 000, 000 or a term of imprisonment not exceeding two years, or both, fine and imprisonment.

3.3.3 Factors determining the necessity of an ESIA

The second schedule of this Act, gives several determination as to whether a potential project requires the preparation of an ESIA. These factors are given below as stated in the schedule.

- The impact on the community
- The location of the project
- Whether the project transforms the locality
- Whether the project has, or is likely to have, a substantial impact on the ecosystem.
- Whether the project results in the diminution of the aesthetic, recreational, scientific, historical, cultural or other environmental quality of the locality.
- Whether the project endangers any species of flora or fauna or the habitat of the flora and fauna of the locality.
- The scale of the project.
- The extent of degradation of the environment.
- Whether the project will result in an increased demand for natural resources in the locality.
- The cumulative impact of the project together with other activities or projects on the environment.
- The contents of the ESIA.

The third schedule of the Act indicates the contents to be considered in preparing the ESIA. It is stated in this Act, that an ESIA shall contain a true statement and description of:

- The location of the project and its surroundings.
- The principle, concept and purpose of the project.
- The indirect or direct effects the project is likely to have on the environment.
- The social, economic and cultural effects that the project may have on the society.
- The communities, interested parties and Government Ministries consulted
- Any action or measures which may avoid, prevent, change, mitigate or remedy the likely effect on the society.
- Any alternatives to the project.
- Natural resources to be used in the project.
- The plans for decommissioning of the project.
- Any other information, necessary for a proper review of the potential environmental impact of the project.

3.4 The Forestry Regulations- 1989

These regulations are deemed to have come into force on the 1st July 1990. The chief conservator holds the same responsibilities as he does for the Act of 1988 being the head of Forestry Division.

Generally community forests are managed by the Forestry Division or by agreement with the Division; it could be managed by the local government, or Community Forest Association. Based on this responsibility of the Division, no protected forest shall be tampered with in any way as is stated in section 21, subsection (2) of the Forestry Act-1988, without written permission from the Chief Conservator of the Forest. In section 15 of the Forestry Regulations 1989, subsection (1) it is states that a license may be issued by an inspector of the Forestry division authorizing the holder of the mining lease, to clear land in a classified forest for the purpose of mining. However, having acquired his license, deforestation of, or vegetation removal from the environment, can only be affected by the mining company under certain conditions. These conditions are found under section 15, subsection 3 and are highlighted below.

- Removal of vegetation, can be done for the land preparation for the nursery and planting of crops for only within an area licensed for this purpose
- The specified land areas shall be cleared within a stated time, but trees requested not to be felled, removed or damaged, are to be left standing.
- Trees to be felled shall be identified, except where total felling is authorized
- A forest severance fee and a minor forest produce fee, shall be paid in respect for all forest produced that is merchantable, which may be removed by clearance of vegetation.
- At the completion of mining, the area shall be replanted with approved crops or trees by the mining company, or provision made for this to be done by payment of the estimated reforestation cost.
- Required method of cultivation and silviculture specified by the chief conservator must be employed.

As a method of environmental protection, it is stated in section 38 of part XI, that no land between the high and low water marks, nor those above the high water mark on both sides of the bank of any waterway, covering a distance of one hundred feet (approx. 33m), shall be cleared of any vegetation except permitted by the local authority.

Sacred bushes are protected by the stipulated regulations of section 40, whereby clearance of vegetation from land designated as sacred bush, is prohibited except by clearance authority from the Chief conservator.

3.5 Ministry of Water Resources

The Ministry of Water Resources is responsible for coordinating the activities of the water distribution sub-sectors. The development of water supply and the generation of water are

all functions of this Ministry. It is expected to develop the water resources and enhance current production to meet and satisfy the needs of the country as well as provide adequate water supply to the nation. It enhances the improvement of water supply and delivery facilities and maintenance of existing ones.

3.6 Ministry of Agriculture, Forestry and Food Security

This Ministry is mandated to preserve and conserve, as well as through managed commercial exploitation to provide for sustainable and permanent regenerating forest reserve. It is responsible for issuing licenses to exploit and maintain all forest types including mangroves, on public lands and to monitor their harvesting so that they are sustainable and ecologically stable.

3.7 The Ministry of Lands Country Planning and Environment

The ministry of lands country planning and environment has the right to issue state lands for development purposes, with regards to development activities, this aspect has being removed from the lands ministry to the local council administration with technical advices from the lands ministry as and when necessary.

3.8 Ministry of Tourism and Cultural Affairs

The ministry of tourism and cultural affairs is charged with the responsibility of all entertainment within the country, so any development that is to be taken within cultural and entertainment places needs to inform or collaborate with the said ministry for the management of such development project.

3.9 Local Government and Administration

The enactment of the Local Government Act in 2004, paved the way for the establishment of local government councils that replaced the appointed local councils or Management committees, which are accountable and answerable to the local communities.

The Local District and or Town Council is the highest political authority in the locality, with legislative and executive powers, and responsible for promoting the development of the locality and the welfare of the people in the locality with the resources at its disposal (The Local Government Act 2004). The local council is responsible among other things, for the mobilization of human and material resources necessary for overall development and welfare of the people of the locality; promoting and supporting productive activity and social development; initiating and maintaining programmes for the development of basic infrastructure and provide works and services; initiate, draw up and execute development plans for the locality; oversee Chiefdom Councils in the performance of functions delegated to them by the local councils; determine the rates of local taxes and approved the annual budgets of Chiefdom Councils and oversees the implementation of such budgets. The local council is also responsible for the formation of committees.

The Chairman is elected by universal adult suffrage for a four-year term. The Vice Chairman, who is elected by the elected Councilors, assists the Chairman. In addition, in each council there is the Chief Administrator, who is appointed by the local council and is the Secretary to the local council. He/she heads the administration of the local council.

The local councils are made up several Wards. Each ward establishes a Ward Committee, which consists of every Councilor, the Paramount Chief of the Chiefdom and not more than ten others, at least five of whom shall be women, resident in the ward and elected by the ward residents. The Ward Committee is responsible for mobilizing residents of the ward for the implementation of the self-help and development projects; provide focal point for the discussion of local problems and needs and take remedial action where necessary;

organizes communal and voluntary work; make proposals to the local council for the levying and collection of rates for special projects and programmes and educate the residents on their rights and obligations in relation to local government and decentralization.

3.10 Chiefdom and Village

Paramount Chiefs constitute an important component of governance. They are elected for life by Chiefdom Councilors, who in turn are elected by residents in each chiefdom. Each of the 149 chiefdoms in Sierra Leone has a Paramount Chief, or a Regent Chief who is appointed upon the death of a Paramount Chief and until a successor is elected. A Paramount Chief is appointed for general administration, the maintenance of law and order and the development of their chiefdom. The administration of the chiefdom occurs through a hierarchical system of traditional authorities under the Paramount Chief. There is a Chiefdom speaker who assists him and deputizes him when he is absent from the Chiefdom. The Chiefdom is divided into sections comprising a number of villages. A Section Chief heads each section while a Town Chief heads each village. The primary tasks of the Chiefdom Structure are the distribution of land, collection of land taxes and the settlement of disputes. The Paramount Chief works with a Chiefdom Committee, council of elders and the Native Administration. The local government powers relate to raising and disbursing of funds.

The Ministry of Local Government and Rural Development in consultation with the respective Paramount Chiefs appoint local court chairmen in the 149 chiefdoms in the country. The local court buildings are known as court barriers. There are 287 court barriers throughout the country. The Native Administration utilizes the services of the Chiefdom Police and has “locks ups” for law enforcement purposes.

3.11 Forestry Act: 1988

The operation of the MFC in the implementation of their Agroforestry project may involve the clearing of the natural vegetation within its operational area. Most of the land, farm bush, primary and secondary forest within the Yoni Chiefdom that have being utilised by Miro Forestry Company are likely to be Government owned. Section 18 of this Act stipulates that:

The chiefdom council of any chiefdom may conclude an agreement with the Chief Conservator of Forests providing for the constitution as a community forest of any land within the chiefdom, subject to the approval of the District Forest officer for the district in which the land is situated.

Every Agreement under this section shall:

- Describe the area included in the forest by reference to geographical features, markers, co-ordinates and measurements and indicate the same on a map of suitable scale, which shall be annexed to the agreement;
- Describe the forest resources and potential of the area;
- Indicate the purpose of the forest, such as supply of fuel, building poles, production of commercial timber, protection of soil and water supplies;
- Contain a detailed inventory of an rights that will be suppressed upon the constitution of the forest and provide for adequate compensation for such rights, either in money or through the allocation or equivalent rights in other land within the chiefdom;
- Contain a list of existing rights that will be confirmed by the agreement; and
- Be valid for such period not exceeding 99 years as it reasonable in view of the purpose for which the forest is to be constituted

The Minister may by notice in the Gazette constitute any state land, and land in respect of which there is an agreement in forces under this section, as a community forest?

A community forest agreement may be terminated or modified by mutual consent of the

Parties there to. The Chief Conservator of Forests shall agree to termination or modification of an agreement when the needs of the community require such termination/modification.

Before agreeing to the modification or termination of any community forest agreement, the Chief Conservator of Forests shall give such notice as is reasonably necessary for any person affected to communicate his views on the modification or termination under consideration.

The Minister may at anytime revoke or modify a notice constituting a community forest in a Manner contrary to any agreement under this section regarding such forest. The Minister shall also revoke or modify a notice constituting a community forest as necessary to reflect any Medication or termination of an agreement.

In addition to secondary regrowth in the project areas, there are high moist semi-deciduous Fragmented evergreen forests along streams and river courses and around the residual hills.

This ESIA has be developed with due consideration of this Act.

3.12 The Ministry of Fisheries and Marine Resources

The fisheries policy outlines the sectoral policy objectives and corresponding strategies for Sustainable aquaculture development in Sierra Leone. The Ministry of Fisheries and Marine Resources is the government agency with the legal mandate to undertake all fisheries Management and development activities. The Fisheries Management and Development Act, 1994, is the legal basis for the Ministry's functions and provide the guidelines for the Management of all aquatic resources including Fisheries and fishing industries.

The exclusive management and control of fisheries and other aquatic resources within the Fishery waters are vested in the government. Management and control may be exercised directly by the government or by the Minister.

The Director of Fisheries or any other authorized officers, subject to the policy guidance of the Minister, is responsible for the management, planning and development of research on fisheries and other aquatic resources of Sierra Leone.

The Ministry of Fisheries and Marine Resources is the sole government agency with the legal mandate to promote aquaculture activities in the country. The Ministry's overall responsibility is the control, development and conservation of all aquatic organisms, including marine and freshwater environments. Its specific role in aquaculture development is the promotion of sustainable aquaculture through research and extension, focusing in particular on: construction of community ponds in identified rural communities; maintenance of an aquaculture tool bank for hire to fish farmers and associations; provision of technical support to private fish farmers; identification and awarding of aquaculture research contracts to the university.

The Ministry has a separate unit in charge of inland fisheries and aquaculture. This unit is headed by an Assistant Director of Fisheries, supported by a Principal Fisheries Officer and a team of intermediate and junior technical field staff.

3. 13 International Environmental Requirements

Sierra Leone is a signatory to many international conventions, some of which include:

3.14 The Stockholm Convention on Persistent Organic Pollutants

This Convention was adopted on the 22nd May 2001 in Stockholm and Sierra Leone became a signatory on the 27th August 2001.

Persistent Organic Pollutants (POPs) are chemicals that are persistent bio-accumulates found in fatty tissues. They are bio-magnified through the food chain, and adversely affect health and the environment. This convention recommends the elimination or restriction of production and use of all internationally produced POPs (i.e. industrial chemicals and pesticides). The chemical to be eliminated are Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, Hexachlorobenzen (HCB), Mirixtexaphene, Polychlorinated Biphensylsis (PCBs).

The convention also seeks continuing minimization and, where feasible, ultimate elimination of the releases of POPs, such as Dioxins and Furans. Stockpiles and waste containing POPs, must be managed and disposed of in a safe, efficient and environmentally friendly manner, with regards for international rules, standards and guidelines.

3.15 Convention on Biological Diversity (CBD)

This convention, whose main objectives are to preserve biological diversity and rehabilitate all degraded areas, was ratified by Sierra Leone on 12th December 1994. All signatory states are obliged to affect the prescribed undertakings which include:

- Development of national biological diversity strategies plan;
- Establishment of protected areas;
- Prevention, control and eradication of invasive and alien species;
- Provision of educational facilities.

3.16 Convention of the International Trade of Endangered Species-(CITES)

The requirements of this convention became effective in Sierra Leone on the 16th January 1995. The convention seeks to eliminate and/or reduce trade in certain species inclusive of those that are considered endangered. By this convention, a list has been produced comprising of species that require protection against trade. The majority of the species listed in CITES, are these also considered by the International Union for Conservation of Nature and Natural Resources (IUCN), as endangered and threatened. CITES also takes cognizance of species not necessarily threatened, but which require trade control to protect them from being threatened or endangered

3.17 World Bank Requirements

3.18 World Bank Guidelines

Appropriate IFC/World Bank policies and guidelines include:

- Biological diversity (OD 4.00) – promotes conservation of endangered plants, animal habitats and protected areas;

- Cultural properties (OD 4.25)- protection of archaeological sites, historic monuments and historic settlements;
- Environmental guidelines)open pit and underground);
- Indigenous people (OD 4.25) addresses the traditional rights of people including land and water rights and ensures that indigenous people benefit from development project;
- Induced development and other socio – cultural aspects;
- Involuntary resettlement (OP 4.12) – describe how to proceed when involuntary resettlement is unavoidable.
- Land settlement (OD 4.31);
- Occupational health and safety guidelines;
- Environmental assessment (OP 4.01) – policy and procedures for environmental assessments whereby potential impacts are taken into considerations.
- Account in selecting, sitting, planning and designing projects. Designed to ensure that IFC projects are environmentally and socially sound and sustainable;
- Water Resources Management (OD 4.07)- policy to promote economically viable environmentally sustainable and socially equitable water management

3.19 World Bank Environmental, Health and Safety guidelines on Open Pit

A. Liquid Effluent

The following are guidelines for effluent discharged to receiving water from tailings impoundments, mine drainage, sedimentation basins, sewage systems, and Agriculture and storm water drainage.

pH	6 to 9
BOD_5	50 mg/1
Oil and Grease	20 mg/1
Total Suspended Solids	50 mg/1
Temperature at the edge of a designated mixing zone	Max 5^0 C above ambient temperature of receiving waters. Max 3^0C if Receiving waters >28^0 C3.19.1

3.19.1 B. Residual Heavy Metals

The following are recommended target guidelines below which there is expected to be no risk for significant adverse impact on aquatic biota or human use. In cases where natural background concentrations exceed these levels, the discharge may contain concentrations up to natural background levels. Concentrations up to 110% of natural background can be accepted if no significant adverse impact can be demonstrated.

Arsenic	1.0	mg/1
Cadmium	0.1	mg/1
Chromium, Hexavalent	0.05	mg/1
Chromium, Total	1.0	mg/1
Copper	0.3	mg/1
Total Iron	2.0	mg/1
Lead	0.6	mg/1
Mercury	0.002	mg/1
Nickel	0.5	mg/1
Zinc	1.0	mg/1

3.19.2 C. Ambient air

Concentrations of contaminants, measured outside the project property boundary, should not exceed the following limits:

Particulate Matter (<10 micron)	
Annual Arithmetic Mean	100 microg/rn^3
Maximum 24 - hour Average	500 microg/rn^3
Nitrogen Oxides, as NO^2	
Annual Arithmetic Mean	100 microg/rn^3
Maximum 24 – hour Average	200 microg/rn^3
Sulfur Dioxide	
Annual Arithmetic Mean	100 microg/rn^3
Maximum 24 – hour Average	500 microg/rn^3

3.19.3 Other General Environmental Requirements

A. Erosion and Sediment Control Plan

Project sponsors are required to prepare and implement an erosion and sediment control plan. The plan should include measures appropriate to the situation to intercept, divert, or otherwise reduce the storm water runoff from exposed soil surfaces. Project sponsors are encouraged to integrate vegetative and non- vegetative soil stabilization measures in the erosion control plan. Sediment control structures (e.g. detention/ retention basins) should be installed to treat surface runoff prior to discharge to surface water bodies. All erosion control and sediment containment facilities must receive proper maintenance during their design life.

3.19.4 B. End of Project Reclamation Plan.

Project sponsors are required to prepare and implement a reclamation plan. The plan should include reclamation of open pit areas, sedimentation basins, and abandoned mill and camp sites. The main objectives of the reclamation plan are:

1) Return the land to conditions capable of supporting prior land use or uses that are equal to or better than prior land use, to the extent practical and feasible
2) Eliminate significant adverse effects on adjacent water resources
3) the reclamation plans should incorporate the following components
4) Conserve, stockpile, and use topsoil for reclamation;
5) Slopes of more than 30% should be recontoured to minimize erosion and runoff
6) Native vegetation should be planted to prevent erosion and encouraged self – sustaining development of a productive ecosystem on the reclaimed land
7) Budget and schedule for pre-and post – abandonment reclamation activities
8) Plan view that show areas cleared, refilled, and re-vegetated during each of the next 5 years and estimated activities at subsequent 5 year intervals.

3.19.5 C. Sewage Sludge Disposal

Sewage sludge must be disposed of in an environmental acceptable way In compliance with local laws and regulations. Project sponsors are encouraged to evaluate the environmental and health implications of using sewage sludge in reclaiming the lands; waste dump areas.

3.19.6 D. Solid Waste Disposal

Project sponsors are encouraged to recycle or reclaim materials where possible. If recycling or reclaim is not practical, these wastes must be disposed of in an environmentally acceptable way in compliance with local laws and regulations. Solvents and similar hazardous materials must not be disposed of in a manner likely to result in soil or groundwater contamination if groundwater is potentially useable for potable water or irrigation purposes. Waste dumps should be designed and engineered so that materials with high potential to generate acid leachate are isolated from oxidation or percolating water.

3.19.7 E. Health General

1. Sanitary facilities should be well equipped with supplies (e.g. Protective creams) and employed should be encourage washing frequently, particularly those exposed to dust, chemical or pathogens
2. Ventilation systems should be provided to control work area temperatures and humidity
3. Personnel required to work in areas of high temperatures and/ or high humidity should be allowed to take frequent breaks away from areas
4. Pre-employment and periodic medical examinations should be conducted for all personnel, and specific surveillance programs instituted for personal potentially exposed to toxic or radioactive substances.

3.19.8 F.Training

1) Employees should be trained on the hazards, precautions and procedures for the safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area

2) Training should incorporate information from the Material Safety Date Sheets (MSDSs) for potentially harmful materials.
3) Personnel should be trained in environmental, health and safety matters including accident prevention, safe chemical handling practices, and proper control and maintenance of equipment and facilities.
4) Training also should include emergency response, including the location and proper use of emergency equipment, use of personal protective equipment, procedures for raising the alarm and notifying emergency response teams, and proper response actions for each foreseeable emergency situation.

4.0 Drafted Environmental Policy for Miro Forestry Company (SL) Ltd

Miro Forestry Company (SL) Ltd, as a corporate entity is committed to implementing sound environmental practices through the company's introduction of new environmental concepts that meets with stringent international environmental standards. To attain its environmental policy objectives, the company is committed to the following:

- To ensure compliance with national and International legislation guidelines on environmental health and safety;
- To assess the impact of any proposed activities, products and services on the environment, health of project personnel's and the local population;
- To implement a range of preventive measures aimed to preclude any emergency and mitigate impacts on the environment;
- To prioritize actions and measures, projected and under implementation, aimed at preventing an adverse impact on the environment, personnel and local population;
- To strive for continuous improvement in the quality of the environment in the area where their Agroforestry project is been implemented.
- To ensure a pro-active involvement of staff in environmental and occupational safety activities.

- To inform on a regular basis all regulatory parties of the environmental and safety performance;
- To ensure all the personnel perform in compliance with the existing safety standards and labour and environmental protection rules.
- Training will be a key activity in achieving these objectives of MFC.

The Company's priority objectives are health protection of women and children, an safety of personnel in the local communities were they operates while at the same time enhancing social, agricultural, Maternal Child Health, economic and ecological benefits. To achieve this, occupational health safety issues, child survival interventions and environmental safety systems will be adopted in keeping with national laws, and guidelines for such operations.

MFC aims at providing a high quality service while maintaining an environment that is safe and secure to their Project staffs and the local residents. The Company will take necessary steps to ensure that adverse impacts to the environment are identified, mitigated and managed in a manner to enhance social, economic and ecological benefits.

MFC will hire an Environmental and Health Safety officer or a trained specialist who will be charge with the above responsibilities.

4.1 ECOLOGICAL & SOCIO- ECONOMIC BASELINE CONDITIONS OF MIRO FORESTRY PROJECT AREA.

4.2 History of the Project Areas

On behalf of the land owners according to Cap 123 of the provincial lands Act 2000. The Miro forestry company (SL) Ltd Project development areas are located in the Yoni Chiefdom, Tonkalili District. The surveyed area is a large, gently undulating plain unlimited land. The project areas are approximately twenty thousand, nine hundred and eighty 20,980 hectares (20,980).

4.3 Geophysical Environment

In general the Project communities are made up of the Leonean and the Liberian group granulites and the sandy and clayey sediments of the Marampa upper group with some deposits of alluvium and colluvium in valleys/swamp areas. The Leonean geological formation consist of a series of high grade basic granulites flanked by amphibolites, which developed into a zone of extreme sheer deformation to form the south east margin of the Archean basement complex. Rock samples reveal rocks of Precambrian age mostly gneisses and granite which are typical of the Leonean and the Liberian Group of rocks and the Marampa group upper Terrain. It is underlain by Archean granite complex with local Rokel river group, with some deposits of alluvium and colluvium in wetlands and valleys. The bedrock consist of fresh and weathered coarse grained magnetized granites that are overlain by different types of alluvial deposits mainly gravel and sand. The maturity of the gravel varies considerably in different areas. In the swamps and streams, although some may show some degree of abrasion, the quartz gravels are angular and sub-angular and may be iron stained and enclosed in a grey or brown clay matrix. Higher maturity is shown in the high gravels which in some areas are overlain by lateritic gravel or duric.

4.3.1 Location and Accessibility of the project Areas.

The project area is found within the Masiaka and Mile Ninety one (91) high way, in a village called Royanka in the Yoni Chiefdom Tonkalili District. The total land areas apply for is approximately 20,980 hecters.

4.4 Topography

Three broad topographic zones occur within the study area.

- Land in the south has level to gentle sloping gradients with slopes of 1 to 5%. Elevation above sea level is 0 m at the Rokel River, to 20 m in the north. Extensive wetlands occur which are saline in places.
- Strongly sloping land with slopes of 2 to 15% occur at elevations to 20 to 600 m. Outcrops seldom occur. Numerous perennial and ephemeral channels occur, segmenting this area into many micro catchments.
- Steep to very steep land with slopes of more than 30% occur at 40 m to 320 m altitude. This some what rugged mountainous region runs in a north west to south east direction, and splits the area into two major catchments – drainage to the north via the Rokel River.

4.5 Climate

Rainfall is recorded at the main office at Sierra Rutile. Reliable data is available for the past 12 years, a summary of which is presented in Table. The closest reliable recording of other meteorological data is at Falcom Bridge in freeown, located some 100 km away and at the coast. Although it is acknowledge that the climate at Mile 91 in the Tonkalili district is unlikely to be the same as that at Sierra Rutile, it is likely to be similar. The climate data from Sierra Rutile thus presents insight into trends and likely climatic conditions at the study area. Hence, tempreture, sunsine hours, evapotranspiration and humidity recorded at Moriba town are also presented in the Table below.

The study area has a tropical, humid climate. There are two distinct seasons – the wet seasons from May to October and the dry seasons from November to April. From December to April over the dry spell, the dry Harmattan winds blow from the Sahara.

A very high mean annual precipitation of 2630 mm occurs at Sierra Rutile. This is favourable for agriculture, but the monthly rainfall distribution is problematic. Tropical downpours are almost a daily occurrence in the six month rain period (May to October) where 2401 mm is received, being 91% of the total rainfall. The converse occurs from November to April (dry season) where only 229 mm or 9% of the mean annual precipitation falls. Commercial agriculture must note this limitation, and depending on crop choice and crop water requirements, supplementary irrigation may be required over the dry spell. Some rainfall is recorded over the dry spell, with the month of January receiving the least, being 9mm on average. An inspection of the monthly data from Methological office indicates that there are years when there are months with virtually no rain and hence averages in dry months can be misleading as crops are cultivated under actual conditions. For example in the 2007 dry seasons the rainfall on a monthly basis from November to March was recorded as 54 mm; 0mm; 0mm; 2.5 mm; 23.5 mm. What is not reflected here is the timing of the rainfall in November and March. A dry-land crop could potentially have had no water for nearly five months. Refer to the Associated high rainfall during May to October is high volumes of overland flow. This presents an erosion hazard, especially on increased slopes.

Mean daily maximum and minimum temperature ranges are fairly constant throughout the year, ranging from a high of 33 *c in summer to 22 *c in winter. Mean annual temperature is 27 *C. Humidity is also high all year round.

Total evapotranspiration is 1293 mm, which is considered somewhat low when compared to subtropical climates. The trend appears to be an increased atmospheric evaporative demand from October through to May. This corresponds roughly with the dry spell,

indicating that not only will crops be under moisture stress due to low rainfall over this period, but will also endure further stress due to excessive evaporative demand. Conversely, the high rainfall period experiences a low evaporative demand. This trend is significant for crop growth and reiterates the necessity for supplementary irrigation during the months of November to April. Of course, should rain-fed agriculture be pursued, then crop yields will decline somewhat. Mitigation is to establish crops best tolerant of this adverse climatic limitation, or alternatively short seasons crops that are not cultivated in the dry season.

Mean daily sunshine hours are 4.9, which is low. Associated with low sunshine hours is a reduction in photosynthesis, implying a reduction in plant cell transpiration, associated with overall crop growth retardation.

Table 2: Showing the Climate Data within the Miro Project Areas

	Jan	Feb	Mar	April	May	June	July	AUG	Sept	Oct	Nov	Dec	
Mean Monthly rainfall mm (Sierra Rutile-12 years	**8.8**	**11.5**	**63.6**	**102.6**	**225.2**	**353.3**	**470.2**	**640.8**	**434.5**	**279.6**	**154.8**	**12.8**	Mean annual Precipitation 2630.3mm
Means of daily maximum temperature c (Tonkalili District)	**31.3**	**32.4**	**33.1**	**32.5**	**31.7**	**30.1**	**28.5**	**28.3**	**29.4**	**30.5**	**31.2**	**31.1**	Mean max temperature 30.8 c
Means of daily minimum temperature-c (Tonkalili District)	**22.7**	**22.1**	**23.4**	**23.7**	**23.6**	**23.3**	**22.8**	**22.9**	**23.0**	**23.1**	**23.4**	**23.1**	Mean min temperature 23.1 c
Daily mean temperature-c (Tonkalili District)	**27.0**	**27.3**	**28.1**	**28.1**	**27.7**	**26.7**	**25.6**	**25.6**	**26.2**	**26.8**	**27.3**	**27.1**	Mean temperature 27.0 c
Mean sunshine Hours/day (Tonkalili District)	**6.26**	**6.45**	**6.32**	**5.91**	**5.16**	**4.24**	**2.75**	**2.52**	**3.30**	**5.04**	**5.55**	**5.77**	Mean daily sunshine hours 4.94
Mean Evapotranspiration mm (Tonkalili District)	**114**	**113**	**137**	**127**	**121**	**100**	**86**	**84**	**91**	**107**	**104**	**109**	Total annual evapotranspiration 1293 mm
Humidity %	**78**	**77**	**76**	**80**	**81**	**86**	**89**	**90**	**87**	**87**	**84**	**82**	

4.5 **Table 3: Current land use**

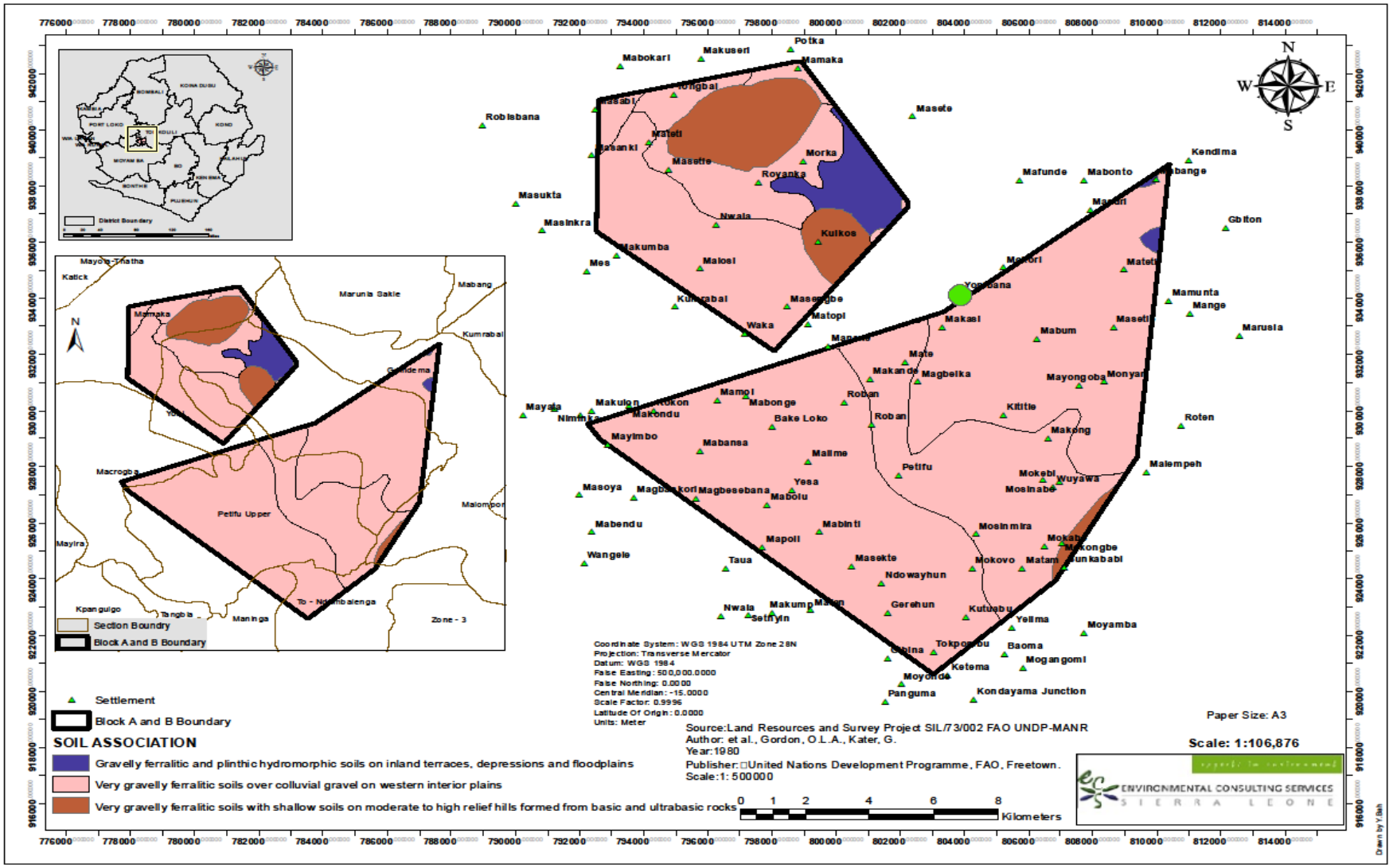
Current Land Use
Vegetation Disturbed tall forest Bush Subsistence agric and rural villages Agriculture experimental farm
Natural surface water Wetlands Streams Rivers

4.5.1 Soils

Soils in Sierra Leone have been grouped into 12 soil associations by the Land and Water Development Division (LWDD) each with different attributes. The Figure below is a map of Sierra Leone showing soil associations. Most soils in Sierra Leone are acidic (pH 4-5). The soils of Sierra Leone, like most tropical soils, are ferralitic and excessively leached as a result of the humid tropical conditions.

The project area is underlain by the Quarternary and tertiary, recent marine alluvial sediments. The derived soils are sandy and clayey – the former tending to occupy lower elevations near and adjacent to the wetland areas. The clayey varieties occur on elevated sites, some distance from MFC camp site. Soils are typically deep and dark in hue. Some red variants also occur. These Ferralsols and Cambisols present favourable sites for agriculture. As some of these sediments are associated with concave and low lying areas, some sites are commonly associated with wetlands and have impeded drainages

Figure 5: A map showing the Soil Association within Miro Forestry Company (SL) Ltd Project Areas.



4.6 WATER QUALITY

A statement on water quality is required to review background levels of critical indicators as well as to identify and quantify actual and/or potential impacts associated with the implementation of this project. A study carried out in May 2014 included the collection of spot samples at MFC project areas. A schematic of the sampling grid used for this exercise is shown in the table below. Data from the May exercise determined that levels of critical water quality parameters (TSS, N and P) in the project Community were well within the local standards interim and proposed standards for recreation waters and marine life.

The water quality monitoring component of the area was carried out in May 2014. Eleven sites in the operational area were monitored for water quality (Table.4).

Table 4: Showing the Water Monitoring Sites

Village name	Monitoring site name
Royanka	Batiyanka Stream
Rogbonla	Sokei
Kulkus (11)	Norbop Stream
Royanka	Hand dug well
Royanka	Robatiyanka Stream
Bongababay	Bongababy river
Malowsa	Malowsa Stream
Petifu	Petifu River
Massetleh	Well
Massengba	Massengba Stream
Bongababay	Well

World Health Organization (WHO) drinking water guidelines was used because of the absence of water quality standards in Sierra Leone. Based on this, the following parameters were used for the analysis:

- Cat ions: Al, Ca, Cu, Cr, Fe, K, Mg, Mn, Na, Mb, Zn
- Anions: Cl, F, SO4, HCO3, S^-
- Physical parameters (*in situ*): pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), temperature, Turbidity, and Dissolved Oxygen (DO)
- Nutrients: Residual Chlorine, Nitrate (NO3), Nitrite (NO2), Phosphate (PO4), $SO3^-$.
- Bacteriological: e. coli, faecal coliforms, Non-faecal coliforms, Vibro parhaemonemonella sp., Salmonella sp.

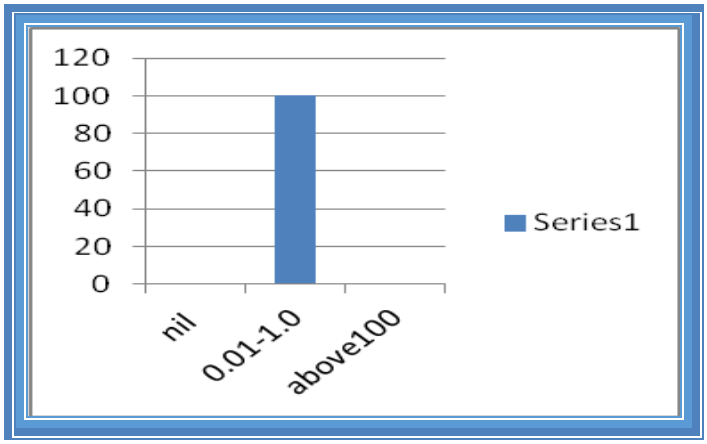
Eleven water quality samples were collected and the results are provided in (Table 10) below.

Physical or in-situ parameters were measured using a potable field probe; a multi-meter. The Multi-meter was used to test for electrical Conductivity, pH, Total Dissolved Solid (TDS) and Temperature. The determination of faecal-coliforms on water samples was done by the membrane-filtration technique using the WAGTECH POTALAB kit. Chemical analysis was done by spectrophotometric method using the HACH DR/2010 Spectrophotometer and photo meter 7100.

(I) Faecal Indicator Bacteria: Faecal coliforms are a group of intestinal tract microbes and their presence in drinking water sources is an indication of faecal contamination. According to World Health Organization **(WHO),** these bacteria should not occur repeatedly in drinking water and therefore recommended zero faecal coliforms counts per ml water sample. Although data in this report were obtained from single analysis of water samples, they are nevertheless useful indicators of the chemical and bacteriological quality of drinking water sources monitored thus far.

Table 5: **showing the Faecal-coliform count per 100ml water sample**.

Faecal-coliform count per 100ml water sample	Percentages of wells
Nil	62%
1-100	43%
Above 100	0%
Total percentage	100%



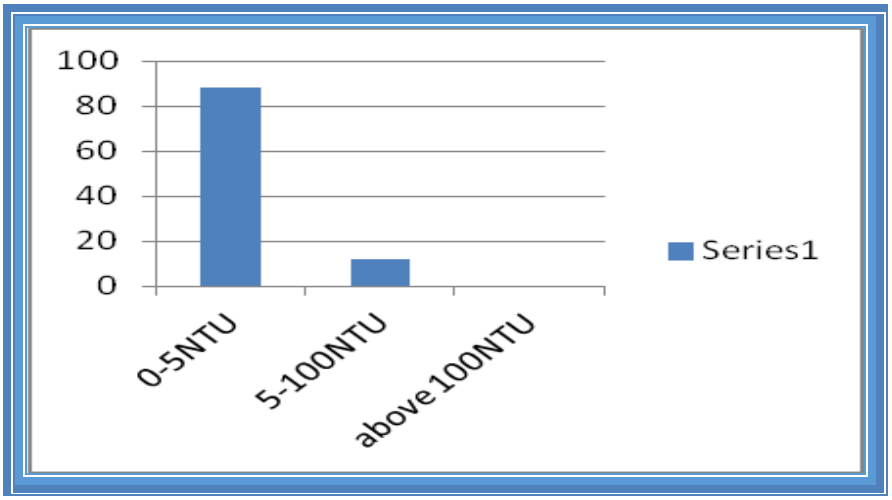
Faecal coliform were discovered in different proportion in some of the water sources monitored.

(II) Turbidity

This is caused by suspended particles as clay, silt, organic and inorganic matter, plankton and other microorganisms in water. Turbidity is thus a measured of water clarity. Although turbidity does not have a direct effect on health, it reduces the effectives of disinfection procedures. Micro- organisms can be shielded from disinfections by suspended matter. Highly turbid water can lead to user rejection of water source purely for aesthetic reasons. According to **WHO**, the threshold at which turbidity can be detected in water by the naked eye is above **5NTU**.88% of turbidity of the sources measured thus fall within the permissible limits of **5 NTU** (indicating clear water?)

Table 6: **showing the percentages of the Turbidity of the water sample.**

Turbidity	Percentage of source
0-5NTU	88%
6-100NTU	12%
Above 100NTU	0%
Total percentage	100%

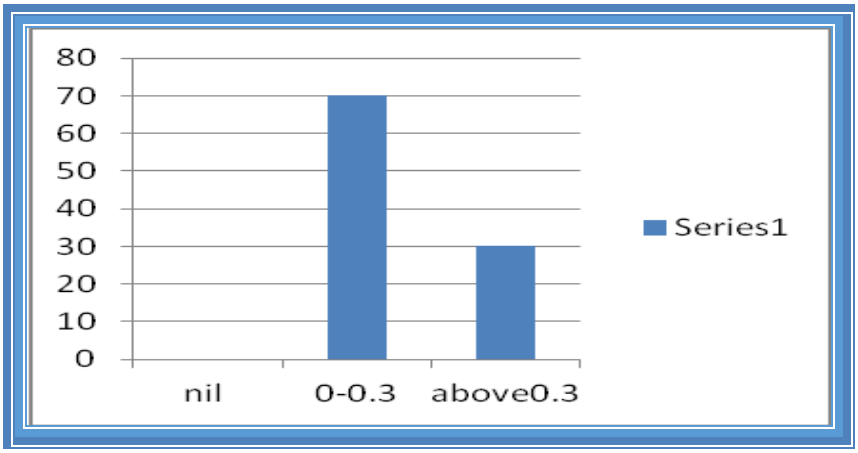


(III) DISSOLVED CHEMICALS

Iron: This is present in natural waters in the form of ferrous or soluble state, which is easily oxidized to ferric. Iron in domestic water supply stain cloths and gives a stringent taste to water causing more of a nuisance than health hazard. Although iron is needed for blood formation, very high levels can impact negatively on the liver. High iron content was discovered in 3 of the water sources monitored.

Table 7: showing the percentages of Iron in the sample Water.

Concentration Iron	Percentage in water
Nil	0%
0-0.3	70%
Above 0.3	30%
Total percentage	100%

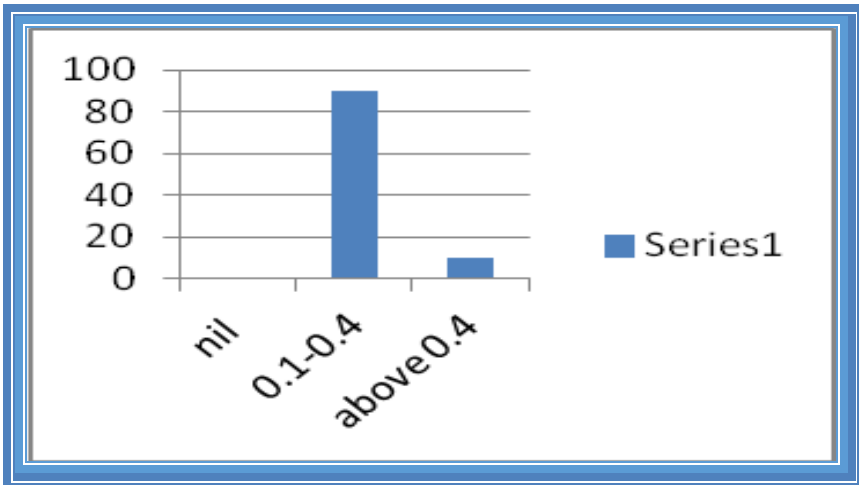


Taste threshold of iron in water is 0.3mg/l according to ***WHO*** standard. Above this, staining and taste conditions will lead to user reject of water.

MANGANESE: This is present in groundwater as the divalent ion (Mn^{2+}). High concentrations of manganese in water cause dark stains in laundry and plumbing fixtures. It imparts an objectionable taste to beverage and tea. In natural waters, manganese rarely exceeds 1.0 mg/l, but the levels above 0.5mg/l are sufficient to cause taste and staining problems. Maximum allowable limits in ground water is therefore 0.4mg/I manganese content. Most of the sources had low concentration of manganese.

Table: 8 Showing the Percentages of Manganese in Hand Dung Well

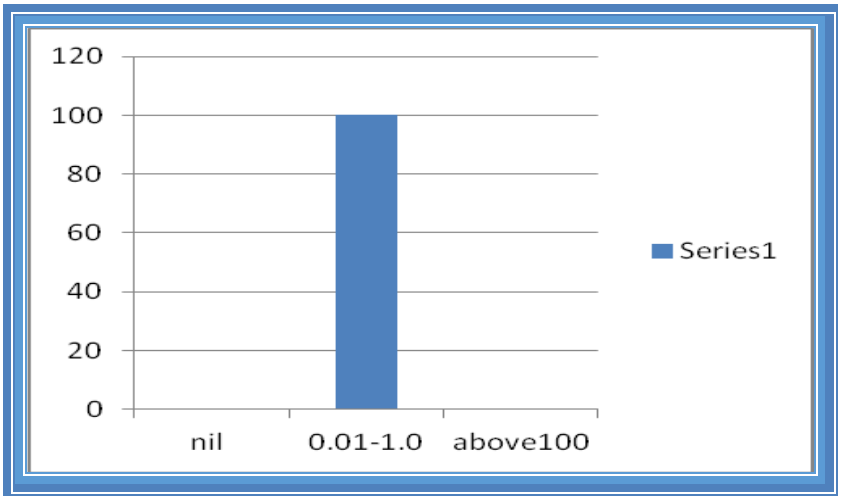
Manganese concentration	**Percentage of well**
Nil	0%
0.1-0.4	90%
Above 0.4	10%
Total percentage	100%



Copper: May be found in natural waters as soluble copper salts. Trace amounts of copper are necessary for normal body metabolism and its absence may cause nutritional anaemia in children. Large oral dose can cause emesis and liver damage. Large amount of copper in water can be toxic to aquatic life. Concentration of copper above 1 mg/l can impart a bitter taste to water. Average concentration of copper in water can range from 0.03 – 0.6mg/l according to World Health Organization.

Table 9: showing the percentages Copper in the sample wells.

Copper concentration	Percentage of well
nil	0%
0.01-1.0	100%
Above 1.0	0%
Total percentage	100%

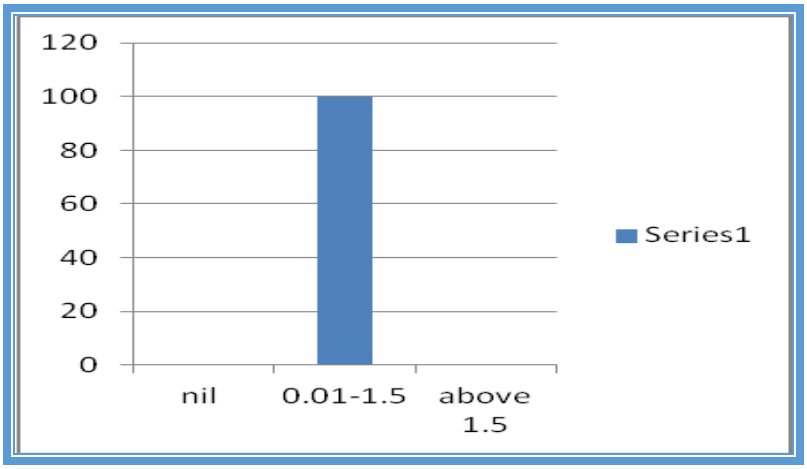


The concentration of copper in the sample was very low and within the permissible limits of the WHO recommended standard.

Fluoride: Fluoride in drinking water sources has a direct effect on human health. Excess of it can lead to dental or skeletal fluoride and its deficiency can cause dental caries. The concentration of F in the entire sample is within the WHO limits.

Table 10: showing the percentage of Fluoride concentration in the sample wells.

Fluoride concentration	Percentage of well
Nil	0%
0.0-1.5	100%
Above 1.5	0%
Total percentage	100%



ELECTRICAL CONDUCTIVITY (EC)

This is a measure of the ability of water to conduct electricity. It is an indication of the total amounts of dissolved ions in water. In Sierra Leone, groundwater with EC values of up to **450µs/cm** is considered **"good**" while groundwater values greater than **850µs/cm** becomes progressively less palatable.

The conductivity of all the sources is within the recommended WHO value.

Water Temperature: Temperature has an influence on certain physical characteristics of water as well as on chemical and bacteriological processes. For example, solubility of CO_2 in water at normal atmospheric pressure decreases from 0.7mg/l at 10^{o}C to 0.38mg/l at 30^{o}C. The amount of dissolved oxygen in water, which is also important in water chemistry and micro-biology, also decreases with increase in temperature. The temperature of all the samples thus far was 27.4^{o}C – 27.6^{o}C. These values are in consonance with the mean air temperatures.

Water pH

pH is an important factor in water chemistry because the effectiveness of water treatment processes depends on the pH. The result shows that most of the water sampled is acidic, which is the case for most waters in Sierra Leone.

From the analysis, it can be seen that the chemical quality of most of the sources was good with exception of few with (iron). Concentration of other dissolved chemical ions in the water samples including sulphate, nitrate, nitrite, copper, fluoride, aluminum etc. were in

most cases minimal and are within permissible limits recommended by the World Health Organization.

Also, nitrate which is a by-product from inorganic fertilizers are not found any of the water sources. However, frequent misuse of the source through poor agricultural practices will render the sources susceptible to contamination. Therefore, MFC should ensure their staff is given training on the use of fertilizers and other practices that will render the water sources useless.

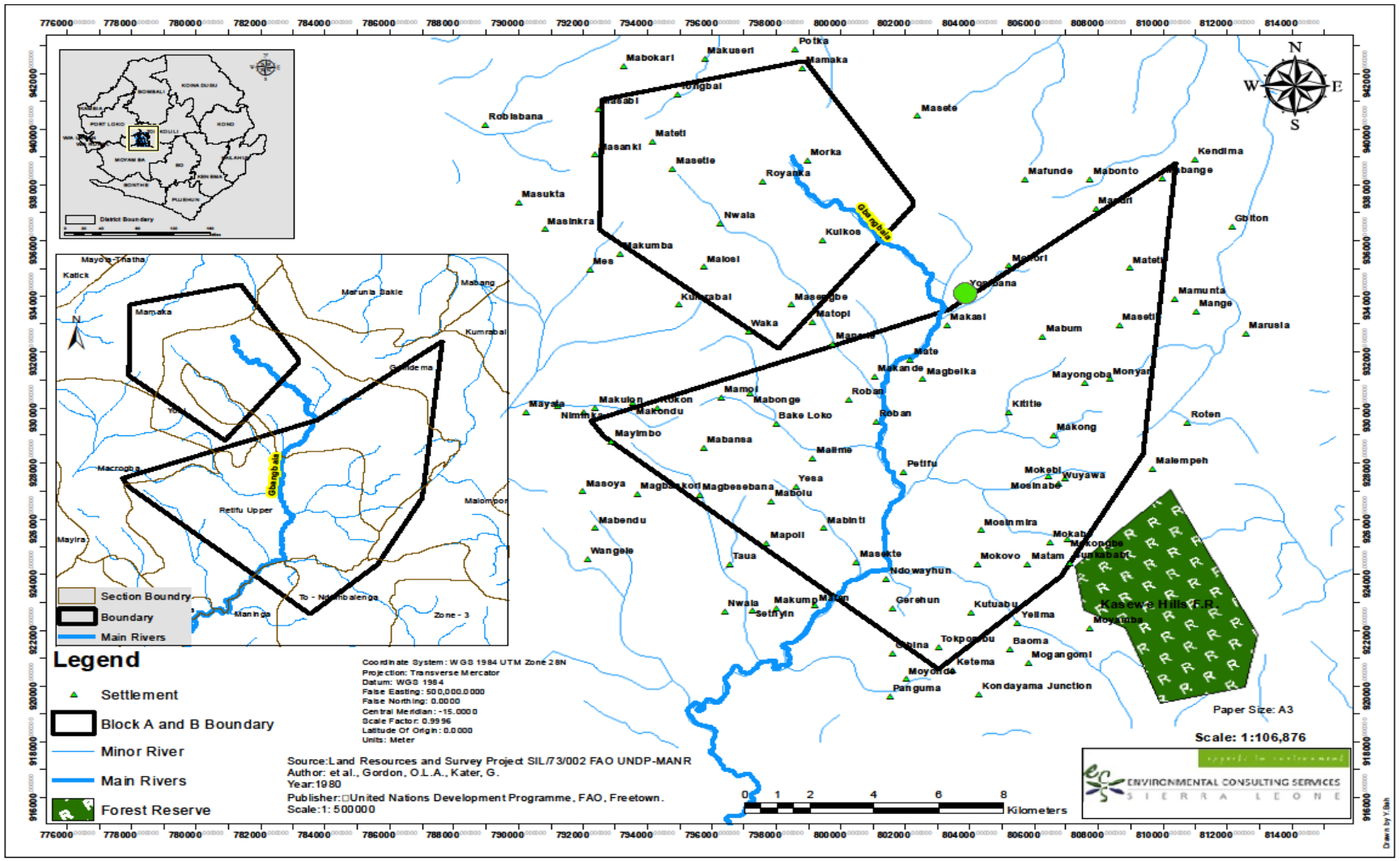
Table 11: Showing the Water Quality Monitoring Sheet

District	Tonkalili District in the Northern Province of Sierra Leone										
Chiefdom	Yoni Chiefdom										
Location	MFC Nursery site	Bongababay	Massetleh	Bongababay	Patifu	MFC Nursery Site	Rogbonla	Malowsa	Massengba	Kulkus	Royanka
Water Source	well	Well	Well	Bongababay River	Patifu River	Batiyanka Stream	Sokei Stream	Malowsa Stream	Stream	Sorbop Stream	B/Hole
Date	18-8-13	18-8-13	18-8-13	18-8-13	18-8-13	18-8-13	18-8-13	18-8-13	18-8-13	18-8-13	18-8-13
Time											
Water Temperature	24.7	27.5	26.9	25.3	24.9	25.8	26.5	27.4	28.3	27.2	27.5
pH	5.26	5.19	6.27	5.11	5.39	5.9	5.5	5.28	5.56	5.16	4.9
Turbidity (NTU)	6.2	0.5	9.1	1.6	0.6	12.5	0.8	0.1	0.6	0.1	0.2
Conductivity (µS/cm)	31.3	207	188.4	16.64	11.59	11.89	57.5	85.9	39.7	82.7	51.4
TDS (mg/l)	15.5	103	94.5	8.21	5.77	5.9	28.8	41.6	19.9	41.7	25.8
Dissolve Oxygen (mg/l)	-	-	-	-	-	-	-	-	-	-	-
Residual Chlorine (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Aluminum (mg/l)	0.03	0.02	0.04	0.01	0.00	0.00	0.02	0.00	0.01	0.02	0.03
Ammonia (mg/l)	0.02	0.01	0.01	0.00	0.01	0.00	0.04	0.03	0.01	0.01	0.01
Calcium Hardness (mg/l)	3	17	21	2	1	1	6	7	4	8	7
Chromium (mg/l)	0.02	0.03	0.03	0.01	0.01	0.01	0.06	0.02	0.02	0.07	4
Copper (mg/l)	0.12	0.06	0.31	0.17	0.08	0.12	0.11	0.04	0.63	0.42	0.39
Fluoride (mg/l)	0.24	0.21	0.14	0.22	0.25	0.27	0.64	0.22	0.12	0.19	0.17
Iron (mg/l)	2.1	0.3	1.3	0.4	0.2	0.5	0.2	0.1	0.2	0.1	0.3
Magnesium (mg/l)	3	15	14	2	2	1	5	5	3	5	3
Manganese (mg/l)	0.8	0.2	0.6	0.3	0.1	0.2	0.1	0.1	0.1	0.2	0.2
Molybdenum (mg/l)	-	-	-	-	-	-	-	-	-	-	-
Nitrite (mg/l)	0.08	0.09	0.05	0.02	0.01	0.00	0.05	0.08	0.03	0.05	0.08
Nitrate/Nitrogen (mg/l)	0.24	3.85	4.49	0.19	0.48	0.24	1.01	3.88	0.38	3.25	3.41
Potassium (mg/l)	0.5	1.3	1.7	0.2	0.62	0.44	1.6	1.3	1.5	1.8	1.7
Phosphate (mg/l)	1.7	12.8	12.5	0.4	0.40	1.8	3.5	6.6	2.1	5.2	3.1
Sulphate (mg/l)	2	26	10	2	1	0	3	4	3	5	3
Sulphide (mg/l)	0.11	0.22	0.16	0.09	0.06	0.05	0.14	0.11	0.15	0.13	0.14
Sulphite (mg/l)	2	15	8	0.00	0.2	0.5	3	6	2	6	3
Chloride (mg/l)	0.2	1.8	1.6	0.4	0.6	0.7	1.8	1.4	0.7	1.6	1.9
Bi-carbonate (mg/l)	2	14	15	2	1	1	4	6	3	6	3
Zinc (mg/l)	0.01	0.02	0.02	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.03
E. Coli (cfc/100ml)	-	-	-	-	-	-	-	-	-	-	-

Faecal coliforms (cfu/100ml)	60	0	0	0	5	0	5	5	0	0	0
Non-faecal coliforms (cfc/100ml)	55	0	0	25	35	10	5	0	10	0	0
Vibro parhaemonemonella sp.	-	-	-	-	-	-	-	-	-	-	-
Salmonella sp. (cfc/100ml)	-	-	-	-	-	-	-	-	-	-	-

TNTC means Too Numerous to Count World Health Organization recommended guideline values for Potable Water (third edition) Parameters: Boron 1mg/l Nitrate/Nitrogen <10mg/l Escherichis coli zero cfc Water temperature No value Bromine No Value Potassium <6.0mg/l Faecal coliforms zero cfc pH 6.5 -8.5 Calcium Hardness <500mg/l Phosphate <20mg/l Non-Faecal Coli<10 cfc Turbidity <5NTU Copper <1.0mg/l Silica <15mg/l Vibro sp zero cfc Electrical Cond. <450µs/cm Fluoride 1.5mg/lSulphate <400mg/l Salmonella sp zero CFC TDS<248mg/l iron<0.3mg/l Sulphide <0.5mg/l Salinity 0.4ppt Magnesium <200mg/l Sulphite No value Residual Chorine0.3-0.5mg/l Manganese 0.4mg/l Zinc <5.0mg/l after 30min Aluminum <0.2mg/l Molybdenum 0.25mg/l Ammonia No value Arsenic 0.01mg/ lChromi <0.05mg/l Bi-carbonate No value Chloride <250

Figure 6: A map showing the Major Rivers along Miro Forestry project Areas



4.6.1 Surface water

No comprehensive survey of surface water was done but from field observations, the main surface water drainage feature within the project areas is a stream, which is running west of the project areas and flows downwards towards the wetland areas.

The stream is a relatively unregulated ephemeral freshwater that originates from the hills flowing westerly and empties in the Rokel River.

Surface runoff is the main source of flow within the streams; groundwater has a relative minor contribution to flow.

Water quality monitoring would be undertaken by MFC `on quarterly bases during stream flow events to be identified during project implementation. The stations would measure the following parameters; the levels of pH, total suspended solids (TSS), total dissolved solids (TDS), chloride and oil and grease which would vary with the quantity of water flowing in the water courses.

4.6.2 Biological Environment

This survey was done on a systematic basis throughout MFC project areas within Tonkalili district in May 2014, and it confirms the spread of the biodiversity of the tract of secondary forest.

For this ESIA study, a line transect survey was conducted for mammals, amphibians, Plants reptiles and birds by taking physical observation at regular intervals of 100m along the project areas within the existing roads of the project area. Surprisingly, mammals were not encountered during this transect survey. Although birds were seen in flocks of larger numbers, the absence of mammals might not be unconnected to the fact that the endangered and threatened species move away from the noise and obstruction by the heavy vehicular and human movements along the areas. Interviews

with local hunters confirmed that these mammals, amphibians, reptiles and birds do not maintain their habitats anywhere near the communities.

4.6.3 Vegetation

Study of the vegetation covering project area was done through reviews of existing maps at the Sierra Leone Information Systems (SLIS), Statistics Sierra Leone (SSL), and Forestry Division at the Ministry of Agriculture, Forestry and Food Security (MAFFS) and from the First Atlas of Sierra Leone; and through site observations during study visits.

The vegetation of Sierra Leone is continually being altered by economic activities, mainly mining and farming. The major part of the country lies within the moist forest zone of West Africa. A smaller part lies within the moist savannah woodland zone and except in the south; there is a small mangrove zone along the coast. Most of the country is a mosaic of forest regrowth, secondary forest and derived savannah which now covers most of the upland areas of the country and inland swamp plant communities which occur in the moist forest zone, the forest savannah mosaic zone and moist savannah woodlands zone (NBSAP-UNDP, 2003).

The project Communities traverses a vegetation of mainly farm bushes, rain tropical forests and savannah grasslands. About 75% of the project area is covered by farm bushes, with vast areas characterized by thick secondary undergrowths, believed to have been part of the Tropical Rain Forest, but having been subjected to clearing, burning and tree cutting for several years. How ever, there is no existing rainforest within MFC project areas.

Forests are densest in the south-east and contain varieties of palm trees and to a lesser extent, mahogany and teak. Among the numerous small animals are squirrels, Antelopes', monkeys, and porcupines.

4.7 Floristic Studies

This report covers floristic survey done on fifteen communities (Royanka, Ronolla, Kulkoss, Mamorka, Masecheleh, Bonkababay, Kethibio, Masegkra, Patisu Malosie, Makomgba, Rothongbai, Masangba, Matetie and Makessie all within the Tonkolili district. This is to provide data base on the plant species present within these communities that are expected to be destroyed during the agroforestry operations of Miro Forestry Company. The field assessment conducted here is a prerequisite before the project commences.

4.7.1 Methodology of the Floristic Studies

For this study, plant specimens were recorded and collected during a 7-day observational walk and field inventory, with voucher specimens collected for a large number of plant species.

Forest trees are usually assessed (Cain *et al*. 1956, Lamprecht 1962) by the Importance Value Index (IVI) method of Cottam & Curtis (1956). For long time surveys, plots should be more than 100 m x 100 m in tropical forests for approaching the minima area (Loizeau 1992, Kouamé 1998). For the current survey, the main method employed was plant inventory in 15 m x 30 m plots. Trees and shrubs were identified. Due to the logistical difficulties associated with collecting data and inadequate time available, only 30 plots measuring 15 m x 30 m plots each were sampled at the fifteen communities.

For this study no DBH were measured. All plant species inside or surrounding each plot were identified and recorded. For unfamiliar ones, specimen vouchers were collected. Plants were named according to Lebrun & Stork (1991, 1992, 1995 and 1997), Aké Assi (2001 and 2002) and Hawthorne & Jongkind (2006).

4.7.2 Plants Identification

There are many methods used in plants identification. The most common one we used is taking into account the colour of the bark of trees, type of leaves, i.e. simple, compound, pinnate, bipinnate, type and colour of flowers, seed type, colour of bark

slash (exudates), the liquid that comes out of the bark of the tree when slashed, smell and type of pods, even their physical morphology was also used in this survey

4.7.3 Results of the Floristic Studies

After some days of vigorous and effective rapid botanical survey within the fifteen Villages , Royanka, Ronolla, Kulkoss, Mamorka, Masecheleh ,Bonkababay, Kethibio, Masegkra, Patisu Malosie, Makomgba, Rothongbai, Masangba, Matetie, Makessie, a total of Two Hundred and Twenty – six plant species (226) belonging to 71 families were recorded. The most common family is the Euphobiaceae (19 species). When compared to Loma mountains (36 species). This finding is impressive. However, the most common family in Loma Mountains is the family Rubiaceae with 81 species. This community also harbors few species of conservation concern (table 12).

Table 12: species of conservation concern recorded in the fifteen communities

SPECIES NAME	STATUS (IUCN)
Eriosema arenicola	Very rare
Heritaria utilis	Endangered
Millicia regia	Endangered
Millicia excels	Endangered
Nuclear didirhichii	Vulnerable
Terminalia ivorensis	Vulnerable

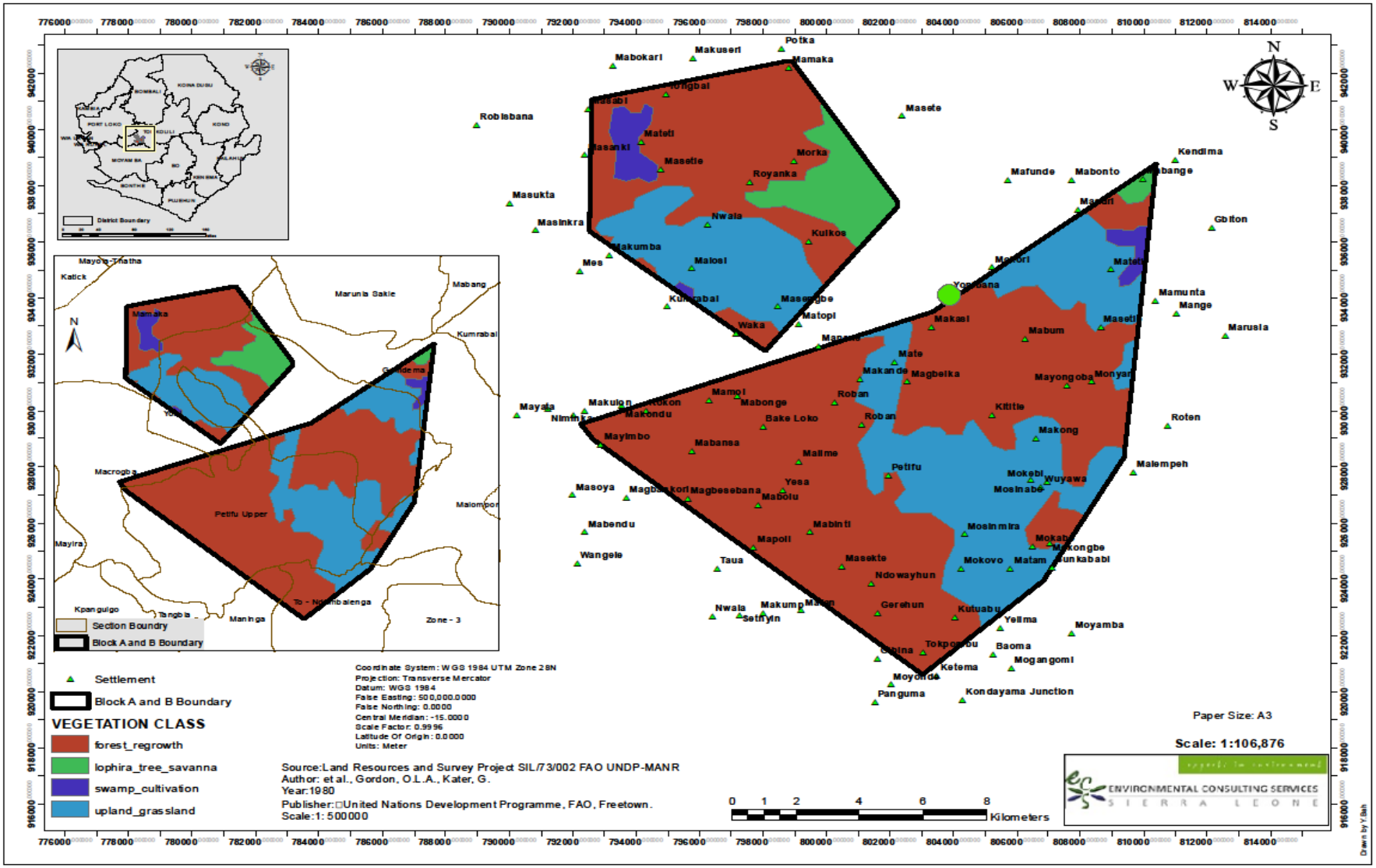
This whole study when compared to Loma Mountains that has been researched thoroughly, has a record of 1,576 species distributed across 757 genera and 135 plant families were recorded (Jaeger 1983). The four endemic plant families found in Tropical Africa are represented on Loma by *Triphyophyllum peltatum* (Dioncophyllaceae), *Octoknema borealis* (Octoknemataceae), *Bersama abyssinica* (Melianthaceae), *Napoleonaea leonensis* (*N. vogelii*) (Lecythidaceae), one, *Napoleona heudelotii* (Lecythidaceae) is recorded in this study (Lebbie *et al* 2008)

Typical plant association for the closed forest regrowth area and Guinea savanna include *Uapaca species*, *Cola lateritia* var. *maclaudi*, *Parinari excelsa*, *Piptadeniastrum africanum* and *Canarium schweinfurthii* (Cole 1968) do also occur in this study.

Plate 1 Interview session at kulkoss

Plate 2Interview session at Malosie

Figure 7: A Map Showing the Vegetation of MFC Project Areas



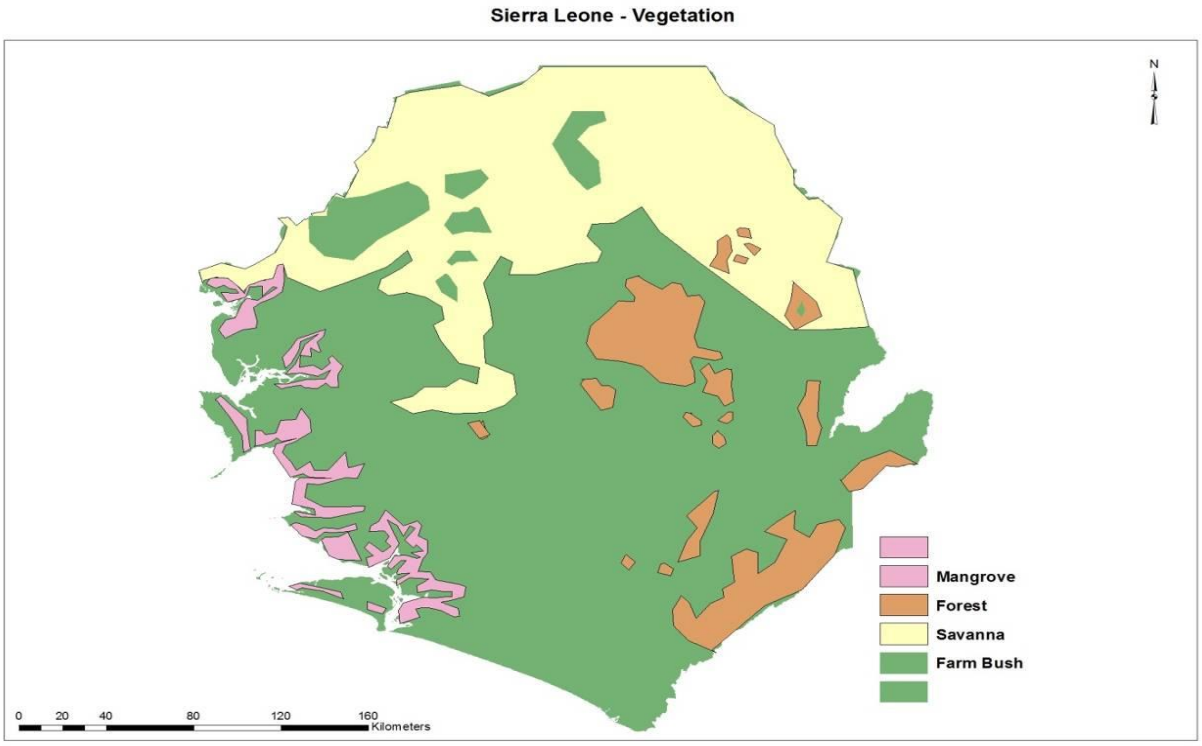


Figure 8: Showing the Vegetation Map of Sierra Leone

4.8 Fauna

The raw material for the study of abundance is usually some estimate of population size. In its simplest form, this process involves conducting simple counts of individuals present (Begon et al, 2006). Records with respect to conservation status, abundance and distribution of mammals in Sierra Leone are inadequate (Kortenhoven et al, 2008). The only available information on this subject was the one published by (Grubb *et al.* 1997). According to Kortenhoven et al, (2008), this document is presently outdated although thorough and wider in scope. Given the present situation of continuous rate of deforestation, the country is believed to have less than 5% of its original vegetation cover (Grubb et al, 1997). Due to this unprecedented rate of deforestation coupled with the country's overwhelming desire for bush meat consumption especially among the rural poor that targets mammal species, it is very obvious that the mammal species in the country can only be protected through conservation interventions (Kortenhoven et al, 2008).Therefore, conservation in Sierra Leone must be considered as one key

element for public debate and be acted on positively if her mammalian fauna is to have any future.

4.8.1 The Rationale for the survey

As part of the requirement for MFC (SL) Ltd and with its aim of establishing an offset to mitigate the disturbance the company would possibly cause to the biodiversity of its operational areas, The Terms of Reference (ToR) included ecological information to establish the categories of biodiversity present in these areas and give an indication of the offset required.

General objectives

The aim of this survey was to:

- Obtain data on, small mammals and primates present in the operational areas of MFC (SL) Ltd.
- Sightings, mapping of critical animal species of conservation concern
- Habitat mapping, watershed characteristics, flood plains etc
- Assessment of rare species of flora and fauna

Specific survey objectives:

- Obtain data on small mammals including primates
- Obtain data on rare species of fauna
- Habitat mapping
- Watershed characteristics and flood plains

4.8.2 Survey Design and Methods:

In line with MFC (SL) Ltd project activities, two primary sampling units namely, the hunters and the agroforestry sites were identified for the survey. Information on small mammals and primates was collected using field guides, field observations, tracks, nests, footprints, etc and interviews.

4.8.3 Preparation for fieldwork:

Before the commencement of actual fieldwork, the survey team took a preliminary visit to all MFC (SL) Ltd project sites with the aim to visually assess the locations and to estimate the quantum of work at hand. This exercise was followed afterwards by holding of consultative meetings in each study community with the community leaders, representatives of youth groups and other stakeholders that are residence in each community to disclose the nature of consulting team exercise. The meetings took place in May, 2014.

4.8.4 Selection of the study Communities and Socio-economic Profiles:

The survey was conducted in Yoni chiefdom and fifteen communities in MFC (SL) Ltd programme implementation areas in Yoni chiefdom located in Mile 91 area, Nothern Province of Sierra Leone (See Table13).

Table 13: Surveyed communities/Areas

District	*Chiefdom*	*Community*
Tonkalili District	**Yoni**	Royanka
 **Picture 3 Guides directing our path through the farmbush**		Ronolla
		Kulkoss
		Mamorka
		Masecheleh
		Bongababay
		Kethibio
		Masegkra
		Patisu
		Malosie
		Makomgba
		Rothongbai
		Masangba
		Matetie
		Makessie

The surveyed communities presented very good examples of rural settings and are characterized by a whole range of socio-cultural, environmental and economic attributes. They are predominantly Muslims and grow crops like cassava, corn, and rice on a small scale. Cassava in these communities is grown on a large scale which is their major source of income.

4.8.4 Materials and MethodS:

Field note books, files and pens were provided to complement the data gathering. To ensure safety, rain boots and raincoats were also provided for the teams, tour guides were allocated to the teams to facilitate the work.

4.8.5 Methodology of the Study Sites:

For this study, fifteen (15) study sites were identified within the MFC (SL) Ltd project areas based on the survey maps provided (the selection of these site as sampling sites was done by the consulting firm- Environmental Consulting Services . GPS coordinates of all study sites were recorded. The study was conducted in May, 2014 and the study sites were each described in respect of their vegetation types (Table 13). The methods used in this study were observation, interviews, identification of tracks, foot prints, dung, and feeding space.

4.8.6 Qualitative interviews

To complement data from field surveys, informal interviews were organized with key informants. The hunters and tour guides were very helpful in this case, they gave very valuable information leading to the conclusion that these species exist in those places. Tour guides nominated by the community leaders also double as hunters. These

hunters/tour guides were asked to name the species they often come across in their hunting activities and the areas they occur. There was no need for a translator since the survey team comprised of people that speak Temine, the dominant tribe in the programme area. Care was taken not to asked questions that will lead to the answer. We used a field guide on primates of West Africa to identify some of the recorded species. Similar method was used by (Kortenhoven et al, 2008) although they did not use a checklist to identify the species.

4.8.7 Data Treatment and Analysis:

This study was descriptive and data quality was guaranteed in the field as well as during the data entry process. Data sheets were often checked at the end of each day to ensure that all the species are entered correctly and clearly. At the end of the field exercise, all the data sheets were collected and the entries compiled. Data analysis involved preparing species lists for each surveyed point to establish the presence or absence of a species in the sites under consideration.

4.8.8 Results and Discussion:

Table : List of mammal species recorded in MFC (SL) Ltd project sites based on this survey and the conservation status; O=observed, H=heard, N= nest, F= feeding evidence, T=tracks, D=dung, I=interview with Tour guides/hunters.

Table 14: showing the primate lists.

Common Names	Scientific Names	O H F T D N I	IUCN Status
Primates			
Chimpanzee	*Pan troglodytes verus*	* * * *	EN
Red colobus	*Colobus polykomos*	*	EN
Campbell's monkey	*Cercopithecus campbelli*	* *	LC
Green monkey	*Cercopithecus sabaeus*	* * *	LC
Sooty mangabey	*Cercocebus atys*	* * *	VU
Olive monkey	*Procolobus verus*	* *	UN
Bush baby	*Bosman's pottos pottos*	* *	UN
Lesser spot- nosed monkey	*Cercopithecus petaurista*	* * *	LC
Demmidoff's galago	*Galagoides demidovii*	*	Rare
Water chevrotain	*Hyemoschus aquaticus*	*	UN
Ungulata			
Red river hog	*Potamochoerus porcus*	*	LC
Maxwell duiker	*Philantomba maxwelli*	* * *	NT/LC
Royal antelope	*Neotragus pygmaeus*	* * * * *	NT
Black duiker	*Cephalophus niger*	* * * *	NT
Yellow back duiker	*Cephalophus silivcultor*	* * * * *	NT
Bush buck	*Tragelaphus scriptus*	* * * *	UK
Rock hyrax	*Procavia johnstoni*	* *	UK
Zebra duiker	*Cephalophus zebra*	* *	Threatened to extinction in Sierra Leone
Rodentia			UK
Cane rat	*Thryonomys swinderin*	* * * *	UK
Brush tailed porcupine	*Atherurus africanus*	* * * * *	LC
Rope squirrel	*Funisciurus pyrropus*	* * *	LC
Giant rat		* *	UK

Giant Forest Squirrel	*Protoxerus stangeri*	* * *	
Small Sun Squirrel	*Heliosciurus punctatus*	* *	
Cannivora			
Slender mongoose	*Herpestes sanguinea*	*	LC
African palm civet	*Nandinia binotata*	*	UK
Common genette	*Genetta genetta*	*	LC
Musk cat		*	UK
Philodota			
Tree pangolin	*Phataginus tricuspis*	*	UK
Chiroptera			
Buttikofer's Epauletted fruit bat	*Epomops buettikoferi*	*	LC

EN=Endangered LC= Least Concern, VU= Vulnerable, NT= Near Threatened,

UK= Unknown

The team recorded(30) thirty species belonging to (6) six groups and a number of signs including foot prints, feeding evidence, tracks and chimpanzee nest of mammals. The team was able to observe, heard and through interviews with tour guides and hunters recorded 30 species as mentioned above. The list comprised of 10 species of primates, 8 species of ungulates, 6 species of rodentia, 4 species of canivora, 1 species of philodota and 1 species of chiroptera (bat) (Table 14). There had not been any record on previous survey reports to have acted as baseline from which all references could have been drawn.

4.8.9: Information on rare and endangered species in the study locations:

The present survey recorded no sign of pan troglodyte's verus though the community people inform the research team about their presence between the boundaries of moyamba and Tonkalili district. And this species is some of conservation interest, *Pan troglodytes verus,* recorded by International Union for Conservation of Nature (IUCN) as

endangered, *Galagoides demidovii* as rare in the survey areas from feedback by the local communities**.**

4.8.10 Watershed characteristics and floodplains

We observed a number of tributaries and brackish waters (where fresh and fresh water meet). These tributaries were confirmed to be connected to the Rokel River and empties into it. At Royanka nursery, the team observed numerous streams and water well close to the nursery site one of which acts as irrigation water for the nursery. At the permanent planting site, there is a river which flow pass the site the source of which is not known. A number of flood plains present in the Marshy lands of the surveyed areas within Miro forestry Company concession areas.

4.8.11: RESULTS AND DISCUSSION

Mammal diversity and abundance recorded in the survey area during this survey was fairly small especially in the areas uncultivated. During this survey we recorded the presence of chimpanzee (Red colobus *(Colobus polykomos),* Campbell's monkey *(Cercopithecus campbelli),* Green monkey *(Cerpithecus sabaeus),* which have been classified by the International Union for Conservation of Nature (IUCN) as endangered. However, there are far more mammal species recorded previously in Sierra Leone. A total of 71 large mammal species altogether have been recorded (Grubb et al, 1996). The team could not find species like the bongo (*Tragelaphus eurycerus*), but zebra duiker (*Cephalophus zebra)* previously noted to be at risk of extinction in Sierra Leone (Kingdon, 1997). There was the absence of Diana money (*Cercopithecus diana diana),* A more thorough survey is needed to establish the presence of this species categorized as endangered by IUCN (Kotenhoven et al, 2008).

4.9: Birds/Avian Studies

Miro Forestry Company (MFC (SL) Ltd) are implementing plantation forestry project within the yoni chiefdom in the northern province of Sierra Leone.

The current decline in the status of the world's biodiversity is alarming. Thousands of species have disappeared and many more are facing the threats of extinction. This situation has resulted largely from human strike towards improved standard of living. The rate of species loss at the end of the 20th century was put at one a day, but this was expected to rise to an unprecedented 130 species a day by 2000 (Myers, 1985, 1990). This puts the annual rate of extinction at a staggering 50,000 species; a rate that is estimated to be 100 – 10,000 times what would be under natural conditions free from anthropogenic influence (Myers, 1990; Wilson 1989, 1992).

Ironically, as rich habitats with many species are being replaced by a few species that are adaptable enough to survive urban development, agricultural monoculture or polyculture and degraded and polluted forest and wetland, the very quality of life that mankind is struggling to improve is threatened.

Ornithological surveys started in Sierra Leone as far back as 1930. The number of species recorded up to 1994 stood at 626, excluding 10 species that are either extinct or whose presence requires further proof (Okoni-Williams *et al*, 2004).

Sierra Leone holds 23 species of global conservation concern. Of these `are 11 globally threatened, two endangered, nine vulnerable, ten near threatened and two data deficient. Despite a number of surveys conducted in the region in recent or relatively recent years (e.g. Allport *et al*. 1989; Gartshore 1989; Gartshore *et al*. 1995; Demey & Rainey 2004, 2005, 2006; Rainey & Asamoah 2005; Demey 2007), the avifaunas of the majority of these forests are still inadequately known. The fifteen communities within the project areas in Yoni Chiefdom did not qualify as an Important Bird Area as this is the first bird survey that has being conducted for Miro forestry company within their Tonkolili concession areas.

The current survey was conducted as part of an Environmental and social Impact Assessment requirement before the full blown implementation of the plantation forestry project of MFC (SL) Ltd takes off as long-term to document avian fauna that may be lost due to the effects on the ecosystem in the immediate vicinity of the project.

4.9.1 Study Areas and Methodology:

The field work was carried out in fifteen communities within the Yoni Chiefdom from where MFC (SL) Ltd is implementing the plantation forestry project.

Table 15: Showing the GPS Coordinates and Elevation of MFC (SL) Ltd Project Areas

Communities	North Coordinate	West Coordinate
Royanka	08 28’ 44.7’’	012 17’ 53.5’’
Ronolla	08 27’ 46.7’’	012 18’ 33.6’’
Kulkoss	08 27’ 37.2’’	012 16’52.3’’
Mamorka	08 29’ 05.1’’	012 17’ 07.9’’
Masecheleh	08 28’53.1’’	012 19’ 26.6’’
Bonkababy	08 21’ 14.5’’	012 12’ 46.7’’
Masegkra	08 21’ 50.8’’	012 14’ 14.1’’
Kethibio	08 24’ 12.9’’	012 13’ 47.8’’
Petifu	08 22’ 59.0’’	012 15’ 23.8’’
Malosie	08 27’ 00.3’’	012 18’ 49.7’’
Masangba	08 26’17.7’’	012 17’16.1’’
Rothongbai	08 26’ 17.7’’	012 17’ 16.1
Matetie	08 29’ 22.1’’	012 19’ 40.5’’
Makessie		
Makomgba		

All these communities were situated in Tonkalili districts. A few motor roads and foot paths connect these communities. These networks of foot path and motor roads also acted as transects for this study.

Point counts also formed part of the methods used to collect data. This was principally done in farms. The consulting team created open habitats for clearer observation. Notes were taken on both visual observations and bird vocalizations. Field work was normally carried out from dawn (usually 07:00) until about 13:00, and again in the afternoon (15:00) until around 18:30–19:00 depending on the prevailing weather condition that day. Some species were recorded opportunistically during the night. Mist-netting was carried out for two days, one morning and one afternoon at Kulkoss community only (this was the only habitat with minimal disturbance). The motive was to obtain records of secretive and silent species which can pass unnoticed during general observations. A 12-metre net was set in secondary forest next to small streams for a total of 42 hours.

For each field day a list was compiled of all the species that were recorded. Numbers of individuals or flocks were noted, as well as any evidences of their presence, such as the presence of juveniles, and basic information on the habitat in which the birds were observed. It should be noted that several bird species do not sing (e.g. some cuckoos and owls) and may have not been recorded.

The weather was usually mixed (some days partly sunny, partly rainy; some other days completely cloudy). It should be noted that this study was conducted at the peak (May) of the rainy season in Sierra Leone. The temperatures ranged from 20–30°C. It rained every day at night. Fortunately, the rains ceased before dawn. Thus, the rains did little to disturb the study.

For the purposes of standardisation, we have followed the nomenclature, taxonomy of Borrow & Demey (2001, 2004).

4.9.2: Results of the Avian Studies

A total of 108 bird species were recorded during the entire study (see Appendix-A). Out of these, two are of global conservation concern (BirdLife International 2000, 2004 and updates posted at www.birdlife.org). One is classified as Endangered (Rufous Fishing Owl - *Scotopelia ussheri*) and the other Near Threatened (Rufous-winged Illadopsis - *Illadopsis rufescen)* (table 16)

Almost all species have previously been recorded in various habitats throughout the country such as the Loma Mountains (Ron Demey *et al*, 2008), Bumbuna Hydro-electric Dam (Thompson *et al,* 2005). However, one species (Lemon dove - *Aplopelia larvata*) need further research for confirmation - it would have been new for Sierra Leone and would therefore need proper documentation. The more striking species that needs in depth research is (Abssinian Ground Hornbill - *Bucorvus abyssinicus*). For this species, the locals reported of its existence within their locality (Appendix). The Crested Malimbe – (*Malimbus malimbus*) also recorded in this study suggests an extension of its range. Its common habitat is the Southeastern and Western part of the country.

The bird species recorded during this study belong to 31 families. These comprise 80 residents, 09 Palearctic migrants and 02 Intra-African migrants. The remaining two species are both resident individuals and either Palearctic or Intra-African migrants, and one is an African vagrant.

This result is far below those recorded in other parts of the country (table 16). The probably reasons are: the season the study was conducted and the length of time the research was conducted.

Table 17: Species of Global Conservation Concern recorded in Loma mountain non-hunting reserve, Bumbuna Hydro – electric Dam and (Mile 91) MFC (SL) Ltd present study areas

SPECIES		CONSERVATION STATUS	LOMA MOUNTAINS	BUMBUNA	PRESENT STUDY(MFC(SL) Ltd
ENGLISH NAME	SCIENTIFIC NAME				
Pallid Harrier	*Circus macrourus*	NT	**X**	-	-
Lesser Kestrel	*Falco naumanni*	VU	-	-	-
Rufous Fishing Owl	*Scotopelia ussheri*	EN	-	-	X
Brown-cheeked Hornbill	*Bycanistes cylindricus*	NT	-	-	-
Yellow-casqued Hornbill	*Ceratogymna elata*	NT	**X**	X	-
Baumann's Greenbul	*Phyllastrephus baumanni*	DD	**X**	-	-
Yellow-bearded Greenbul	*Criniger olivaceus*	VU	-	-	-
Black-headed Rufous Warbler	*Bathmocercus cerviniventris*	NT	**X**	X	-
Sierra Leone Prinia	*Schistolais leontica*	VU	**X**	X	-
Yellow-headed Picathartes	*Picathartes gymnocephalus*	VU	**X**	-	-
Rufous-winged Illadopsis	*Illadopsis rufescens*	NT	**X**	X	X

Copper-tailed Glossy Starling	*Lamprotornis cupreocauda*	NT	**X**	X	-
Emerald Starling	*Lamprotornis iris*	DD	**X**	-	-
TOTAL			**9**	**5**	**2**

4.9.3 Species of Restricted Biomes

Table 18: Species restricted to the Upper Guinea Forest that are recorded in the study area and other places.

Species		**Loma mt.**	**Bumbuna**	**Present study Areas**
English name	**Scientific name**			
Rufous Fishing Owl	*Scotopelia ussheri*	X		X
Brown-cheeked Hornbill	*Bycanistes cylindricus*	X		
Yellow-bearded Greenbul	*Criniger olivaceus*	X		
Black-headed Rufous Warbler	*Bathmocercus cerviniventris*	X	X	
Sierra Leone Prinia	*Scistolais leontica*	X	X	
Sharpe's Apalis	*Apalis sharpii*	X		X
Yellow-headed Picathartes	*Picathartes gymnocephalus*	X		
Rufous-winged Illadopsis	*Illadopsis rufescens*	X	X	x
Copper-tailed Glossy Starling	*Lamprotornis cupreocauda*	X	X	
Total		**9**	**4**	**3**

In total, three species recorded belong to Species restricted to the Upper Guinea Forest (Table 17). In Sierra Leone, only 14 of such species occurred. i.e. land bird species which have a global breeding range of less than 50,000 km^2, that make up the Upper Guinea forests Endemic Bird Area (the area from Sierra Leone and south-east Guinea to south-west Ghana that encompasses the overlapping breeding ranges of restricted-range species: Stattersfield *et al*. 1998) are now known from these sites. Some of the above-mentioned species are of restricted range as is the non-threatened Sharpe's Apalis

Apalis sharpii. The study area (Mile 91) thus holds negligible proportion of the Upper Guinea endemics specie

4.9.4: Non Species of Conservation Concern

Rufous Fishing Owl *Scotopelia ussheri* (Endangered).This owl was sighted in Bongababay area along the road leading to the village. This secondary forest has a myth that has helped in its conservation .The University of East Anglia expedition had seven sightings of probably two individuals along the Benge River (Atkinson *et al*. 1996). This Upper Guinea endemic is a rare to scarce resident, from Sierra Leone to Ghana (Ron Demy *et al*, 2008).Rufous-winged Illadopsis *Illadopsis rufescens* (Near Threatened) Fairly common; with few singing individuals recorded during the study.

4.9.5: Results and Discussion

One hundred and eight bird species were recorded during this survey, of which most (if not all) had been recorded previously. This figure is high considering the short study period for this field work in bird identification). This finding in the fifteen communities is impressive, representing 16.27% of the species documented for the whole country. Although not all major habitats have been surveyed (due to the raining season), this number may increase with additional survey work conducted at different times of the year and more expertise employed. Even species of global conservation (two) were recorded during this survey. This represents 6.80% of those known for the country. Among these, the rare and little-known Rufous Fishing Owl is particularly worthy to note.

The number of restricted-range species within the study areas is less striking (Appendices) (Table 30). Three species out of the 14 restricted-range species thus 21.43% recorded in Sierra Leone were found within MFC (SL) Ltd concession areas. Furthermore, twenty- (12.24%) Guinea-Congo forests biome species and 2 (7.14%) Guinea – Sudan biome restricted species were recorded (Stattersfield *et al*. 1998, Okoni-Williams *et al*. 2001).

Table 19: Conservation status and biomes restricted species compared

Species of Conservation concern	Loma mt	Bumbuna	Present study areas (MFC)	Sierra Leone
Endangered	12	5	2	29 (30)
Vulnerable	1	0	1	2
Near threaten	4	1	0	10
Data deficient	6	4	1	14 (15)
	2	0	0	3
Upper Guinea Forest restricted species % of total recorded in Sierra Leone	9 64.29	4 28.57	3 21.43	14
Guinea- Congo forest Biome restricted species % of total recorded in Sierra Leone	128 73.5	69 40	22 12.24	174
Guinea- Sudan biome restricted species % of total recorded in Sierra Leone	6 21.5	9 32	2 7.14	28
Total number of species	332	226	108	633
% of total recorded in Sierra Leone	52.5%	35.5%	16.27	

By comparison, 226 species were listed in the Bumbuna Hydroelectric Project area over 30 days between February and July 2006 (Nippon Koei UK 2007). Of these, six are either misidentifications or require proper documentation to be accepted: Yellow-fronted Tinkerbird *Pogoniulus chrysoconus*, Western Olivaceous Warbler *Hippolais (pallida) opaca* and Black-headed Weaver *P. melanocephalus* would be new for Sierra Leone. 332 species were listed for Loma Mountains over a period of 16 days. The survey team comprised FOUR SEASONED ORNOTHOLOGISTS including the Author of the book "Field Guide on the Birds of Western Africa"

Although the ornithological diversity in the fifteen communities (in the Mile 91community) where MFC (SL) Ltd Project area is comparatively low, compared to other sites in the country (see e.g. Okoni-Williams *et al*. 2001), the Yoni chiefdom area appears to have less conservation value.

5.0 Amphibians' Studies

The Report from the findings of the Rapid Herpetological survey in the Yoni chiefdom in the Tonkolili District within fifteen villages.

In each of these villages many sites were surveyed which included cassava farms, swamps, farm bushes, savanna areas, small patches of secondary forest, oil palm plantations, stagnant waters i.e. ponds, and small lakes.

This section of report covers only the Herpetology study. For the herpetological survey there have been no records for these areas so far, this is going to be the first record for this chiefdom/selected Villages.

5.1 STUDY SITES

The survey was carried out during the month of May 2014. The team worked around Royanka, Ronolla, Kulkoss, Mamorka, Masecheleh, Bonkababay, Kethibio, Masegkra, Patisu Malosie, Makomgba, Rothongbai, Masangba, Matetie and Makessie respectively. In these areas, swamps, cassava farms, secondary forest, lakes, mangroves, oil palm Plantations, rice fields, savanna, streams, cleared farm field, were surveyed.

5.2: Methodology of the Amphibian Studies

During this amphibian survey, only two methods were applied. They included visual and acoustic. This was from the fact that most of the amphibian species are cryptic. Therefore, most herpetologists prefer the visual and acoustic to identify them.

Their possible habitats (swamps, marshy areas, stagnant water bodies etc were thoroughly searched for amphibians). However, care was taken in their search because their predators (snakes) are almost always present in their habitat.

Mostly, we used the capture and recapture method. This method involved removing the last digit toe but in a way that could not disturb the frog or toad. This is then preserved in 78% Ethanol. Then photo is taken and released. In general all species have different way of calling. Knowing different type of calls gives more credence for identification. This is known as acoustic method. Within our survey days, both methods were used.

5.3: Results of the Amphabians Studies

In total, fourteen (14) species of amphibians were found or encountered either visually or acoustically. Amongst these found, *Phrynobatrachus liberiensis*, *Phynobatrachus alleni* and *Bufo taeinsis* are classified as Near Threatened (IUCN red list). The rest species are classified as least conservation concern.

5.4 Species Found During the Survey.

Table 20: Species recorded during the survey at different locations.

SPECIES	HABITAT	IUCN
Phrynobatrachus alleni	Swamp	NT
Phrynobatrachus phyllophilos	Cassava	LC
Phrynobatrachus liberiensis	Cassava	NT
Phrynobatrachus fraterculus	Savanna	LC
Amietophrnus maculates	2° Forest	LC
Amietophrynus regularis	Oil palm	LC
Bufo superciliaris	Cassava	L c
Bufo taeinsis	2° Forest	NT
Bufo togoensis	2° Forest	LC
Ptychaden bibroni	Cassava	LC
Ptychaden superciliaris	Farm bush	LC
Ptychaden oxyrhnchus	Village community	LC
Phrynobatrachus annulatus	Farm bush	LC
Leptopelis viridis (a tree frog)	Savanna	LC
Phyrnobatrachus annulatus	Swamp	LC

NT: Near Threatened
LC: Least Concerned

In total, Fourteen (14) species were found or encountered during this survey. A total of 51 individuals were found. Two of which are of conservation concern; Near Threatened

6.0: Socio-Economic Environment

A wide-ranging social baseline survey was conducted as part of the socio-economic impact assessment (SIA) during this ESIA studies. A site visit to the project areas was conducted in May 2014. During the visit, a questionnaire was administered. These questionnaires were administered mainly by University Students and Teachers who were trained as to how the questionnaires should be administered. The questionnaire consists of information on the baseline demographic and socio-economic information which includes; education levels, health, livelihood strategies, employment, and income. The survey was conducted in one district, Tonkalili Districts and the villages surveyed are Royanka, Ronolla, Kulkoss, Mamorka, Masecheleh,Bongababay, Kethibio,Masegkra,Patifu, Malosie, Makomgba, Rothongbai,Masangba, Matetie and Makessie; the current site were the forestry plantation program is ongoing and the nursery site camp site is located in Royanka Village. The data were captured by using SPSS, analysed and then used to describe and interpret the socio-economic and cultural environment for the project areas.

The Project area is surrounded by a number of small villages and much of the population relied heavily on farming and petty trading. It is inhabitants to both the local indigenes who are mainly Temines and Limbas. However, because of the long time logging activities of the local residence within these areas, the area is diversified with different ethnic groups of the country, hence a diverse cultural settings.

The lack of job opportunities and particularly the uncertainty in the Miro forestry company in terms of employment and untimely redundancy by Salcost Construction Company within the Yoni Chiefdom has encouraged many of the youth to leave the road construction company and moved to MFC (SL) Ltd. As such most of the project areas are flooded with youth waiting to have their chance of joining the company. The youth are of the opinion that, MFC (SL) Ltd is here to stay and as such they prefer working for them instead of other company.

The presence of the MFC (SL) Ltd will provide employment, business, training opportunity for both skill and unskilled workers and other additional benefits through their corporate social responsibilities.

In addition to its inherent considerations, social and economic development is linked to and will be pursued as an integral part of the environmental management dimension of the company's operations. This will be done relative to the Sierra Leone Environmental Protection Act of 2008.

Projected socio-economic development potential and anthropogenic effects of the Company's activities include, but are not limited to, employment-related and income generating criteria, waste management and health and safety issues.

6.1: Socio-Economic Profile

This part of the report presents and analyzes the socio-economic profile of the study area mainly from the questionnaire. It provides a brief overview of the key socio-economic features of the community. The section is expected to provide a context within which the company impacts can be viewed and assessed. Royanka, Ronolla, Kulkoss, Mamorka, Masecheleh, Bongababay, Kethibio, Masegkra, Patifu, Malosie, Makomgba, Rothongbai,Masangba, Matetie and Makessie Mocharles are the reference point for the socio-economic survey.

6.2 Sex Distribution

Gender distribution varies among the villages, probably due to the small size in some of the villages. However, what is clear though is that young men (Figure 11) have migrated to these areas in search of job opportunities. The male population between 20-30 years is very high. This high number is not a coincidence as most of the areas are flooded with youths who are seeking employment.

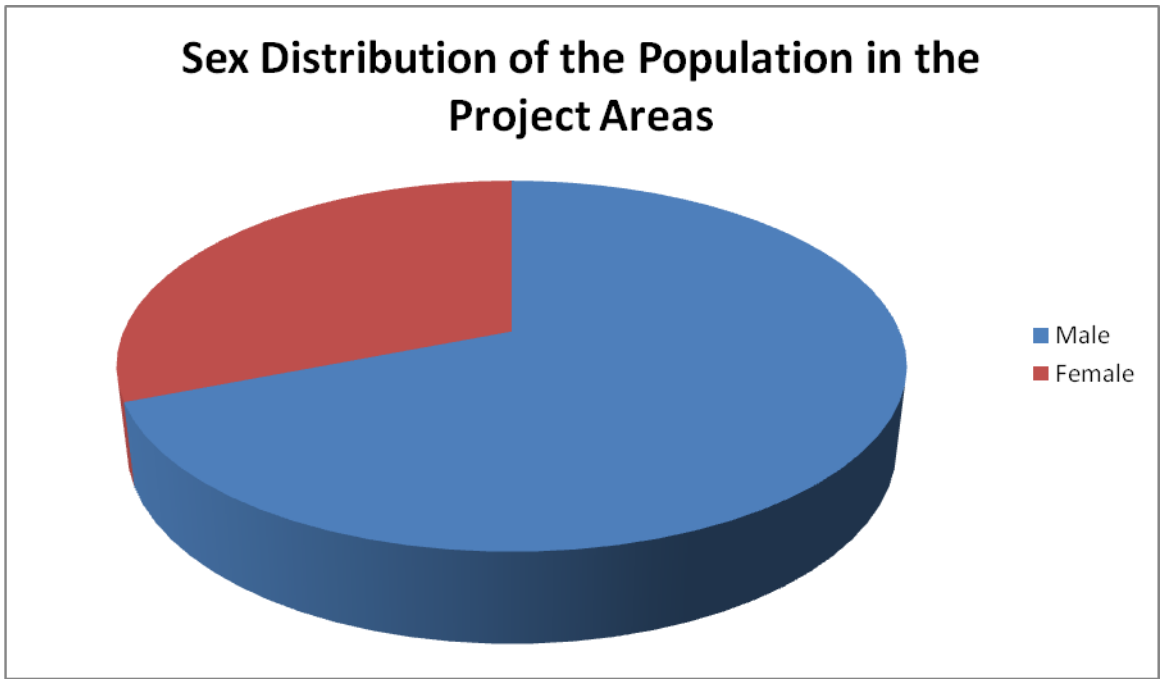


Figure 10: Sex Distribution of Respondent

6.3 Age Distribution

It is statistically useful to combined factors especially when dealing with small proportions of populations as in the project area. Therefore, due to the small size of the population at the project area, which the sample was taken from, the age range of respondents was aggregated, rather than differentiated by sex.

(Figure.11) indicates that majority of the people interviewed are heads of household and hence they are over 40 years. However, most of the youths are within the working age of 20-30 years and most of this youth have the requisite skills and are willing to be trained.

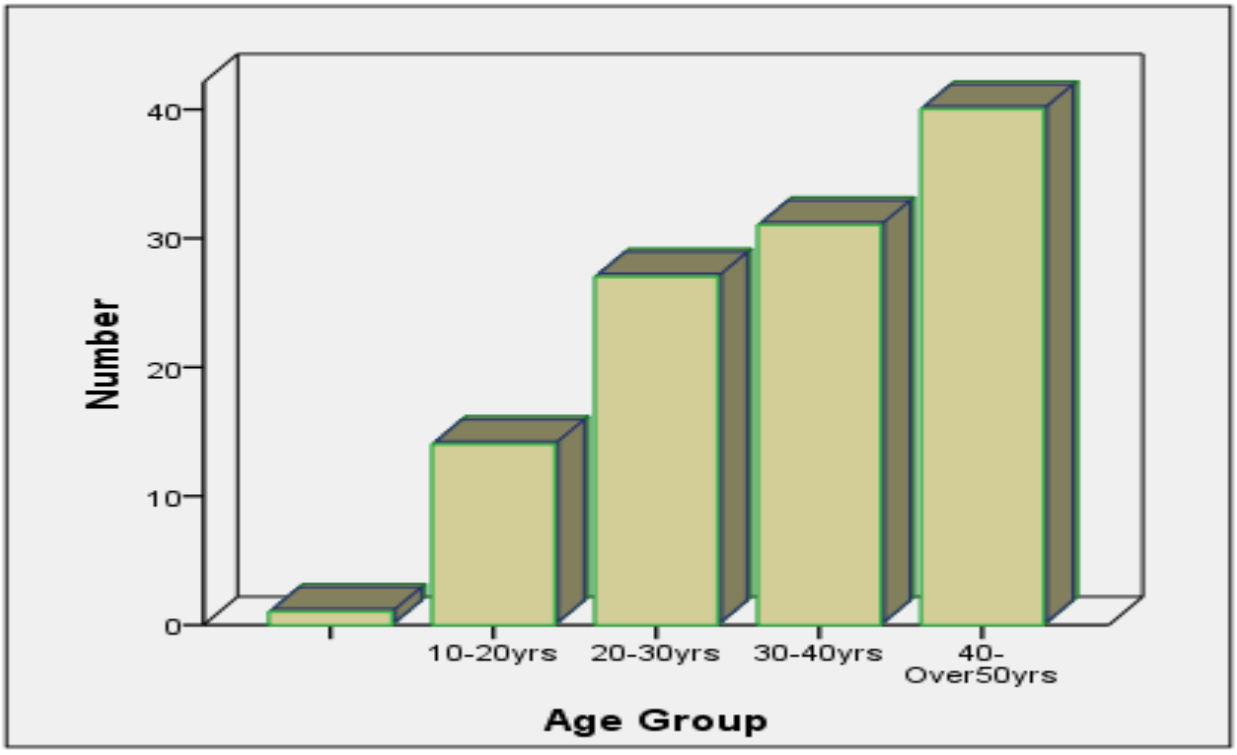


Figure 11: Age Distribution of the population in the project Area

6.4 Marital status

75% of the population is married, 3% divorce, 7% are widows with only 15 % single as shown in (figure.12) this is an indication that the population is bound to increase in the immediate future, hence modalities for social and educational facilities should be considered by MFC (SL) Ltd in their future plans.

Picture 4: Interview session at Bongababy Village

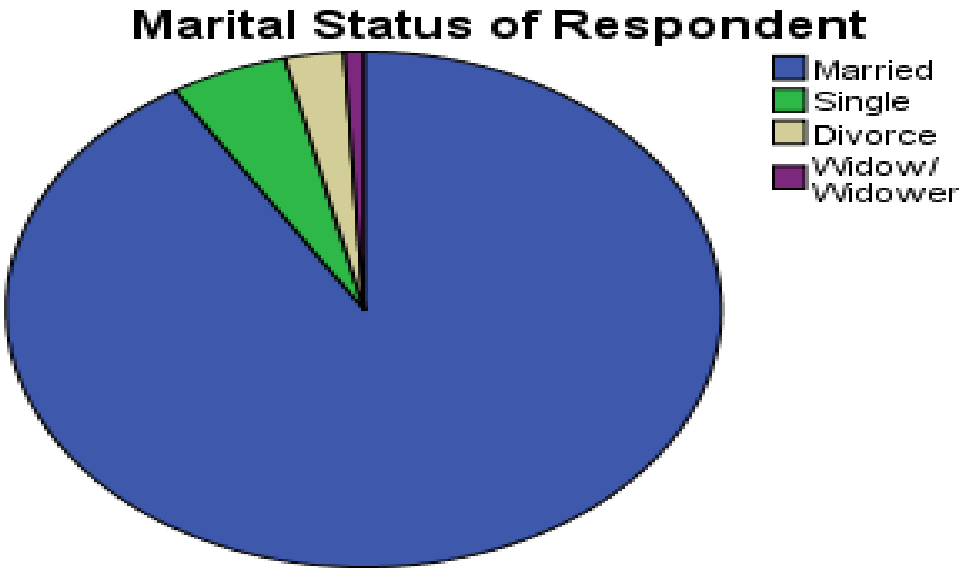


Figure 12: Marital Status of Respondent

6.5: Religious background

80.5% of the respondents were Muslim, with only 19.5% Christian as shown in (Figure 10). Mosques are a common element in the research area. Thus, any upgrade to these facilities by MFC (SL) Ltd will be welcome news to these communities.

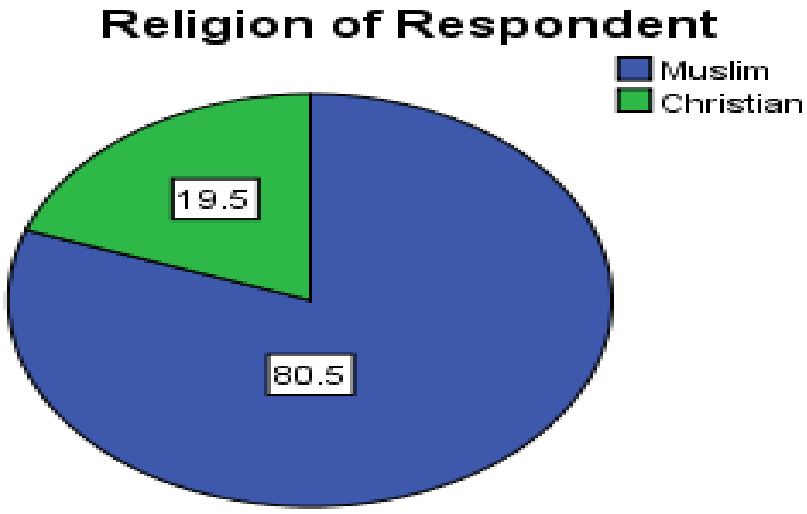


Figure 13: Religion of Respondent

6.6: Ethnicity Composition

Most of the respondents interviewed were Temine (70%), Limbas (15%), Lokos (10%), Fullah (3%) and Mandingo (2%). The dominance of Temines and Limbas is because they are the indigenes of the area and the rest are immigrants that migrated as a result of the Salcost Construction Company and the Sierra Leone Roads Authority (SLRA).

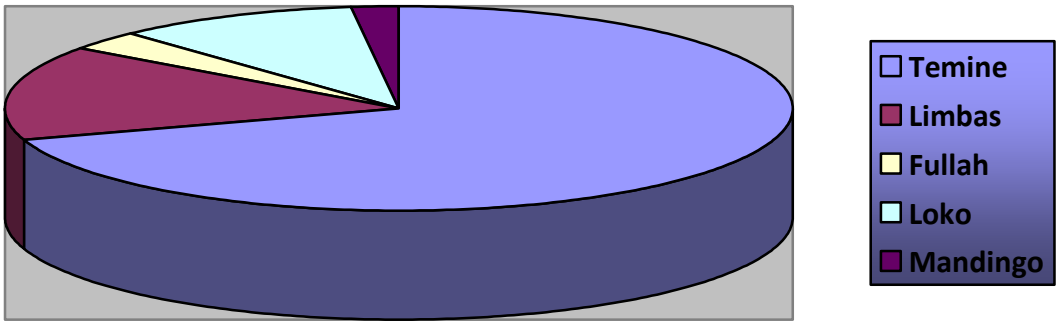


Figure 14: Ethnic Composition of Respondent

6.7: Educational Status

Despite government and NGO efforts to improve primary education across Sierra Leone, access to educational facilities remains a challenge in rural areas. Financial support of infrastructure, basic teaching resources, and teacher's salaries are limited and hence not forthcoming.

Approximately 65% percent of the population aged 10–20 years is in school, predominantly at primary and junior secondary school level. However, the distance from many of the more remote villages to educational facilities means primary school attendance is often low. It is as a result of this that the communities are requesting for Miro Forestry Company to assist in giving scholarships to school children.

Despite these schools, educational attainment for pupils over 10 years of age is very low as shown in (Figure 15); 68% of the respondents are illiterate with only 46% having formal education (Figure 15). The reasons for these are attributed to the poverty and farming activities that have been taking place in these areas for many years.

Table 21: Frequency and Percentage of respondent that attended school

	Frequency	Percent	Cumulative Percent
Yes	46	41.6	41.6
No	68	58.4	100.0
Total	113	100.0	

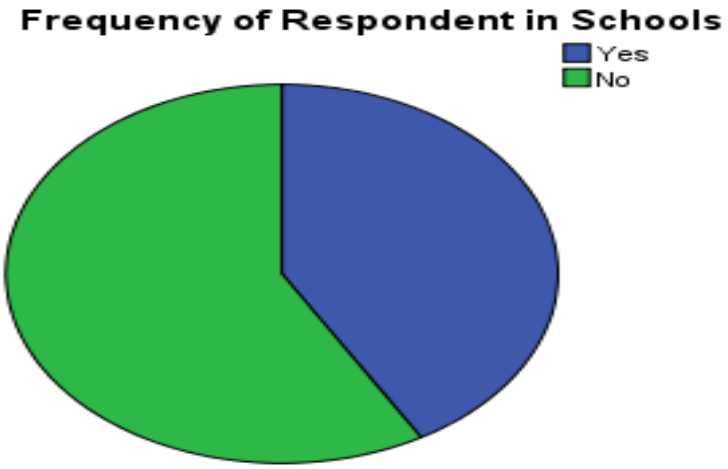


Figure 15: Frequency of Respondent that went to school

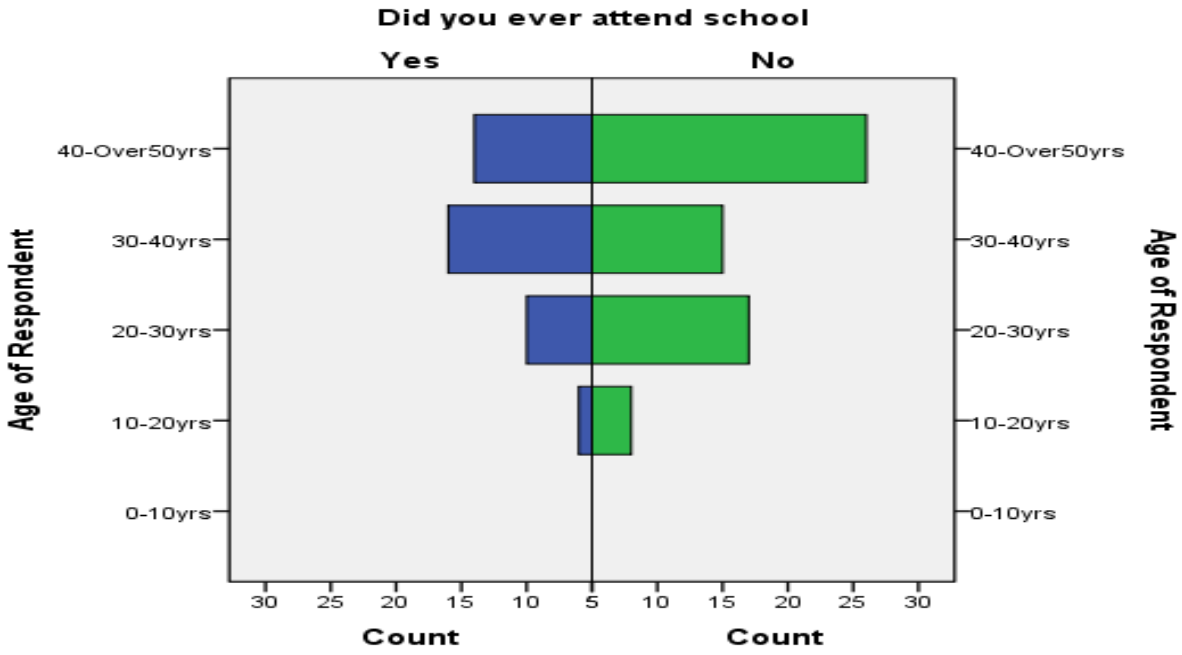


Figure 16: Age of Respondent that attend school

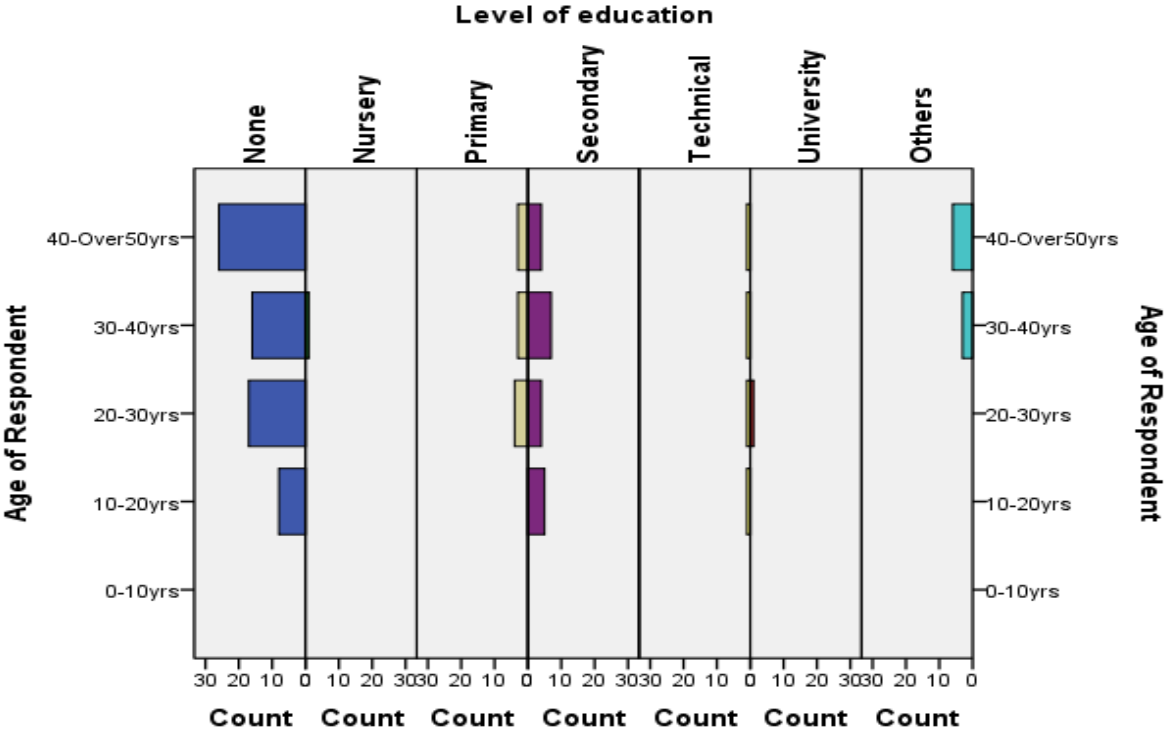


Figure 17: Age of Respondent and their level of school

6.8: Residence status

Resident status in an area may indicate the degree of attachment to a particular environment expressed by individuals. Indigenes of an area would be more concerned about operations either positive or negative in their communities than in-migrants. Based on the survey methodology it was observed that most of the respondent has been living in the area for between 11 and 20 years (Table 22). This is a clear indication that the population in the area is mostly sedentary and thus is likely to have serious concerns for the utilization of resources in the area. As has been shown from similar studies carried out in other parts of the country residents do not oppose the project idea , however they are cautious and are concerned about job creation opportunities and the potential for increased accidents with more vehicular traffic passing through their villages. While some of these may be dispelled with effective public awareness.

Table 22: Number of years living in the Village

Age Groups	Frequency	Percent	Cumulative Percent
1-10yrs	20	17.7	17.7
11-20yrs	28	24.8	42.5
21-30yrs	31	27.4	69.9
31-40yrs	17	15.0	85.0
Over-41yrs	17	15.0	100.0
Total	113	100.0	

6.8.1: Occupational distribution

The occupational distribution of an area is a useful indicator of the type of trained and skills manpower available and that would assist potential developer make judgments pertaining to their requirements for labour.

The survey results presented in (Table.24) shows a higher percentage of farmers, Machine Operator, timber operators, miners and self-employed workers. Hence, a good

indicator suggesting that majority of the people are farmers and they will only be required to undergo skill training particularly as machine operators and skilled farmers.

Table 23: Occupational Distribution

Type of Occupation	Frequency	Percent	Cumulative Percent
Housewife	1	.9	.9
Timber Operator	18	15.9	16.8
Machine Operator	2	1.8	18.6
Shop Owner	1	.9	19.5
Miner	11	9.7	29.2
Security Guard	1	.9	30.1
Farming	74	65.5	95.6
Self Employed	5	4.4	100.0
Total	113	100.0	

6.8.2: Environmental Health and Sanitation

In general the survey focused on the primary sources of health hazards within the communities. This included the sources of drinking water, methods of disposal of solid and liquid waste, and frequently occurring diseases.

6.8.3: Sources of Drinking Water

Availability of safe drinking water greatly contributes to good health. Unsafe drinking water can be a significant carrier of diseases like cholera and typhoid. Therefore, access restrictions to safe drinking water have a significant influence on the health status of the local population. This is further worsened by the distances in which the medical facilities are located within the project areas.

To a very large extent, the source of drinking water can qualitatively determine its suitability for drinking purposes. In the study area sources of drinking water are mainly from Rainfall, Well, stream and River. With most of the river/stream polluted as a result

of farming activities, the community as part of it request to the company is to construct boreholes/ hand dug wells for them as this will save them from an unprotected source.

6.8.4: Sewerage and Garbage Disposal

The main method of defecation used by the community is by open defecation (OD) around the back of dwelling houses. However, some community members use nearby rivers/streams and bushes, thus resulting in the contamination of rivers/streams and hence a recipe for diarrhea. The main form of garbage disposal within the communities is via burning it or throwing it into the bush.

6.8.5: Fuel source

From the result below (Figure 18) 77% of the people use fuel wood for heating and cooking purposes. This shows that most people will be deprived from the use of the forest land, as these areas have been there main source of fuel for cooking and business. Hence, MFC (SL) Ltd should provide alternative source for the indigenes in order to avoid future confrontation.

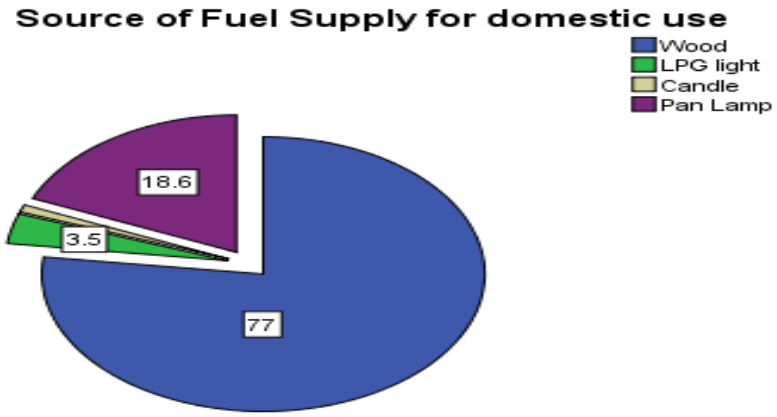


Figure 18: Source of fuel supply for domestic use

6.8.6: Health Impacts

The most common disease in the community is malaria (Figure 19), which is affecting almost everyone. Diarrhea, typhoid, laser fever and cholera are also reported by household members. These diseases are mostly water borne indicating that there incidence is due to poor sanitary condition and lack of clean portable water. The lack of

clinic or hospitals in the project areas suggest that many households are unable to visit a doctor and obtain tests for illnesses, instead self-diagnosing and medicating in times of poor health is the norm.

Table 24: Incidence of Illnesses within the surrounding MFC (SL) Ltd Project communities.

Types of Diseases	Frequency	Percent	Cumulative Percent
Malaria	82	72.6	72.6
Diarrhea	5	4.4	77.0
Dysentry	1	.9	77.9
Cholera	7	6.2	84.1
Typhoid	2	1.8	85.8
Worm infestation	3	2.7	88.5
Laser fever	7	6.2	94.7
Others	6	5.3	100.0
Total	113	100.0	

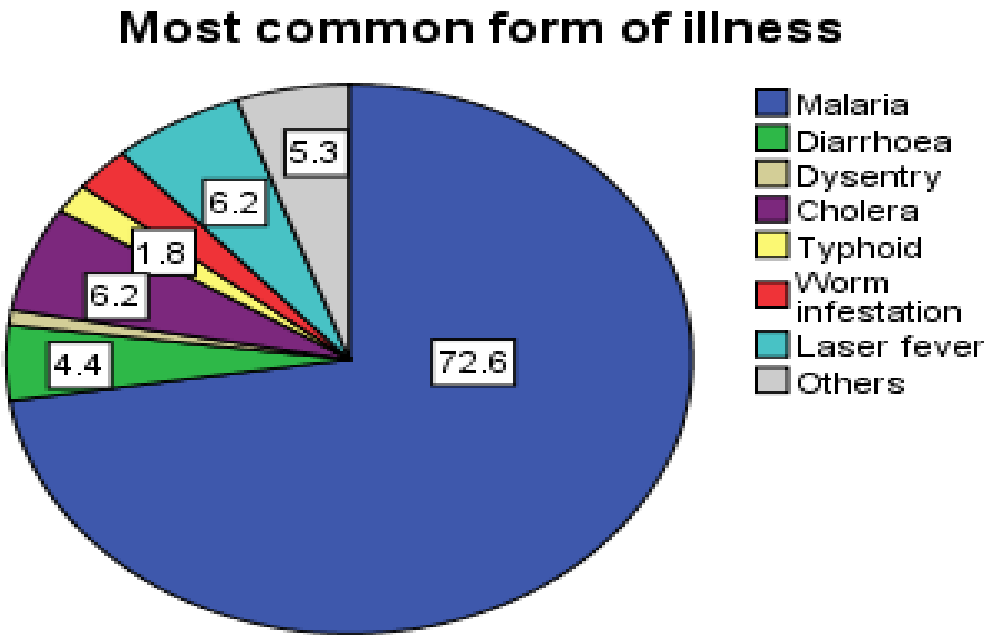


Figure 19: Common form of illness in the project area

6.8.7: Cultural and Archeological Resources

On the issue of cultural heritage and archeological sites, questions were asked as to whether any cultural or archeological sites exist. From the results, it was shown that Bondo bush, Poro bush and cemetery are the main areas of cultural heritage. However, from the survey, no archeological site was present in all the project areas. When asked as to what should be done to this site, 80% of the correspondence said that they have no problem with the site been cleared if only traditional ceremonies are performed to apiece the gods. While 20% of the correspondent said the site should not be cleared as it is their traditional heritage from their forefathers.

Plate 5: Showing the nursery site under construction and the forest Plantation Site at Royanka

7.0: STAKEHOLDER PERSPECTIVES

The participation of key stakeholders during this ESIA preparation to get their perspective on the project is very crucial. Due to time constraints and logistical considerations the Team pieced together this section of the ESIA based mainly on expert knowledge and a few interviews with some of the stakeholders. However, it should be emphasized that continuous and direct engagement of stakeholders to solicit their views is a key criterion for the ESIA process.

7.1 Key Stakeholders

The key stakeholders involved are:

Stakeholder 1 – Government Institutions (Central)

- Forestry Division (FD)
- Environment Protection Department (EPD)
- Ministry of Local Government and Community Development (MLGCD)
- Ministry of Labour, Employment and Social Security (MLESS)

Stakeholder 2 – Government Institutions (Local)

- Tonkalili District Council

Stakeholder 3 – Yoni Chiefdom.

7.2 Stakeholder Description and Possible Concerns

The following is a summary of the possible concern of the stakeholders of the MFC (SL) Ltd Project areas.

7.2.1 Stakeholder 1 – Government Institutions (Central)

7.2.1.1 Environment Protection Agency

The following key issues would be of concern of the Agency:

- Protection and management of the biodiversity of forests
- Cooperation and collaboration with the FD and other stakeholders
- Respect of the ESIA process (compliance)
- Adherence to the tenets of the ESIAs by investors
- Protection of the rights of local communities to their natural resources

7.2.1.2 Forestry Division

The following key issues would be of concern to the FD as part of MFC (SL) Ltd project activities:

- Investors should comply with the rules and regulations that would be stipulated in the contract or agreement, i.e., forest management harvesting plans, environment regulations, social forestry issues, etc.
- The Division should have had some input into the Terms of Reference (TOR) for the conduct of this ESIAs to ensure that all areas pertinent to the operations are covered.
- Land-use planning and the potential conflicts between forestry and NGOs.
- Areas should be allocated for biodiversity conservation and should not be breached under any circumstance. These should be strategically located within concession areas.

7.2.1.3 Sierra Leone Roads Authority (SLRA)

The following key issues would be of concern of the Authority:

- Road usage by trucks can damage the road quickly
- The increase number of trucks can cause a more rapid deterioration of the road
- Reckless road usage and risk of accidents

7.2.1.4 Ministry of Local Government and Community development (MLGCD)

The following key issues would be of concern to the Ministry:

- Concerns extent of the involvement of the local authorities in the process of the lease agreement with a view of protecting the rights of the communities.
- Land-use planning as a potential conflicts between the community people, project staff and forestry division

7.2.1.5 Ministry of Labour, Employment and Social Security (MLESS)

The following key issues would be of concern to the Ministry:

- Workers occupational health and safety issues
- Employers meet the conditions as stipulated in the social security act

7.3.2 Stakeholder 2 – Government Institutions (Local)

7.3.2.1 Tonkalili District Council

The following key issues would be of concern to the District Councils

- The increase in activity will be positive for the communities as it should increase wages, standard of living, population, and employment opportunities.
- Should be invited or notified at the appropriate time concerning any meetings, especially if these meetings involve social and economical issues for the communities.
- More knowledge about the intention of MFC (SL) Ltd for developing the communities from a social and economic perspective.

7.3.3 Stakeholder – Communities Concern:

Possible key issues of concern to the residents of the Project Communities:

- Opportunities for jobs and employment but at the same time skepticism on benefiting from these based on previous experience with similar projects.
- More economic activity and opportunities for the people of the area.

Table 25: Summary of stakeholder concerns

Stakeholder Perspectives	FD	EPA	SLRA	MLGCD	MWHTM	MLESS	Residents of the Project areas
Area allocated for biodiversity conservation should not be breached	√	√					
Increase road usage, with respect to congestion and probably increase in transportation. This could translate to added logging cost			√				
Road usage by trucks to carry agricultural products can damage the road quickly			√				
Trucks use of road in the rainy season can lead to deterioration			√				
Reckless road usage and risk of accidents				√			√
Increase in activity will be positive for residents within the project communities should increase wages, standard of living, Population, and employment opportunities	√	√		√	√		√
Investors social and economic mandate must be carried out	√	√		√	√		√
Jobs being could be “high-jacked” by “outsiders”				√		√	√
NGOs should comply with the rules and regulations that would be stipulated in the contract or agreement	√	√		√	√		
Compliance with occupational health and safety issues						√	
Nassit payment for employees						√	
No comment							

8.0: IMPACT ASSESSMENT AND MITIGATION

There is a wide range of potential environmental effects caused by agroforestry activities which planning authorities need to consider when dealing with Agroforestry Project Implementation or new development, or for significant expansion of existing project. Such impacts may arise during the development stage (e.g. Project starting phase) or may endure throughout the life of the project implementation, possibly over several decades. The impact can be permanent, even after closure and decommissioning, unless carefully planned rehabilitation is undertaken.

The purpose of this section is to assess, based on the social, ecological and physical information provided. Impacts have been characterized into those that affect the biophysical environment, and those, which affect the socio-economic environment. For each impact a brief description is provided as well as an analysis of its significance.

For the purposes of this assessment and in accordance with international guidelines, significance is assessed as a function of:

- Magnitude and extent
- Reversibility
- Longevity
- Probability of occurrence of the impact

As such, significant impacts are the ones considered highly likely to occur and which may be large in magnitude and duration and likely to affect the project implementation. Mitigation measures for the prevention and control of adverse significant impacts are recommended.

8.1 Impact Assessment: Definitions

In order to assess the nature of the impacts it is essential to have a clearly defined starting point. For this study the starting point is interpreted as the 'present situation' of the project where the project site has been identified and the project implementation stage.

At the time of this ESIA, Detailed Design and Project Operational Plan were available. Based on information gathered, and the consultants' knowledge and experience with projects of this nature, the project is expected to be undertaken in two phases.

Plate 6: Showing the Community Land for Agriculture.

Plate 7: Showing the rehalbitated road by Miro Forestry Company (SL) Ltd.

Table 26: ***Key Environmental and Social Impact Assessment Matrix of the Miro Forestry Company (SL) Ltd Project Activities.***

			PROJECT ACTIVITIES OF MFC (SL) Ltd PROJECT										
Impact Assessment Matrix Possible Impacts 1 Minor adverse impacts 2 Moderate adverse impacts 3 Major adverse impacts A Minor positive impacts B Major positive impacts U Uncertain			Land Clearing		Land Preparation			Crop Establishment			Crop Management		
			Clearing of Vegetation	Disposal of debris	Construction of Roads and Bridges	Installation of drainage and Culverts	Terracing	Preparation of Planting holes	Planting of Crops	Planting of Legumes Cover Crops	Manuring/ fertilizing/ lining	Weed Control	Pest Control
ENVIRONMENTAL COMPONENT	SOIL	Surface erosion (upland) Acid formation (lowland) Subsidence (lowland) Soil compaction Top soil loss (upland)	3 1 1		3 1 2	2 1 3 A 1	B 1 1	1	1	B A B	 A A		
	HYDROLOGY	Water yield Stream flow Surrounding swamp	3 3 1		1 1 2	3 A 3				BB			
	WATER QUALITY	Sediment load Turbidity Physical Quality Chemical Quality Biological Quality	3 3 3 3 1	3 2 2 2 1	3 3 3 3 1	3 2 3 3	B B B A	1 1 1 1	1 1 1	BB B A	3	3	3
	DRINAGE	Sedimentation Drainage pattern		3	3 2	3 B	B	1	1	A			
	GROUND WATER	Water table recharge Ground water quality				2					1	1	1

	ATMOSPHERE	Local climate Regional climate Air pollution (dust, etc)	U U	3	1	1	U 1						
	LAND USE	Adjacent land uses Downstream land uses			B A	1 1						A	A
	SPECIES AND POPULATIONS	Vegetation Wildlife Aquatic life	3 3	2	1 1 1	1 1 2					A 1 3	3 3	3 3
	HUMAN AND SOCIAL ECONOMICS	Domestic water supply Physical safety Short-term employment Long-term employment	3 2 A	3 3 A	3 2 A	3 2 A	B A	1 A	1 A	A A	3 A B	3 A B	3 A B

The Environmental and Social Impact Assessment (ESIA) study of the MFC (SL) Ltd Plantation Project identified potential impacts related to their agroforestry development within the Yoni chiefdom consisting mainly of lowlands and peat swamp within the project communities.

The ESIA has been prepared on the basis of field surveys, site visits, and desk studies. Special attention has been given to the irreversible impacts on the unique peat swamp forest regrowth ecosystem within and adjacent to the study areas. The proponent of this Project is Miro Forestry Company (SL) Ltd.

8.2: Description of the Project

Miro Forestry Company ("MFC" or the "Company", which includes subsidiaries where the context implies) is a green-field, profit-oriented forestry group operating in West Africa to supply sustainable value-added timber products to local and regional markets.

MFC is primarily growing fast-rotation eucalyptus for the production of transmission poles and wood based panels for the local and regional market as well as wood chips for pulp and biomass. The Company is also growing a proportion of teak for high-value sawn timber export.

MFC operates two plantations in West Africa in Ghana ("Boumfoum" plantation) and Sierra Leone ("Yoni" plantation) totalling over 30,000 hectares of forestry land. The Company was established in late 2010 and is a private Cayman Island exempted limited Liability Company, now with over 25 shareholders.

8.2.1 Description of the Environment

Geophysical Resources

Soils

The area consists predominantly of low-lying Claysoil and Sandy loamy soil with few wetlands (peat swamps) of flat topography along the south east and at the mouth of Rokel Rivers, with low hills marking the southern hinterlands. The altitude varies from 3 to 30 meters (m) above mean sea level (MSL). There is no tidal influence within the the operational areas of MFC-(SL) Ltd. There is little seasonal variation in the extent of stream water intrusion from the Southern part of MFC (SL) Ltd operational areas.

The predominant soil type is organic / peat soils (Dystric Histosols, based on Food and Agriculture Organization (United Nations) (FAO-classification), these soils have been subdivided into deep peat soils and shallow peat soil with a layer of about 300 centimeters (cm) depth. The remainder of the peat soils is shallow, underlain by non sulfidic clays.

Alluvial soils are found further upstream along the Rivers that are transverse by the main road that is leading to the nursery site of MFC (SL) operation areas and its tributaries.

Two types of the said soil do occur and both are derived from riverine alluviums, which are distinguished below:

- The Gley soils, which are poorly drained soils of clayey texture, and

- Alluvial soils, imperfectly to well-drained soils of clayey texture. Both soil types are subject to seasonal flooding.

Red-Yellow Podzolic Soils are found in the south eastern (upland) part of the study areas (Bongababay, Patifu and Kethibio on moderately steep hill slopes. They include soils of the Clayey Series and the fine loamy soil series. Grey-White Podzolic Soils are also found in these uplands.

8.2.2 Ecological Resource

Forests

The predominant forest regrowth formation in the area is tropical secondary rain forest. The deep peat soils in these areas are virtually undrainable. Six subtypes of peat swamp forest are distinguished, four of which are found in the study area.

The peat swamp forests in the study area represent the peak of evolution of this Low land forest formation in Tonkalili District. They represent very distinct habitats for a large and unique variety of specialized plants and animals. The peat swamp forests also act as important reservoirs for fresh water and provide essential fresh water inflow for the some communities. They also play a crucial role as a storage reservoir for flood- and storm water and act as a buffer between the upland and the coastal zone, and maintain the hydrological balance in coastal zones. Many of the tree species within these forests re-growth area has a low commercial value.

The secondary forests also provide habitat for some wildlife species.

Mixed dipterocarp forests originally covered the upland soils in the eastern part of the study area. Logging, shifting cultivation, Mango trees and some few Oil Palm plantations (now mostly abandoned) are about to replaced the original secondary forest cover. Shifting cultivation is followed by secondary shrub which, in places, has evolved into secondary forests.

8.2.3 Land and Resource Uses

Agriculture

More than half of the study area has become as farm bushes which is due logging activities, slash and burn agriculture, coal mining etc. Secondary vegetation occupies one-quarter of the study areas. Much of the cropped area has been subjected to shifting cultivation, with the remainder used for cassava production. In some places, groundnut has been intercropped with potatos, but most of these potatoes have been abandoned because of the low prices and disease problems. Many of garden eggs have been abandoned because of poor growth.

8.2.3.1 Aquaculture

Fresh water pond aquaculture should be established by the managemet of Miro Forestry Company (SL) Ltd.The main constraints are the lack of high quality inputs and insufficient field extension.

8.2.3.2 Forestry

Forestry is one of the key backbones of the Tonkalili district economy. The value of total exports came from forest products. Tonkalili district is also making progress in the export of value-added timber products. The harvesting of commercial forest as well as on State Land Forests (SLFs) is organized through a concession system. The concession holders are required to adhere to an accepted forest management plan that prescribes harvest techniques, felling cycles, minimum diameter limits, allowable harvestable volume, etc. The prescribed felling system is a selective felling system.

The government's forestry policies cover both the conservation of forests and Maximization of economic returns from the use of forests. One element of this policy is to scale down log exports and to encourage processing and marketing of semi finished wood products. The government also encourages research on potential medicinal and genetic forest resources as part of its biotechnological research and development

programs. Another element in Governments' forest policy is the development of forest-based ecotourism, which implies the development of tourist and jungle adventure facilities in or near existing and planned protected areas.

8.3 Anticipated Environmental Impacts and Mitigation Measures

Following the identification of the main project activities for each stage of the Project and of the existing environmental impacts due to Project activities in the area covered by the Project, an ESIA matrix was prepared (see Appendix 1). The specific mitigating or abatement measures that will be adopted by the proponent of the Project to minimize the potential significant impacts are discussed in the following paragraphs.

8.3.1: Impacts and Mitigation Measures Related to MFC (SL) Ltd Project Areas.

Clearing Vegetation (general).

None of the proposed sites for the said project implementation is a Primary forest. Most of the areas are characterized as secondary or forests in an advanced succession stage. The remaining volume of harvestable cassava plantations in such areas is insignificant.

8.3.2: Drainage (general).

The main impacts will occur in peat swamp areas. The drainage water from the reclaimed peat swamps is usually acid (pH range from 4.2-4.7). The reclamation of a peat swamp is a drastic and irreversible intervention. It lowers the water table and the water storage and buffering capacity of the reclaimed land and influences evaporation and transpiration. Therefore, it is essential that large adjacent areas be retained under permanent forest cover, a condition that is fully taken into account in the present Project area.

8.3.3: Peat soil Oxidation and Subsidence.

The peat soils are in a state of permanent water saturation and are water logged for most of the year, especially at the fringes of the peat domes. The drainage of these largely organic soils (dead plant material) will cause the loosely packed peat to subside when it is dried and exposed to the air. The result is peat oxidation and its expected rate of subsidence is 120 cm over 15 years, with subsidence of 60 cm during the first five years, and 6 cm/year there after. These rates are based on the assumption that ground water levels are retained at 50-70 cm below surface. More intensive and deeper drainage would increase the rate of subsidence.

8.3.4: Acid Formation.

It is difficult to predict whether acidity problems will occur in the area covered by the Project. During a detailed soil survey of the project area, it was found that only about 10 percent of the shallow peat was underlain by sulphidic clays. Based on this survey, it is predicted that no serious soil acidity problems are expected once the overlaying peat has subsided and oxidized.

8.3.5: Impact on River Water Receiving Drainage Water.

The drainage and seepage water from peat swamps is acid and of poor quality for most purposes. Dark brown colored "fans" develop at the interface of the natural waterways and the drainage water. The brown coloring is due to dissolved pectin substances, and the foaming to saponification reactions of the organic substances. In the study area, these phenomena already occur, because all the swamps drain naturally into the rivers.

8.3.6: Impacts on Crops grown down stream.

During the development of soils for nursery site, the drainage water may have contained silt and organic material for a long time. The suspended organic material normally settles which is the reason that usually looks clear, albeit dark in color. Thus, the sediment load entering the river through the drains could increase. However, it is

unlikely that serious siltation problems will occur. The drainage water from the swamps in the area contains little silt, and the mineral soil content of the surface layer is very low. No impacts on crops grown in the areas down stream are expected because virtually all the crops cultivated by local people are 60% rain fed.

8.3.7: Impacts on Aquatic Production Systems.

The pH of river waters in the area is in the range of 6.5. These saline waters support a variety of aquatic life including species of economic and nutritional importance that provide a large part of the protein diet of riverine people. The experience has been that where acid drainage water of pH 4-4.5 enters the main rivers, the water mixes and the pH of the river water at the drain outlet drops to 5.6. At such sites, a narrower range of species and lower fish densities could be expected.

Because of continuous outflow of drainage water, these fans may become permanent, although tidal movements and river discharge would guarantee continuous dilution.

8.3.8 Aluminum Toxicity.

Considering the nature of the mineral subsoil in the selected sites, no serious aluminum toxicity problems are expected to occur during the development and Operations of the plantation.

8.3.9 Irreversible Drying.

The drainage and exposure of peat soil to the air may lead to irreversible drying of the peat surface. If this occurs, dry and hard granules are formed that are difficult to rewet, and create a very poor growth medium, both physically and chemically. These Layers will have to be removed to restore the moisture retention capacity of the soil.

8.3.10 Impacts on the Hydrology of Swamp Forests.

None of the sites in the upland areas and lowland areas are near or adjacent to swamp forests. The drainage of these sites and the subsequent peat subsidence would

eventually drain the bordering swamp area, unless specific measures are taken. Also, where smaller drains are cut through Swampy terrain, small areas on both sides of the drainage channel will also be drained. Measures should be incorporated in the design of the Project to prevent drainage of adjacent peat swamp forests.

8.3.11 Salinity Intrusion.

The presence of saline and brackish water in the rivers with fluctuating high and low water levels twice a day requires gated (flap gates) drainage outlets if salinity intrusions in the project areas at Royanka are to be avoided. The requirement for this work should be incorporated in the design of the MFC (SL) Ltd Project.

8.3.12 Mitigation Measures Related to the Location of the Project Areas

Site Selection Criteria and Environmental Protection, to minimize or to prevent negative impacts on the environment, the following criteria for site selection should be incooperated in MFC project design for implementation.

Table 27: Showing the Mitigation of the Project Areas.

1	No encroachment on undisturbed forests, wetlands, important wildlife habitats and Spawning and breeding sites of aquatic organisms
2	Retaining buffer zones between rivers and coastline and the sites.
3	Areas where peat or soil level is below gravity drainage level are not to be considered for agroforestry development.
4	Areas where the mineral soil level beneath the peat dome is below mean river level are not to be considered for agroforestry development; after peat subsidence and oxidation, gravity drainage of such lands would be impossible; the thickness of the peat layer at areas for agroforestry development should be shallow (less than 1.5 m thickness, smaller areas up to 2.5 m thickness), with good drainage;
5	Special drainage provisions and adequate buffer zones are to be included for Selected Sites at the periphery of project domes, to avoid drainage and irreversible changes in adjacent natural peat swamps

9.0: Impacts and Mitigation Measures Related to Ecosystems, Wildlife and Biodiversity

All of the lowland areas to be converted into plantations area are rich in soil moisture. Their value as a habitat for plants and animals has been reduced by logging, clearing, hunting, poaching, and trapping. Because these areas are outside Permanent Forest Estates, they have not been subjected to prescribed management and development policies. Consequently, all the secondary forests are degraded. However, some of the degraded forests have retained their buffer and water retention/regulation function, and still provide a habitat for birds, reptiles, and other animals. These functions, including their remaining floristic values and it will be lost after conversion to agriculture uses.

The loss of habitat would not have a major impact on the survival of wild flora and fauna species and biodiversity, provided sizable areas of the same ecosystems in the vicinity of the development sites are preserved. Hence, no interference with migration movements of aquatic wildlife of fish species will occur.

There is an urgent need to set aside a sizable area of swampy forest for permanent conservation of a tropical swamp ecosystem. The conservation of such an area would also support sustainable development, because the area would be the single most important fresh water reservoir for domestic water supply. Moreover, the area would form an important nutrient reservoir for a diverse spectrum of organisms, some of great economic importance, and it would act as a purified water storage reservoir as well as buffer to trap silt, maintain water quality, and prevent floods and soil erosion.

9.1: Impacts that are related to the Construction of the Project Site.

The following potential impacts have been identified.

Table 28: Showing the Impact during the construction of the Project site.

1	Erosion risks during the raining season
2	Impacts on drainage water quality during raining season
3	Erosion risks in upland areas
4	Potential health risks
5	Impacts on settlements during the planting seasons
6	Impacts related to road construction

9.2: **Erosion Control**.

The potential erosion hazards have been taken into account in selection of the project sites, particularly in upland areas. The plan is to develop plantations in stages to minimize the disturbances to the natural vegetation and the size of the area exposed to erosion at any one time. Terracing is prescribed for upland sites. No slopes steeper than 25 percent should be considered for plantations.

Terraces should be constructed with slight reverse gradient sloping towards the hillside to trap runoff and silt from the upper slopes. Cover crops should be prescribed and buffer zones are planned between the plantations and the river banks, the Permanent Forest Estates and the coastal Mangrove zones. The timing of works should be scheduled so that negative impacts such as soil erosion will be minimized. The work will generally occur during the drier months of March. Other proposed measures include avoiding deep drainage and retaining high ground water levels, compacting and revegetation of excavation spoils to reduce the acidity risk, and proper maintenance of drainage systems.

9.3: Impact and Mitigation Measures of the Road Construction and Maintenance.

The stabilization of embankments by mechanical compacting and revegetation soon after construction will avoid erosion along the side of the roads. The installation of

culverts, bridges, and other civil works will avoid disruption of surface hydrology and natural drainage. The establishment of buffer zones and "set back" zones will minimize the disturbances to nearby swamp land and riverine vegetation. Furthermore, the plans for roads do not include crossing any ecologically sensitive areas. Other mitigation measures to be implemented during the maintenance of the roads include:

Table 29: Showing the Mitigation Measure the Road Maintenance areas.

1	avoiding pollution of soils, water and air
2	providing adequate sanitary and waste disposal facilities in labour camps,
3	filling in and landscaping the borrow pits, which may become breeding sites for animal vectors for human diseases
4	providing prophylactic and curative drugs for laborers exposed to such vectors and
5	Providing compensation for the loss of land and land uses, including crops.

9.4: Impacts and Mitigation Measures Related to Operations

The following potential impacts related to the operation of the Project have been identified, i.e. Judicious, safe, and timely application of fertilizers and herbicides can reduce the long time changes in Soil, Water, peat swampy forest and aquatic ecosystems.

Table 30: Showing the Long Time Impact on the Project Areas.

1	Long-term changes in soil properties
2	Long-term impacts on water quality
3	Long-term impacts on fisheries and aquatic ecosystems
4	Long-term impacts on adjacent peat swamp forests
5	Long-term impacts on wildlife
6	Wildlife damage to crops Expected increase in use of agro-chemicals and its impacts
7	Impacts from agro-industrial operations

9.5: Negative impacts on the environment.

The major concern is about the use of paraquat and other herbicides, in particular when used for weed control at the nursery sites and in drains. This chemical has a high acute toxicity for man, animals and aquatic organisms. A training program on the management and the use of herbicides should be conducted for the project staff and the project beneficiaries to prevent poisoning and pollution, in particular in places where drainage outlets are close to human settlements or to aquaculture/fisheries projects.

In case manual clearing of the drain is not feasible because of costs and labor shortages the obvious alternative is to design the plantation in such a way that mechanical weed clearing of the drains is feasible. Fertilizers and chemicals should not be applied during the wet seasons. Materials applied during the wet months are likely to be washed or leached off, which diminishes the effects and, at the same time, increases the probability of polluting the surface water.

The following measures would avoid potential problems related to agro-chemical use:

Table 31: Showing the Negative Impacts of Fertilizers and their Mitigation Measures

1	The plantation management should closely supervise safety procedures and should prescribe safe handling and application methods, dosage, timing, frequency of application, disposal of surpluses, packing materials, and cleaning of equipment
2	The fertilizers should be applied in split dosage to minimize losses e.g. annual Dosage to be split into 3-4 applications, the use of slow-release fertilizers would be Preferable from an environmental point of view.
3	The judicious application of fertilizers will greatly reduces the runoff and Seepage of residues into drains
4	The circular weeding around crop/plant stem base greatly reduces the residual runoff of herbicide residues into drains, the blanket spraying of herbicides should be avoided
5	The maintenance of soil cover reduces runoff and leaching of chemical residue in to drains, the spillage of herbicides in drains should be avoided
6	The timing, climate (wind direction, rains) and season should be taken into account in foliar spraying of agro-chemicals
7	The regular clearing (preferably manual or mechanical) of drains would avoid the accumulation of excessive weeds and the creation of breeding sites for mosquitoes
8	In the selection of pesticides, consideration should be given to the acute and residual toxicity, the rate of degradation in soil and water and the toxicity of degraded components. The national laws pertaining to prohibited chemicals and ADB-guidelines on Pesticides should be followed
9	If rodent control is required, anti-coagulant compounds should be used in safe baiting areas/stations (baited pieces of bamboo) to avoid secondary poisoning
10	The monitoring of water quality by testing from physico-chemical changes in the water And pesticide residues should be incooperated in to MFC management plan, existing water quality Standards as set For the uses by the Environment Protection agencies in Sierra Leone should be apply and
11	The chemicals for pest and disease control should only be used when the Outbreak has reached the threshold level. If applications are necessary, judicial Usage of the right Chemical at the correct concentration and in the correct Manner should be practiced

9.6 Economic Assessment

- The cost benefit analysis of the Project includes a number of project scenarios (sensitivity tests) based on variations in technical parameters. For example, the economic returns on upland soils, where no drainage is needed area higher than the

economic returns on lowland soils, despite the potentially higher yields of fresh fruit bunches (FFB) on the latter, once they are drained.

The economic returns are lower in the lowland areas because the costs for drainage and development of these soils, which includes the mitigating measures above regarding soil and water management to preserve existing hydrology of the peat domes, are much more expensive. The returns under the Project are based on calculations of actual field operations for the upland Soils and semi detailed field drawings on a site-by-site basis for the drainage Schemes.

- The additional environmental costs of operations of the Project associated with drainage and the use of cover crops for erosion control should be included in the economic analysis of ALA operational Management Plan, including the external costs required for mitigation measures as buffer zones. However, other external environmental impacts to the Project have not been valued and included in the economic analysis. These include costs associated with potential health risks from the use of agrochemicals and cost savings arising from the use of effluent as a fertilizer input.

9.7: Institutional Requirements and Environmental Monitoring

A detailed Environmental Monitoring Plan (EMP) with cost estimates, institutional reporting requirements, and parameters for monitoring of water quality, agrochemical usage, impact on aquatic life, changes in forest and wildlife and other impacts as based on public consultations is included in this ESIA study. The ESIA recommends that the EMP should be handled by a local private environmental consulting firm, especially in the initial implementation stage, After the operations of the Project are handed on to the implementing agency. Several aspects of the EMP could be assumed by them, with periodic checks by an independent authority.

During the first phase, several of the environmental monitoring functions will be performed by MFC (SL) Ltd involved in implementation of the Project. These include, for example, Department of Irrigation and Drainage (DID) which will be responsible for the construction of all access roads, flood control drainage schemes in the lowland areas, including the operation and maintenance while the schemes are still under construction. Upon completion of the Project, the Public Works Department (SLRA) will be responsible for the maintenance of access roads and associated structures and Rehabilitation.

9.7.1: Public Involvement

During the re-design of the Project, efforts should be made to involve participation of the beneficiaries in the planning, implementation, and evaluation of the project. A social base line survey outlining key issues for public involvement should be conducted, and a plan for indigenous peoples should be prepared. Additional efforts to involve the public in a more active way are required. The personnel given the task to implement the Project must be trained in development communications to be able to know how to communicate with the community effectively. During the planning and implementation phases, considerable time needs to be allowed to explain verbally the concept and objectives of the Project to the people, especially when the majority of them are illiterate. Dialogue, meetings and group discussions should be held with the local community leaders, influential people, younger members of the community and the more reticent members of the community. During these functions, the concept, objectives and benefits of the Project, target dates, work mechanisms and work schedules should be discussed and agreed upon. During implementation of the Project authorized staff (Project manager) should discuss work programs and targets for the month or year with the people, particularly women. One of the most effective communication channels, especially in the context of the Temine people, is the elected local committee within the community

9.7.2: Physical Environment

Land Take & Site Selection

The MFC (SL) Ltd project area is already located within a previous prospect therefore the impact of land intake for agroforestry activities for the local population is negligible.

The project areas are ideally located taking into consideration its good agricultural potential (geology), proximity to mile 91, and ease of access, mainly through the main Highways that is leading to Masiaka.

9.7.3: Habitat Destruction

Site brushing would be the most significant form of devegetation that would occur during the start of the project implementation phase. There was some level of habitat destructions and the consequential loss and/or migration of species from the project site, if only temporarily. However, it is recognized from initial site observation and literature on the floral and faunal composition that the project site is comprised of a mix of farm bush and secondary vegetation which is representative of what is being found within the wider Area.

Additionally there are no rare, threatened or endangered species within the project areas. Nevertheless vegetation removal is only recommended for essential works. As much as possible large trees and vegetative cover should be retained. Apart from its ecological function, these will assist with site drainage and serve as a natural buffer for noise, visual intrusion, as well as any dust emissions.

9.7.4: Erosion

The project activities are not expected to disrupt the existing natural drainage of the various sites. While erosion caused by storm water, run-off can be expected to increase proportionally with increasing area of disturbance which will be minimal during the first phase of the project implementation.

9.7.5: Waste Management Plan

Impact

Improper disposal of waste materials during the project implementation activities could lead to pollution and degradation of the environment.

Project activities can be expected to produce solid waste which, if not properly taken care off can lead to pollution of the nearby waterway, the Stream, or accumulate on the site creating an unhygienic and un-aesthetic environment, which can evolve into breeding grounds for insects and lead to health impacts.

The main sources of waste during project activities will be solid. The amount of such waste is expected to be limited and localized and as such does not pose a significant adverse impact.

9.7.6: Mitigation Measure

Placement of garbage receptacles at strategic locations within the project site, including administrative building and eating areas

9.7.7: Drainage and Erosion Control

Sediments derived from erosion by water, and other water borne contaminants such as oil, could be possible sources of pollution arising from the operations of MFC (SL) Ltd and other mining companes. If environmental management is inadequate, water quality may be affected beyond the project boundaries.

Certain minerals have the potential to cause acid drainage pollution when exposed to air and water. A site's potential for causing acid drainage is not likely to be identified until it is being worked. Likely visible signs include the presence of pyrite minerals and iron rich precipitates; these may be evident in the form of brown staining on rocks or in water.

According to International Best Practice, total suspended solids (or Non Filterable Residue) in runoff discharged to inland waters should not exceed 30 mg/litre, unless a dilution factor of at least 50 times exists in the receiving environment, in which case the NFR limit is 60 mg/litre.

9.7.8: Mitigation Measure

A good drainage and sediment capture system is recommended as it would have a number of useful benefits, such as reducing water logging

9.8.1 Drainage

- Wherever possible, drainage works should pattern natural drainage patterns and utilize natural drainage lines with retained vegetation.
- A cut-off drain or diversion banks above the excavation will help prevent water from entering the site and adding to erosion problems. Cut-off drains should discharge into vegetated natural drainage lines or via a level sill that distributes run-off across a stable area.
- Contour banks and contour drains should be used to capture and slow down water that would otherwise gather momentum as it travels down slopes.
- Rate of run-off increases dramatically following vegetation removal; hence the total area exposed should be kept to a minimum.
- Access tracks and roads often have a major impact on water quality. Gradients should be controlled; table drains well maintained and regular cross drains or culverts installed.

9.8.2 Sediment Control

- All run-offs from working areas, which contains sediment, should be collected in settling ponds before being discharged from the premises.

- Run-off should be directed through vegetation prior to reaching any watercourse to enable further filtering of sediment.
- Sediment should be removed from settling ponds as required, so that excess capacity is always available for the next storm event.
- Settling ponds should discharge into natural drainage lines that are stable and vegetated via properly constructed spillways, ripraps or culverts.
- Sediment traps should be constructed on the perimeter drains to accommodate storm water runoffs.

9.8.3 Water Quality

- If cut-off drains are not in place and effective to divert water around the various sites, more stringent limits should be imposed. Regular checks should be made of surrounding waterways to ensure that there is no noticeable discoloration or sediment build up.
- Sampling should be conducted over a wide range of rainfall events in order to obtain an accurate water quality sample. This is elaborated in the Monitoring Plan.
- Discharge should be visibly free of oil and grease. A 40 metre filter strip of undisturbed native vegetation adjacent to all watercourses is one of the best available means of protecting water quality.

10.1 Ecological Environment

10.2 Flora

The principal impact on vegetation during the project implementations and operations will be from direct vegetation removal (clearing of shrubs, bushes and trees), will inevitably have an effect on the vegetation with potentially adverse impacts such as:

- Reduction in number of certain species (particularly in commercial and/or keystone tree species)

- Increase in number and size of canopy openings favoring regeneration of fast-growing pioneer species, leading to long-term changes in species' composition.
- Increased risk of soil compaction and/or erosion
- From field visits and literature as part of the ESIA study the project area is comprised of vegetation consistent with the wider area with relatively medium trees.
- There are some rare, threatened or endangered species within the Yoni Chiefdom that is serving an important habitat function. As such, the removal of secondary growth vegetation is likely to constitute a significant impact. It is envisaged that the site area requirement will be sufficient to cater to the needs of the project and will not require clearing of additional areas within the project boundaries.

10.3 Mitigation

It is recommended that:

- Vegetation removal is done only for essential works.
- As much as possible large trees and vegetative cover be retained for its ecological role and function

10.4 Fauna

Operational activities at the project site could disturb faunal populations, principally through habitat loss and destruction from land clearance as well as leading to permanent species migration.

Loss of habitat in the form of, for example, food source, migration routes, nesting sites (this may occur from actual removal or by isolation caused by haulage roads).

As well, increase in human activity (intentional or unintentional, by increasing accessibility for example) leading to increased levels of hunting.

At present, the project areas have minimum species presence; the impact on fauna from the planning and implementation of the project operational activities is not expected to be significant.

10.5 Mitigation

It is recommended that staff of MFC (SL) Ltd be prohibited from hunting, trapping, killing, harming or capturing of any wildlife. In the absence of specific legislation on wildlife management (apart from the provisions made under the Wild life Act) approaches to discourage trade in wildlife will be mainly through education and awareness.

10.6 Vegetation Clearing and Topsoil Stripping

Topsoil, though only 10 - 30 cm deep contains nutrients, minerals, seed, and organic matter and support the secondary forest vegetation and protect the subsoil from erosion. Vegetation clearing and topsoil removal, if not planned and executed appropriately could disrupt the regenerative capacity as well as lead to deforestation. The regenerative capacity of the natural soil should be protected during the project implementation phase.

10.7 Mitigation

During the operations of the project, the following measures are recommended:

Table 32: Showing the Mitigation Measure for Vegetation Clearing

1	Vegetation being cleared may contain small amounts of seed, or provide useful fauna habitat. Logs, limbs and stumps should be cleared and stockpiled (or cut and removed for timber, etc) separately to the topsoil stripping operation
2	Smaller sized vegetative material may provide useful mulch for later use in erosion prevention works, or else it should be combined with the topsoil.
3	Topsoil is a very important requirement for low cost revegetation of disturbed sites. Topsoil from all working areas and access tracks should be stripped carefully and stockpiled, or used immediately to rehabilitate worked out areas.
4	Wherever possible, stripped topsoil should be placed directly onto an area being rehabilitated. This avoids stockpiling and double handling of the soil. Topsoil placed directly onto rehabilitation areas contains viable seed, nutrients and microbes that allow it to revegetate more rapidly than topsoil that has been in stockpile for long periods.
5	Avoid stripping topsoil when saturated, as this will exacerbate the damage to the soil

	structure.
6	If topsoil must be stockpiled, it should be taken into consideration that it does deteriorate in quality while stockpiled. The following practices will help maintain soil quality
7	Topsoil should be kept separate from overburden, gravel and other materials; If possible, windrows of topsoil should not exceed one metre in height to reduce 'souring'
8	Topsoil stockpiles should be protected from erosion;
9	Growing vegetation on the stockpiles (shrubs or grasses) reduces erosion and will maintain biological activity in the soil,
10	Top oils should not be buried or driven on, as this will damage soil structure. Soil should be stored somewhere out of the way; and excessive handling of topsoil should be avoided
11	A sample of the soil type and plant growth are taken so during the rehabilitation stage the area will be restored to it original state.

10.8 Social and Economic Environment

Employment

The operation of the project is expected to create direct and indirect employment opportunities. It is expected that more jobs will be created during the project expansion and implementation phase.

Nearby communities will be provided with the opportunity to benefit from employment by the project. As noted from the social assessment, many residents there have worked with similar projects and possess the requisite skills and experience. In an effort to ensure this adequate notice should be posted and job interviews conducted there. Employment should be in accordance with Sierra Leone's Labour Laws with specific emphasis on contracts for employment for all employees as well as provisions for NASSIT and other benefits.

10.9 Health and Safety

Incidents which can impact on the health and safety of personnel on site and/or residents are unpredictable. However, steps can be taken to safeguard against these by reducing risks. The ability to effectively minimize these risks dependents to a large extent on the practices to be employed.

10.9.1 Mitigation

The following recommendations are offered:

1	MFC (SL) Ltd abides by the guidelines set out in the Occupational Health and Safety Act of Sierra Leone
2	Act to ensure that workers wear the necessary protective gear at all times.
3	Trained personnel in First Aid are on site at all time during the working hours.
4	Facilities for employees should include drinking water toilet and shower.
5	A First Aid Post is established on-site with the requisite drugs and equipment to cater for any emergencies or occurrences.
6	Liaison is established with the Government Hospital or Health Centre in Mile 91 town in case of any emergencies
7	Emergency Response and Medical Evacuation measures are established to cater to serious emergency situations
8	Identify and train a Health and Safety Officer or Consulting firm to implement this aspect of your MFC project in Yoni Chiefdom of the Tonkolili District.
9	Potential employees should require a complete medical examination to ascertain whether they have respiratory condition.

11.1 The Environmental Management Plan

11.2 Purpose of the EMP

This environmental management plan (EMP) describes the construction activities that are associated with the Miro Forestry Company project in the Tonkolili district, that have the potential to impact on people and the environment. Its purpose is to be a reference document for use by:

- MFC (SL) Ltd staff with responsibility for managing their forestry plantation project operations and its environmental performance,
- environmental auditors (if any),
- regulatory bodies,
- The community monitoring committee established in accordance with the development consent and interested members of the public who may access the EMP via the internet or in person.

For the EMP to fulfill its purpose it needs to contain all of the information relevant to environmental management of MFC (SL) Ltd Agroforestry project. Consequently the EMP incorporates a lot of information from the environmental impact assessment studies, however, only excerpts from these issues that are highlighted in the EMP to avoid it becoming unwieldy.

11.3 OBJECTIVES

The objectives of the EMP area are as follows:

- Present the environmental management strategy for the project implementation.
- Detail practices, procedures, work methods and other requirements necessary for the operation to achieve environmental goals specified by the EPA-SL Act development consent and environment protection license, include within a single document, all of the regulatory environmental requirements for operating within the Yoni Chiefdom.

In general the essence of this EMP is to:

Provide the strategic context for environmental management of the development; identify the statutory requirements that apply to the development; describe in general how the environmental performance of the development would be monitored and managed during the development, describe the procedures that would be implemented to:

- keep the local community and relevant agencies informed about MFC (SL) Ltd project Operation and environmental performance of their development,
- receive, handle, respond to, and record complaints;
- resolve any disputes that may arise during the course of the development;
- respond to any non-compliance;
- manage cumulative impacts; and
- respond to emergencies; and
- Describe the roles, responsibilities, authority, and accountability of all the key personnel involved in environmental management of the MFC (SL) Ltd project implementation.

11.4 PERFORMANCE REQUIREMENTS

The First Schedule of the Sierra Leone Environment Protection Act 2008 identifies activities that require prior consent. In addition to specific requirements referred to the said Act, the implementation of the MFC (SL) Ltd project activities should be in accordance with all relevant Sierra Leonean legislation. Sierra Leonean legislation applicable to Agroforestry Project activities includes:

- The Sierra Leone Environment Protection Agency Act – 2008
- The Forestry Act – 1988
- Forestry Regulations – 1989
- Ministry of Lands and Country planning,
- Ministry of Fisheries and Mineral Resources,

- Ministry of Local Government and Rural Development
- The 2010 forestry and Wildlife act of Sierra Leone.

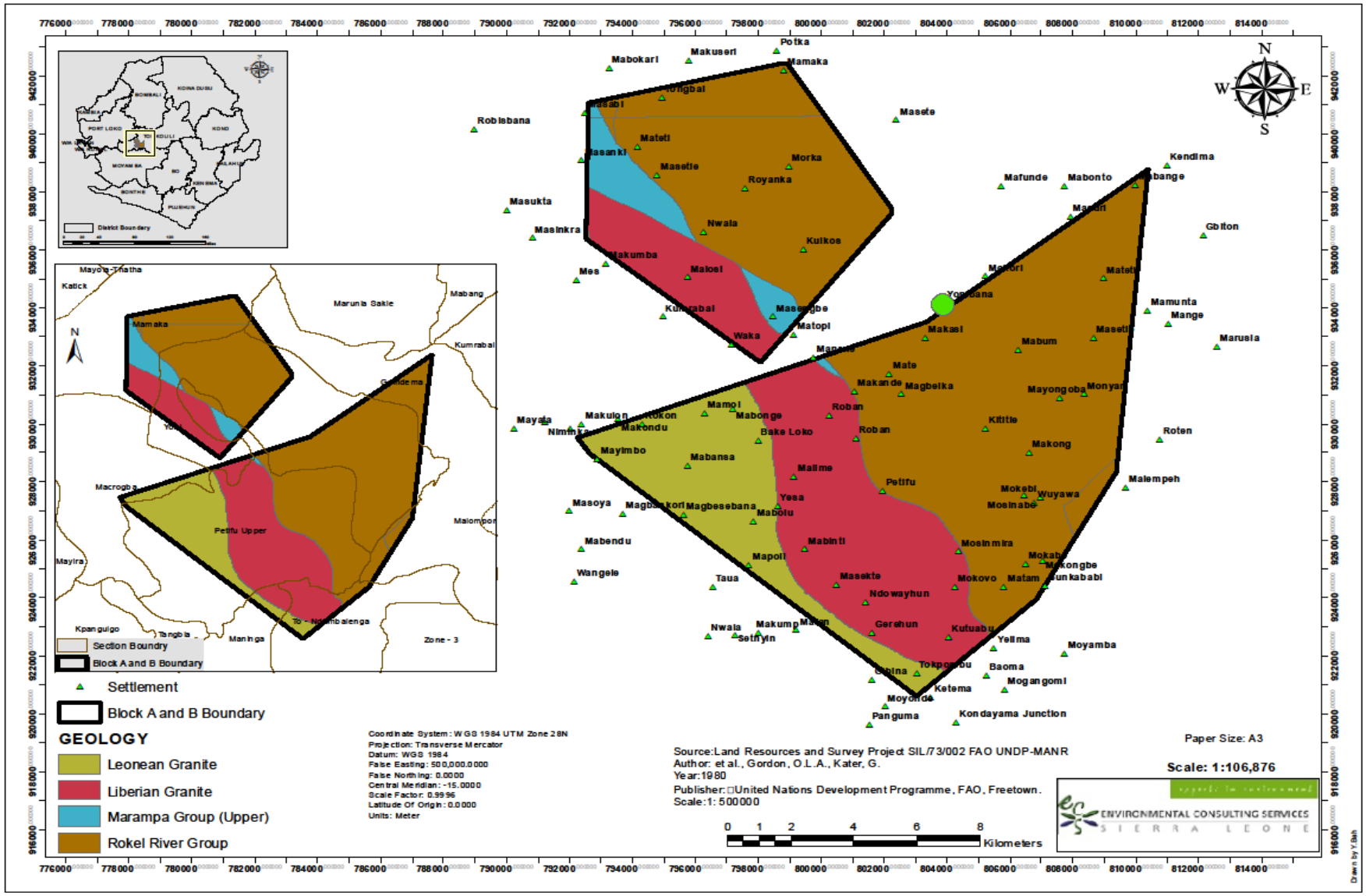
11.5 ENVIRONMENTAL CHARACTERISTICS

11.5.1 Geology and Soils

The geology of the Yoni Chiefdom in the Tonkolili District complex was described in the Sierra Leone Geological Survey report 1962 by M.K Wells. It is essentially composed of repeated layers of leonean, Liberian, Marampa and the Rokel river rocks generally striking NNW-SSC and dipping at moderate angles south westwards. It is the view that the complex was emplaced during the Mesozoic extensional tectonism associated with the initial development of the Proto-Atlantic.

Soils in the project area are generally shallow, gravelly, well drained and strongly to weakly acid. Based on field observations the soils can be divided into 3 broad categories based on landforms, Soils of the Hill crest, Soils of the hill-slopes and Soils of the Terraces.

Figure 19: A Map showing the Geology of MFC (SL) Ltd Project Areas



11.5.2 Surrounding Land Use

Agriculture is definitely one of the very important land uses in the project area. Cultivation normally takes place on the flood plains at foot of the hills and swampy areas. These flood plains are perennially cultivated, with rice planted during the rainy season and vegetables, maize, sweet potatoes and cassava in the dry season. Organic manure is used for vegetables.

Subsistence farming is mainly practiced as vegetable excesses are generally sold to generate income. Backyard cultivation (vegetables) is also practiced, especially by non-communal members who are generally not entitled to plots. These are mainly migrants engaged in small business/Trade whose wives cultivate the backyards with vegetables for subsistence.

11.5.3 Natural Vegetation and Fauna

The field observations identified that, all communities have vegetation on site:

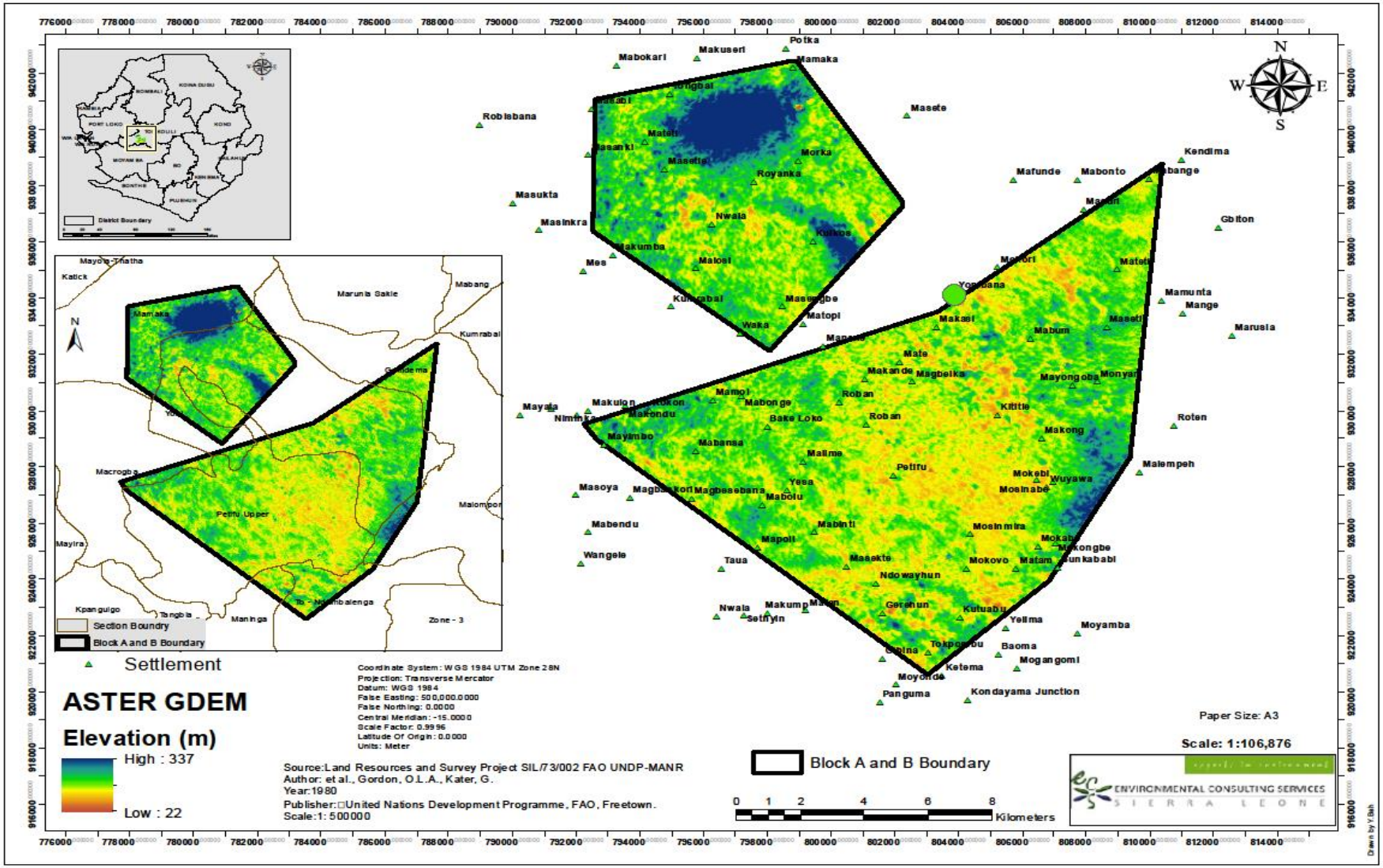
- Rainforest – mainly above the villages /communities.
- Open Forest – mostly cleared with scattered remnants remaining.
- Farm bush – occurs mostly on the edges of forested areas;
- Non-native grassland – most of the land to be used by MFC (SL) Ltd project.

There are two plant species of conservation importance in the area, but no threatened fauna species were recorded in the area.

11.5.4 Archaeology and Heritage

There are some cultural activities claimed to be practiced within Miro forestry project areas. The surrounding forests and bushes evident around the project areas can provide a conducive environment for the meeting and practices of such a secret society.

Figure 20: A Map showing the Height of MFC (SL) Ltd Project Area



11.5.6 VEGETATION AND FAUNA MANAGEMENT

11.5.7 Performance Objective

Source - No approved vegetation and fauna management procedure exist in Sierra Leone, though the Environment Protection Act, 2008 makes provision for their development. This EMP states internationally accepted standards which are applicable in situations where national standards and procedures are absent or in the process of formulation.

Requirement - Conserve and maintain areas of remnant vegetation marked within the Implementation area and re-vegetate bare areas.

Verification - Monitoring and environmental site audit by EPASL.

11.5.8 Design Features

- A *restoration area* would be maintained and the primary management objective is to enhance native vegetation by controlling weeds and allowing natural regeneration of native plants to take place.

- A *re-vegetation area* would be maintained and the primary management objective is to establish native vegetation by planting and nurturing native species, being vegetation that is indigenous to the project areas.

11.5.9 Management Procedures

- Topsoil may be used to improve the growing area in the revegetation area but is not to be used in the restoration areas
- Prior to fencing, all foreign material including dumped rubbish, old fences and Farming debris is to be removed from the restoration/revegetation area.
- An induction is to be given to all personnel working on the site stressing that access within the fenced area should normally be on foot and that the area is not to be driven over or disturbed other than where essential for maintenance or monitoring of the restoration/re-vegetation.

- Soil disturbance is to be minimized in the restoration area but may occur in the revegetation area for the purpose of revegetation and weed control.
- Chemical weed control is not to be used in the restoration area, except for painting lantana stumps, but may be used in the re-vegetation area.
- Plant stock of selected species listed should be included in the Vegetation Management Plan and should be obtained from a nursery that has propagated them from material obtained on the site or in the local area.
- Weeds identified in the Vegetation Management Plan are to be controlled in the restoration/revegetation areas.

11.5.10: The planting method is as follows:

- plants shall be tube stock or similar small stock;
- Water-holding crystals and two tablets of slow-release fertilizer shall be placed in the hole.
- Plants shall be watered at the time of planting, with follow-up watering at least weekly until the plants are established.
- Plants shall be individually bagged but not staked.
- Trees and shrubs are to be planted no more than two metres apart and ground cover plants at a density of two plants per square metre, avoiding any geometric pattern.
- The area around each plant is to be mulched at the time of planting using mulch from the site that is free from viable weed propagation material.
- The following maintenance activities are to be carried out at least quarterly:
- check that fencing is intact;
- carry out weed control;
- water plants as required;
- replace dead plants;
- remove any rubbish;
- treat any erosion or siltation;
- Address impact from animals

11.6 WATER MONITORING

11.6.1 Source

No approved water quality standards exist in Sierra Leone though the Environment Protection Act, 2008 makes provision for their development and the Ministry of water resources is in the process of developing the water right act. This EMP states internationally accepted standards which are applicable in situations where national standards are absent or in the process of formulation.

11.6.2 Method

Groundwater and surface water is sampled and analysed as follows:

	Groundwater	**Surface Water**
Field measurement	Water level, electrical conductivity, pH and temperature	Electrical conductivity, pH and temperature
Laboratory testing	pH, TDS, TSS, Na, K, Ca, SO4, Cl, NO3, NO2, alkalinity, TKN, CO3/HCO3, oil and grease, BOD, TOC, ammonia, total phosphorus and dissolved metals.	Fortnightly – pH, EC, turbidity All other – pH, TDS, TSS, Na, K, Ca, alkalinity, SO4, Cl, CO3/HCO3, oil and grease and dissolved metals.

11.6.3 Frequency

As recommended by International organizations groundwater should be sampled three times monthly for the first two years and six monthly thereafter. Groundwater level monitoring should begin in September and sampling and analysis in December.

Flow monitoring in the watercourses commenced should commence as early as possible in the dry season.

11.6.4 Performance Targets

The initial purpose of water monitoring is to establish over several years the normal range of variability of the parameters being monitored. Subsequently, with the implementation of the Miro forestry Project, any unusual variation may be relevant for investigation. There are no targets for these parameters being measured.

11.6.5 Reporting and Review

The results of water quality monitoring are to be tabulated and included in the Annual Environmental Management Report produced for this project.

11.6 ECOLOGICAL MONITORING

11.6.1 Source

No approved ecology monitoring standards exist in Sierra Leone though the Environment Protection Agency Act, 2008 makes provision for their development. This EMP states internationally accepted standards which are applicable in situations where national standards are absent or in the process of formulation.

11.6.2 Restoration/Revegetation Area

The restoration/revegetation area is to be inspected by a qualified ecologist once per year and a report prepared of the progress in returning this area to native vegetation.

The report shall comment on:

- success of planted stock in the regeneration area;
- natural seeding and growth of native vegetation in the restoration area;
- weed control;
- absence of spoil or rubbish;
- any damage caused by animals or human interference; and
- Recommendations for remedial action, if needed.

12.1 COMMUNITY DEVELOPMENT ACTION PLAN (CDAP)

This report provides guidance to the management of Miro forestry Compant (SL) Ltd, towards community development processes over the next years, including outlines of current proposed projects to be implemented. In order to achieve the social and economic development goals, the following Terms of Reference (TOR) were undertaken: Assemble adequate and appropriate socio-economic baseline information concerning communities within Miro forestry Company Concession area. This information will be used to identify socio-economic development opportunities for communities within the concession areas. Prepare a Community Development action plan, on the basis of these investigations and on-going consultation, to ensure long term community sustainability in the post implementation period. The goal of the CDAP is to foster economic development, to improve the wellbeing of communities around the concession areas and to identify sustainable development initiatives for these communities.

For a sustainable community Development to be undertaken, there is need to assess the prevailing institutional, policy and legal framework (Section 2) which influence it. A brief review of this framework will ascertain how these factors influence development in the area, how they may impact upon the proposed Community Development Action Plan and to find out whether there may be opportunities through the proposed CDAP to address the challenges which may arise from it. MFC (SL) Ltd along with its host communities, stakeholders and partners, aspires to demonstrate corporate social responsibility as a promoter and key participant in the creation of sustainable development outcomes in the concession areas. The strategic framework for this CDAP is to provide a more strategic, participatory and inclusive approach towards community development for adoption by MFC (SL) Ltd in the implementation of its corporate social responsibility policy and by other stakeholders concerned with development in the area.

The purpose of the CDAP is to propose a plan that would provide opportunities for the welfare improvement, which will lead to sustainable development for the community within the project area. The CDAP has been developed to address many of the much needed problems of the community.

As a result of this the company had a series of meetings with the communities to map out the way forward. Below are programs identified in the form of matrix and each of the identified projects will go through stages or Project cycle-planning, resource mobilization, implementation and monitoring and evaluation. The process would involve the active participation of local communities.

- The use of improved crop varieties and livestock management practices is to ensure increase agricultural productivity;
- Improve health standards through the timely provision of quality, affordable and accessible health care services; safe drinking water, improved sanitation and waste disposal;
- Enhance access to formal education through the establishment /rehabilitation of educational infrastructure and facilities;
- Youth empowerment schemes
- Provisions of adult literacy facilities in order to improve adult literacy
- Provision of training for enhanced organizational, managerial and leadership capacities;
- Provision of technical and vocational skills training opportunities for the development of middle level manpower;
- The establishment and effective implementation of a reliable health and safety policy that will adequately address health and safety requirements of MFC (SL) Ltd employees in accordance with established national and international standards;
- Targeted sensitization and awareness raising on the transmission and prevention of HIV/AIDS ,STDs and Ebola virus

- Ensuring the maintenance of an effective communication channel with the beneficiary community through regular meetings of the Community Relations Committee (CRC).

The identified programmes above would each go though the recommended stages or Project cycle-planning, resources mobilization, implementation and monitoring and Evaluation.

The process would involve the active participation of local community and Miro forestry Company. The beneficiary Community (BC) will establish a Steering Committee (SC) Responsible for the implementation of the CDAP jointly.

Other Specialists and interest groups such as line ministries, and Community Development Committee (CDC) will be called upon as and when necessary to provide expert advice and assistance during the planning and implementation stages. This is necessary because the Interest groups are likely to be present and active in ongoing development works following the on going activities of the environmental plan

Table 33: Proposed indicative annual costs for the community development action plan

Cost Area	Category	2015	Future per Annum
Rehabilitation and construction of Water Wells within Miro Forestry Company areas.	MFC(SL) Ltd	$ 10,000	12,000
Rehalbitation of Place of worship (mosques)	MFC(SL) Ltd	$ 10,000	12,000
Construction and rehalbitation of community centres within MFC (SL) Ltd project communities	CSR	$ 5000	7000
Rehabilitation of schools	CSR	$ 5000	7000

Rehabilitation of health centers	CSR	$ 10 000	7000
Rehabilitation of Roads and bridges	Operations	$ 120 000	125,000
Scholarship for primary, Secondary and University students	CSR ongoing	$ 10000	12000
Training in basic Man skill power or machine operations.	Operational and training centres -	$ 6000	12000
Total		$176,000	**194,000**

12.2 The agrochemicals Management Plan for Miro Forestry Company Sierra Leone Limited.

Miro Forestry is concerned about possible adverse effects of agrochemicals (pesticides, herbicides, fungicides, safeners and adjuvants) used in the establishment and protection of forests, nurseries, conservation areas and other crops planted on Miro Forestry land.

To ensure that negative impacts from the use of agrochemicals on the environment are minimized, Miro Forestry have adopted an Agrochemical Code of Practice, which ensures that all employees and contractors abide by the recommended procedures for the safe handling, storage and application of agrochemicals.

12.2.1 The Objectives

Miro Forestry is committed to the safety of its employees, contractors, the public and the environment as a whole. And in achieving this, the management of Miro Company has set the following objectives:

- To fully comply with and endorse the principles and guidelines as laid out in the Environmental Code of Practice in Sierra Leone.
- To protect human health and the environment through avoiding the use of unregistered harmful rates of any Agrochemicals.
- To sustain the long-term health, productivity and profitability of our forests, crops, operators, Communities and conservation areas.

- To ensure the sustainable utilization of species and ecosystems.
- To reduce quantities of herbicides used over time, and promote the use of alternatives, such as biological control, fire and mechanical methods.
- To actively promote participation through an integrated approach to problem plants and animals within the industry through mechanisms such as the National Forestry Action Plan principles and criteria process.
- To promote partnerships and integrated efforts across boundaries.

12.2.2 Achievements

In order to achieve these objectives Miro Forestry will,

- Define and continually update a Code of Practice for the safe and effective use of agrochemicals on all crops and conservation areas.
- Ensure that all employees and contractors applying agrochemicals are adequately and Comprehensively informed and trained, in the safety and use of agrochemicals in accordance With the Occupational Health and Safety act.
- Co-operate with Government bodies, chemical companies and international organizations such as the World Health Organization, on improving the safe and effective use of agrochemicals.
- Adhere to the principle of "The selective use of the least-risk registered products, applied effectively at the registered rates, by the least-risk methods which will lead to the most cost-effective protection program."Products with the following characteristics do not apply to the least-risk category, and motivation for their continued use must be available and signed by the relevant authority:
  - A product that persists in its original form or toxicologically comparable active form for 100 days or more.
  - Products with a standard Reference Dose (RfD) of less than 0.01 mg/kg/ day.
  - Products with an overall 50% Lethal Dose (LD50) level of 200 mg/kg, taking account of all active ingredients in the formulation, including wetting agents, surfactants, solvents etc.
  - Products with an aquatic toxicity of LC50 of 50 microg/l (0.05mg/L) in aquatic

environments.

- Products that are carcinogenic, mutagenic or contain endocrine disruptors.
- Products that display bioaccumulation in the fat or lipid of individual organisms, and that their bio-concentration to higher trophic levels shows the octanol-water differential gradient (Kow) to be over 1000 (or logKow greater than 3).
- Products containing heavy metals of lead (Pb), cadmium (Cd), Arsenic (As), or mercury (Hg).
- Products contaminated with or which produce dioxins when burnt.

A Pesticide register can be found in Appendix A. This register lists the products currently in use and has been graded according to the guidelines in the FSC draft discussion document on Pesticides In Certified Forests (Synnott, 2000), and have been color coded as shown in the Table 34 below.

Table 34: Colour Codes and Ranking of Certificied Pesticides

Label Color	**Group**	**Ranking**
.Red	Group Ia	Very Toxic
Red	Group Ib	Toxic
Yellow	Group II	Harmful
Blue	Group III	Caution
Green	Group IV	

All new products or products not on the register need to be approved by the Regional Technical Manager using the prescribed Agrochemical approval form. Please see Appendix B.

Fulfill the following Safety, Health and Environment (S.H.E.) test namely:

- Carefully read and comply with all label specifications of products listed in the ACOP
- Use the least-risk product with the lowest human and environmental toxicity.
- Ensure the selected product is applied at the registered rate.
- Preference for selective plant or insect specific applications rather than

indiscriminate treatments.

- Time applications to ensure that optimum rates can be successfully applied.
- Adequate protective clothing, which conforms to label registration, is worn at all times.
- Carefully plan operations to ensure that the public, other landowners, water, soil and protected or endangered sites of fauna and flora are considered prior to application, with special consideration given to drift.
- Meet all safety precautions and regulations with respect to the transport, storage and application of all agrochemicals.
- Ensure the safe, effective, and appropriate disposal/return of all empty agrochemical containers and apply the "triple rinse principle" as laid out in the document on the disposal of pesticide containers.

12.3 Planning

12.3.1 Choice of product

Only products registered in accordance with the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies may be used for nursery cultivation, crop protection and maintenance of conservation areas.

The cooperation with chemical companies and research institutes in placing trials for registration testing of agrochemical products, must be undertaken on specific sites that are recorded as recognized research projects with Miro Forestry's Technical Department.

12.3.2 Selection of Program

Careful planning is required to select the correct program, rate, timing and application method for the site. At the same time consideration must be given to the protection of human and wildlife health, non-target fauna and flora, water and soil.

- ❖ Application of agrochemicals must be planned so as to constitute the selective use of the lowest risk registered chemical, applied effectively at the registered rate by the lowest risk method which will lead to the most cost effective protection program.

- Options as defined in the Self-Assessment Program must be adhered to.
- Noxious weeds within conservation areas should be selectively eradicated with ground application equipment only.
- Consolidated areas in excess of 100 hectares in extent should not be sprayed with a non-selective herbicide or a broad spectrum insecticide or fungicide on a single day. Sufficient time between sprays must be allowed so as not to have large homogenous areas denuded of vegetation or insect life. A system of panel or block spraying should be implemented.
- Because of the erosion hazard there should be no overall spraying of slopes greater than 20%. Where such slopes are sprayed, 15 meter wide unsprayed panels must be left between sprayed panels which must not exceed 200 meters in length down the slope.
- Threatened and endangered plants and animals must be afforded the necessary protection.
- Where possible and feasible, biological control measures are to be encouraged. Systems which are effective within this field may include, amongst others:

  - The use of bacteria, fungi, viruses or insects in the control of problem organisms and noxious weeds. Where such biological control program have been established or implemented, clarity on the use of chemicals within these areas must be obtained from Miro Forestry Technical Department. The indiscriminate use of chemicals could have a detrimental effect on the biological control program.
  - The use of a mulch in the form of vegetative material such as forest slash or weed residue, or an established green mulch such as cowpeas, to suppress weed growth.
  - The use of raptor perches for the control of rodents. Detail on their design is available from the Country manager of Miro Forestry Company in Sierra Leone.

12.4 Monitoring

All Pesticide usage will be monitored monthly to determine chemical usage over time. Records are recorded daily by team managers indicating amount used per hectare in a specific compartment

12.5 Transport, Storage, Spillage and Disposal

12.5.1 Transport

During transport, agrochemicals and application equipment must be well secured to prevent spillage, excess jarring or container damage. All agrochemicals and equipment must be carried in a part of the vehicle isolated from people, food and clothing.

Agrochemicals should not be left unattended in an open vehicle where there is any risk of theft or abuse. Precautions should be taken that all agrochemical concentrate is not left or stored in the sun due to the potential volatility of such concentrate

12.5.2 Storage

All storage facilities to comply with proper chemical storing regulations in Sierra Leone. The Standard includes the following points:

- Storage facilities should ideally be located in a separate building but if part of Complex, then no free air must move from store to other rooms.
- Floors should be smooth plastered cement. The door opening should have a wall of 200mm high (bunding) to prevent water coming in or going out.
- Ventilation bricks placed 200mm from roof/ceiling height.
- The roof must not leak.
- Stocks are maintained under lock and key with controlled access. A steel door is preferable, with a proper locking system, or if a wooden door is used a security gate must be installed. Windows need to have burglar bars and should be above head height. Sufficient light must be available to read labels on containers, and if electric lighting is available, it must be flame proof, and the

switch outside. A twirly bird or extractor fan must be used in large stores where there is continuous use of chemicals.

- adequate protective clothing for the handling of all stored agrochemicals must be readily available and use thereof is compulsory.
- Personnel must have access to washing facilities with running water, soap and a towel. An eye water bottle must be available.
- The handling of concentrate should be restricted to fully trained personnel. A plastic apron, gloves and eye protection must be worn while handling any concentrate.
- Only sufficient agrochemical for the day's use should be removed from the store and delivered to the field site. Any leftover agrochemical must be returned to safe storage.
- Store rooms must be equipped with a suitable absorbent material such as clean dry sand to handle any accidental spillage. The disposal of used absorbent material must comply with the spillage below. Provision for controlled water discharge into a retention sump which is one cubic meter per ten square meters of floor space would minimize the risk of fire or flood water run-off reaching a water course.
- Never transfer agrochemicals from damaged containers into drinking bottles or food containers. Chemicals from damaged containers should be decanted into empty containers similar to the original, and a similar copy of the original label must be secured to the new container.
- A person must be appointed as a hazardous substance controller, under which agrochemicals are included, and this person must be trained to manage hazardous chemical substances.

12.5.3 Spillage

In the event of an accidental spillage, the following emergency procedure should be followed:

- Cover spill with sufficient dry sand to absorb the spill - mix thoroughly.
- Seep up the contaminated sand and deposit into plastic bags (as per equipment
- requirement).
- Treat the spill area with clean water - use the broom to effect good mixing –
- once again absorb with dry sand - add to the contents of the plastic bags.
- Report the incident to your supervisor.
- Remove the plastic bags and contaminated sand to an approved disposal site and bury. The disposal site needs to be at least 50 m from any water course, and at least 2 m above any ground water. The site should be fenced and clearly sign boarded. The pit should ideally be 2-3 m in diameter and 1-1.5 m deep. Layers of waste should be lined with 2-3cm of lime. The pit needs to have soil reserved and a final layer of 50 cm of soil must cover the waste when the pit is full.

12.5.4 Equipment requirements

- 2 x 10 liter buckets of clean dry sand
- 1 x bristle broom
- 1 x spade Plastic bags (large and strong walled

12.5.5 Disposal

An employer shall as far as reasonably practical recycle all hazardous chemical substances waste, ensure that all hazardous chemical substance waste that can lead to exposure are disposed of on sites specifically designated for this purpose. Ensure that all employees involved with the collection, transport and disposal of hazardous chemical substance waste are provided with suitable personal protective equipment, and ensure that if the services of a waste disposal contractor are used, a provision is incorporated into the contract stating that the contractor shall also comply with the provisions of the regulations.

- Empty containers derived from the use of Agrochemicals in our silvicultural activities, will, under no circumstances, be allowed to be used for any purpose other than containing decanted and diluted chemicals for field application. The redundant

empty containers may not be sold or given away to any third party unless the third party is the supplier of the original chemical.

- ❖ Prior to destruction, the containers will be thoroughly rinsed by the triple rinse principle, and rinsings should go into the application equipment and subsequently onto the target area (infield). The containers must be destroyed by perforating; flattening and burial in an environmentally acceptable, identified site (refer to point
- ❖ Avoid excess stock which could become obsolete or be withdrawn from registered use. In such an event arrangements must be made to return this product to the distributor. Alternatively, arrangements must be made for its safe disposal by a reputable Waste Disposal Company.
- ❖ Record keeping of empty containers and the disposal thereof must be done as per the example in Appendix.

12.6 Application

12.6.1 Application Rate

Agrochemicals should be applied at the registered rate in meeting the weed or pest control objectives and according to label rate specifications. This will lead to a program of minimum risk to human health and the environment.

12.6.2 Precautions

- ✓ All methods and types of equipment used should be designed to minimize the amount of drift onto the crop or non-target vegetation. This is achieved by careful method and equipment selection and optimization of spray droplet size distribution. Selective treatments are more desirable than broadcast treatments where applicable.
- ✓ Ensure that all equipment which is used to apply, store and mix agrochemicals is inspected daily for leaks, and cleanliness.
- ✓ Where applicable the use of suitable dyes/indicators should be used to indicate sprayed areas and for easier detection of leaks.
- ✓

12.6.3 Methods

The three basic types of application are:

12.6.4 Manual ground equipment Application

Manual ground equipment Application by manual methods is the most widely used system in forestry because of the terrain and accessibility factors. This system includes a number of techniques, namely foliar, (directed herbaceous weed and noxious weed), basal stem, spot and cut surface treatments or soil treatments as in the control of soil-borne pests. Equipment commonly used in applying the agrochemicals includes knapsack, wind box, brushes and wipers and ultra low volume sprayers.

12.6.5 Mechanical ground equipment

Mechanical ground equipment Extensive use of these methods is undertaken where terrain permits but consideration needs to be given to issues such as slope, accessibility, Sensitive soils, e.g. compaction and erosion hazards. The most commonly used equipment is the tractor-mounted boom spray or sledge and the tractor drawn disc.

12.6.6 Calibration

Calibration rates to achieve optimum output are vital, as incorrect application rates will result in either an ineffective or over application on the target. This will lead to higher costs through unnecessary re-sprays and follow-up operations or excess chemical usage; if the spray pressure is incorrect the likelihood of drift is increased.

The five most common areas in which errors in calibration arise are:

- Mixing
- equipment malfunction or incorrect setting
- application speed
- mathematical calculations
- Nozzle uniformity and selection for desired spraying pattern, and wear of nozzles.

Continual monitoring of spray conditions will allow for adjustments to be made to the calibration rate thus ensuring optimum efficiency of all resources. Spot checks must be

undertaken randomly to equipment throughout the day to ensure that time adjustments to calibration rates can be made for changes in spray conditions or operator fatigue.

12.6.7 Mixing

- Follow the label instructions carefully when mixing.
- Wettable powders require pre-mixing with a small volume of water to make slurry which is then added to a half-full tank and then topped up to the required volume.
- Liquid concentrates are added to the tank when it is 80% full and then topped up while the tank is being agitated.
- Do not mix concentrated chemicals together prior to pouring them into the tank.
- Adjuvants and safeners must be added as per specifications. This could either be prior to adding the agrochemical - such as for buffering the water - or after adding the agrochemical to the tank mix, such as for surfactants. Follow the labels carefully.
- The tank should be continuously agitated during filling and application.
- Avoid leaving chemical in the tank overnight. Rather mix smaller quantities at a time. If having a mix overnight is unavoidable, agitate the solution thoroughly before spraying the following day. Certain products such as “Brush-off” must not be kept mixed overnight (see label), as this reduces the products effectively. In the event that this does occur, the mixture must be sprayed out in the normal manner, and the area must be closely monitored as follow ups could be necessary.
- Clearly demarcated mixing and cleaning areas on site must not be within 50 m of any watercourse.

12.6.8 Maintenance

- All spraying equipment should be thoroughly checked daily for leaks and blockages to ensure that the nozzles, pipes, pressure gauges and containers are all operating correctly. Leaks must be repaired immediately or else equipment replaced with service stock.

- Cleaning of all equipment must be undertaken daily in controlled washing areas. French drains to contain water discharge must not be within 50 meters of any watercourse.
- Ensure that nozzle selection is identical on all spray team equipment or boom sprayers.

12.7 Drift control

This is an area of real concern as it has the potential to cause extensive damage to non-target vegetation. The most common cause of drift is an undesirable droplet distribution (usually too small) caused by incorrect pressure settings (usually too high) and / or selection of incorrect nozzle type. The correct pressure setting and nozzle type to obtain the optimum droplet size is therefore essential to ensure that adequate coverage of the target is achieved with the minimum of chemical loss through drift.

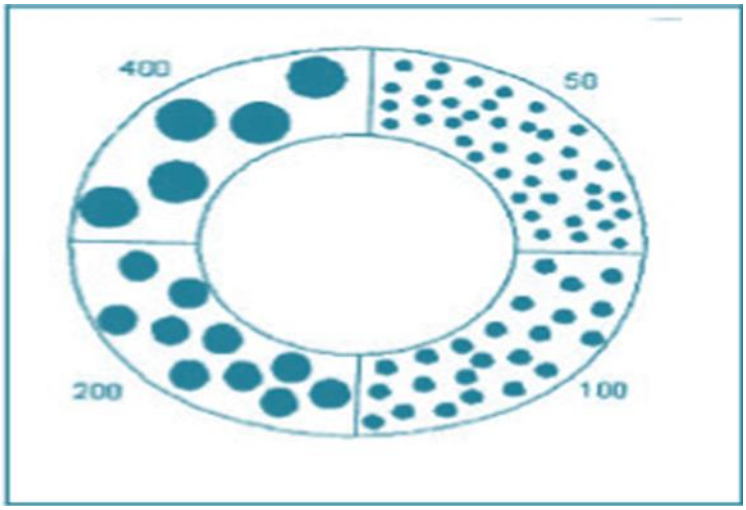
Table 33; Classification according to droplet size

Vol. median diameter of droplets (:m)	Droplet size classification
> 50	aerosol
51 – 100	mist
101 – 200	fine spray
201 – 400	medium spray
> 400	coarse spray

Table 34: Theoretical droplet density when spraying 1litre evenly over 1 hectare

Droplet diameter (:m)	Number of droplets/cm3
10	19099
20	2387

50	153
100	19
200	2.4
400	0.3
1000	0.02



12.7.1 Loss of the chemical through drift is usually of two forms:

- Vapor drift, which is the air-borne movement of evaporated chemical which occurs more readily with some chemical solutions than with others, because of their inherent properties. This is usually referred to as the chemical's "volatility".
- Spray drift, which is the air-borne movement of droplets of the actual chemical solution in its liquid form as it leaves the sprayer.

12.7.2 Precautions

12.7.3: Protection of workers *Clothing -*

An operator spraying agrochemicals must wear a long-sleeved overall, long pants and gum boots. Pants must be worn outside the gum boots or rolled up to just below the top of the gum boot but not tucked in. Preferably the material used should be tightly

woven cotton. Operators should also wear a plastic apron, elbow-length plastic gloves and eye protectors while handling concentrate. Where applicable other safety clothing and equipment must be worn as stated on the label.

12.7.4 Occupational Hygiene

All weed control operators need to have annual medical evaluations including baseline and exit medicals when required.

Each spray team must have soap and clean water for careful washing before meals or rest periods during the day and after completion of the day's spraying. Never eat, drink or smoke while applying agrochemicals. Bathing or the washing of application equipment, empty chemical containers or clothes worn during application, is not permitted in any watercourse. Cleaning and washing must take place in designated areas where runoff water is controlled into suitable french drains or where such water will not come within 50m of any water course?

12.7.5 Supervision and Training

Workers exposure to concentrate must be minimized. Supervisors must ensure that all precautions are strictly adhered to and be aware of poisoning symptoms.

12.7 6: Protection of the Public

- Under all circumstances due recognition must be given to the protection of human health and safety.
- Strict adherence to all label precautions.
- Ground application must not be within 50 m of any human habitation, unless control is required within the area of habitation.
- Aerial applications must not be within 100 m of any human habitation.
- Neighbors in the vicinity of all aerial applications must have prior notification of product to be used and the date of application.

12.7.7: First Aid

In the event of a poisoning, transport the patient plus the chemical label to the nearest doctor as soon as possible. For further information, contact the nearest Hospital listed below,

Our Ladies of Guadalope Clinic. Contact Dr. Patricia 232 76626061

12.7.8 General principles

- It is easier to prevent poisoning than to treat it, so handle agrochemicals carefully.
- People can become ill from natural causes when handling agrochemicals and it is important to establish whether an agrochemical is involved before treatment is given. Wrong treatment may make a patient's condition worse.
- If heartbeat stops, perform artificial respiration immediately.
- Never administer alcohol or milk to the patient when poisoning is suspected.

12.7.9 Symptoms of poisoning

12.7.10: Oral ingestion

Although accidental pesticide ingestion happens less frequently than exposure, when it does occur it may present a considerable hazard. It is often accompanied by vomiting, abdominal pains and diarrhea - symptoms which are common to most chemicals. People who have ingested pesticide must be treated by a doctor promptly, either locally or at a hospital. Meanwhile, keep the patient calm and comfortable and protect him from heat and cold. Administer medical charcoal, if available.

12.7.11: Inhalation

This may especially occur when working in closed areas. If poisoning - however slight - is suspected: Remove patient from work area. Loosen clothing around the throat and chest. Absorption of pesticide by inhalation can result in symptoms similar to those experienced following oral (and dermal) exposure.

12.7.12: Dermal

Many pesticides can irritate skin, and some penetrate rapidly. Wash splashes of concentrate from skin immediately, preferably with soap and water, but at least with plenty of clean water. Remove contaminated clothing immediately and wash underlying skin. If the skin blisters and subsequently becomes broken apply soothing creams. If the chemical penetrates the skin rapidly it is possible that, as with inhalation exposure, symptoms similar to those experienced following oral ingestion will be encountered.

12.7.13: Ocular

In cases where splashes of pesticide have entered the eyes: Wash the eyes thoroughly with cool, clean water for about 10 minutes. Where eye irritation is severe send the patient to a doctor.

Table 35: **PROPOSED INDICATIVE ANNUAL COSTS FOR THE ENVIRONMENTAL MANAGEMENT PLAN**

Cost Area	Impact	Action/s	Equipment	Annual Cost	Frequency
Independent Environmental Monitoring and Advisory services		Hire consultancy firm for environmental services		$2500	
Operational Mitigatory sures	Waste	Collection and disposal of garbage Replacing and/or Rehabilitating waste receptacles and general waste management.	Bins and garbage receptacles Onsite sanitation crew and environmental officers.	 Own Incinerator	Monthly Monthly
	Water Pollution	Water quality tests such as pH, Turbidity, COD, Oils/Grease, and TSS Building of sediment traps and bearers traps Building of a berm around the fuel storage tanks and maintenance.	Samples collected and out sourced to standard bureau or the water directorate at the ministry of water resources Labs for analysis	$ 500	Quarterly
	Air Pollution	Air Quality tests such as Total Suspended Particles (TSP5)	Sample will be collected to analyse by an external agency	$ 200	Quarterly
	Health and Safety	First Aid Kits Protective gear for workers gloves, overalls, respirators, safety boots and ear piece. Training of workers in occupational health, safety and environment Warning signs	To be sourced from over seas	$ 1000 $ 10,000 $ 6,000	During the first phase of the project implementation
	Incidentals and Emergencies	Response needed in event of accidents and emergencies.		$ 7,500	Annually
Community relations		Skill acquisition programmes, Special programs (e.g. 'female sexuality & HIV', women in agriculture', etc.)		$ 2500	Annually
	TOTAL			**$ 30,200**	

Source: Base on the Survey results.

12.8: COMPLAINTS MANAGEMENT

This complaint management system has been suggested for MFC (SL) Ltd to be use in their project implementation phase. This system contains the following elements:

- advertised telephone number, postal address and email address for complaints;
- system for logging and investigating complaints;
- process for recording the outcome of investigations and action taken; and
- Feedback to complainants following investigation.

12.9 Contact Details

The following telephone numbers **+23278021620, +23278266133** is available for 24-hour to the public for complaint. These numbers are used to receive complaints specifically for the project related activities. The number will be made known to the public by:

(i) Inclusion in future telephone directory listings for MFC (SL) Ltd;

(ii) Direct advice to councils, EPA-SL and any persons who may contact the Company regarding a complaint by mail or using existing phone numbers;

(iii) Printing on business cards for issue to interested persons as the opportunity arises, and

(iv) Inclusion on a sign board at the entrance of Miro forestry camp site.

The telephone number is answered by the Country manager or the logistic manager of MFC (SL) Ltd. If the supervisor or the assigned personnel is on leave the phone will be diverted to the Administrative manager.

12.10 Complaints Lodging

When a complaint is received by MFC (SL) Ltd, details will be recorded on a Customer Feedback Form. These forms are designed to be used to record complaints from the company's products as well as members of the community with a complaint about the company's operations. Unused copies of these forms will be kept by the manager at the camp site at all times and will be issued to call on staff.

Completed forms will be sequentially numbered and filed at the company's office in numerical order. A copy will be retained at the Administrative office and may be inspected by authorized persons from regulatory bodies.

12.11 Complaints Investigation

The following procedures will be followed whenever complaints are received:

(i) Every complaint is to be investigated as far as practicable, a response given to the complainant and a record created of the response.

(ii) The procedure for investigating complaints and responding is to be explained to the complainant at the time the complaint is recorded.

(iii) If the complaint is received by staff while an incident is claimed to be occurring, the location of the incident is to be visited, immediately if practicable, to verify and record details.

(iv) If the complaint is received after the incident when the grievance is no longer occurring, or if it is not practical to visit the location, full details are to be obtained from the complainant and recorded.

(v) A record is to be made of the company's activities at the location of the incident during the period leading up to the time of the incident.

(vi) The complainant is to be contacted within two working days of the complaint being lodged to provide details of the investigations and other action taken in response to the complaint.

(vii) The Customer Feedback Form is to be completed to summarise all actions taken to investigate the complaint including:

- Time, date and location of incident;
- Name and address of complainant (if provided);
- Name of the person conducting the investigation;
- Activities at the location during the hour preceding the incident;
- Any observations as to the possible cause of the incident;
- Summary of information given to complainant in follow up call.

(viii) Anonymous complaints are to be recorded and investigated but in the absence of contact details, a personal response to the complainant will not be possible.

13.0: ENVIRONMENTAL MONITORING PROGRAMME

Environmental monitoring is carried out mainly to confirm the accuracy of the predicted environmental effects, the effectiveness of the proposed mitigation measures and environmental management plan (EMP). The aim is to determine whether all aspects of the EMP and associated monitoring networks have been implemented and are in compliance with both EPA-SL and international environmental standards. Monitoring is also carried out in order to address unanticipated environmental issues that may not have been mentioned in the ESIA.

The monitoring program may require modification or updates during the project lifecycle to address changes in environmental conditions and as a result observed project effects on the environment and/or modified based on EPA-SL authorizations and/or approvals. Table presents a monitoring structure to validate the accuracy of a predicted environmental effects and the effectiveness of proposed mitigation measures. This information may be used to support management approaches throughout the project implementation into decommissioning.

13.1: Roles and Responsibilities

The roles and responsibilities of EPA-SL will be:

- To ensure the proponent has designed a monitoring program that meets the requirements of EPA-SL and considers (at a minimum) the components included in the monitoring program framework.
- To review reports associated with the monitoring program to confirm the status of the Project, verify the effectiveness of the mitigation measures and determine were management measures need to be implemented by the proponent.
- Where necessary provide assistance in areas that are pertinent to the project. This assistance would normally consist of providing input to the objectives and design of monitoring studies, reviewing the results, providing recommendations and address monitoring results or unanticipated adverse environmental effects.

The roles and responsibilities of the proponent

- The proponent's roles and responsibilities include implementing the monitoring program by conducting the required baseline studies and monitoring, analyzing the results, implementing management measures where required and reporting on the results and outcomes of the program.
- The monitoring program will be conducted by the proponent in consultation with EPA-SL, Community consultative committee (CCC), and stakeholders, as appropriate.

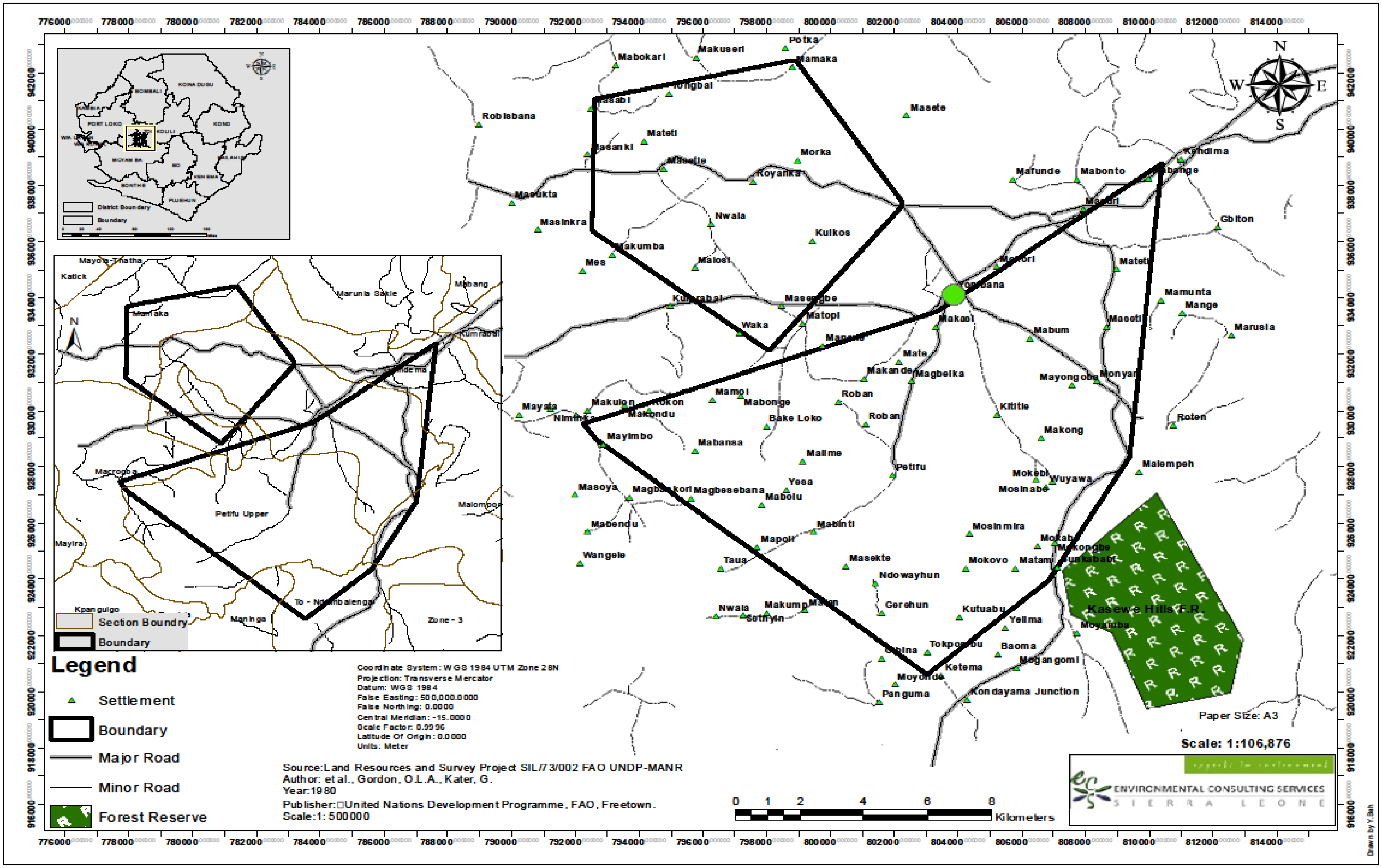
Table 35: Environmental Monitoring program

No.	Area of monitoring	Objectives	Feature/characteristics	Frequency of sampling	Parameters to be analysed
1	Noise	To protect MFC (SL) Ltd employees and the local communities against any adverse health effects due to project related changes to air quality or noise impacts.	Noise from machine, heavy vehicles and generators	Quarterly (day time and night, measuring noise levels each hour)	Noise level in dB (A) (1 hour)
2	Solid /liquid waste	To determine the effectiveness of MFC (SL) Ltd solid/ liquid waste in protecting both groundwater and surface water.	Septic tank and waste dump,	Once monthly	Lubricant/ oil, Hazardous waste, Effluent/discharge
3	Air Quality	To ensure that MFC (SL) Ltd employees and the local community are protected against any adverse health effects due to project related changes to air quality	Dust emissions, Pollutants in the air related to vehicle Emissions, Emissions from generators.	Continuous	NOx, NO_2, CO, SO_2, PM_{10}, Ammonia, Hydrogen Cyanide and any other trace metals which may be present in the natural geology,
4	Water Resources	To determine the quality and changes of surface water downstream and also to determine the quality of groundwater	Up and downstream, water quality of drinking water on site, boreholes/hand dug wells around the Project implementation areas	Quarterly	pH, temperature, conductivity, turbidity, TDS, major anions and cations (Ca, Mg, Na, K, Cl, SO_4, NO_3, F, NO_2, NH_3, Al, Sb, As, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, Zn), E. coli and total coliforms, oil and grease
5	Workplace monitoring	To determine and follow health and safety practices	Staff members	Every day Quarterly	Personal protective equipment (PPE's), Medical check-up, First Aid training, Workshop (disaster + hazardous chemicals)
6	Soil	To determine the status and contamination levels of the soils in the plantation area	Various locations around MFC (SL) Ltd licence area	Once every year	Physicochemical properties (EC, pH, hydrocarbons, metals etc. Depending on potential sources)

13.2: Alternatives

The site selection criteria used to delineate the areas suitable for the development of Agroforestry activities should be taken into consideration and the environmental aspects with a direct impact on plantation forestry productivity such as soil depth, and drainability, and the indirect impacts such as whether the areas selected are adjacent to Protected Forest or are near areas having environmental functions that should be preserved. For these reasons, there is little flexibility in terms of alternative sites.

By Shifting all the proposed sites to the upland area would be economically unrealistic because it would neglect the need to improve agricultural production and to develop communities in the downstream areas of MFC (SL) Ltd Project Areas.


Legend
Settlement
Boundary
Major Road
Minor Road
Forest Reserve
Section Boundry
Boundary
Coordinate System: WGS 1984 UTM Zone 28N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -15.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Source:Land Resources and Survey Project SIL/73/002 FAO UNDP-MANR
Author: et al., Gordon, O.L.A., Kater, G.
Year:1980
Publisher: United Nations Development Programme, FAO, Freetown.
Scale:1: 500000
Paper Size: A3
Scale: 1:106,876
Kilometers
Kasewe Hills F.R.
ENVIRONMENTAL CONSULTING SERVICES
SIERRA LEONE

14.0: Conclutions and Recommendations

14.1: Conclusions

This ESIA describes conditions of the existing environment and the Potential significant impacts of the activities under the Project. The Project will not generate significant air emission pollutants nor will it significantly pollute the waterways, although the use of agrochemicals may have some impact which will be mitigated by both buffers and drainage controls. The potential problems of soil erosion on the upland areas and those associated with the drainage of soils have been also analyzed and mitigating measures prescribed.

The Project would also alleviate poverty by generating significant economic Benefits by enhancing the social amenities in the area. The expected impacts on the environment posed by this Project should pose no significant adverse environmental problems. Most impacts can be prevented or minimized by careful planning and operation of the Project developments. Minimizing detrimental environmental impacts was taken into account during site selection. These included drainability, presence of saline soils and potential acid sulphate soils, non-interference with existing swamp forest classified as Protected Forests, and other issues.

The designs for drainage networks for the proposed sites with fully closed and gated drainage and ground water table Management systems are based on minimizing irreversible changes in soil and water quality.

Identified adverse environmental impacts that must be mitigated and the cost Associated with such measures should be included in the estimates of Project costs. Appropriate project design and precautionary measures are suggested and are compatible with Sierra Leone environmental guidelines for agricultural and natural resources projects. An EMP has been proposed that outlines both the institutional

framework for reporting and the responsibilities for monitoring of specific environmental risks and mitigating measures that are to be adopted, based on the measures that have been incorporated within the Project's design to mitigate serious negative environmental impacts.

This survey also concludes that there is a less biodiversity in the proposed areas especially the uncultivated areas which was due to the activities of the the local resident within MFC (SL) Ltd project areas (Communities).
In total**,** four (4) species were found or encountered during this survey. A total of 20 individuals were found, two of which are of conservation concern; Near Threatened.

Although the ornithological diversity in the fifteen communities (within the Yoni Chiefdom) where MFC (SL) Ltd Project area is comparatively low, compared to other sites in the country (see e.g. Okoni-Williams *et al*. 2001), the Miro forestry company concession area appears to have less conservation value

The current survey leads to conclude that, there is a high plant diversity. This studies could have been more informative had the research period being longer. Surveys of some sort have been not been conducted in MFC (SL) Ltd project communities in the past, access to existing flora checklist is hard to obtain, and have melitated our ability to compile a comprehensive list of plant for the communities to be affected by the project. There is need for additional surveys to be conducted to ascertain the full level of plant biodiversity on the areas not affected by the project

The plantation forestry is necessary and will have a positive effect on the socio-economic situation in the area during it operations and will improve on service delivery in the project area. There are however, potential negative impacts on the bio-physical and social economic environment. These were occurring predominantly in the construction phase and during the project implementation phase of MFC (SL) Ltd. It

must be borne in mind that the bulk of the negative impacts can be mitigated successfully if effective, continuous and committed implementation of the mitigation measures highlighted is carried out by MFC (SL) Ltd, with effective monitoring by CCC, an internal auditor and EPA-SL. Hence, the project is not likely to cause significant adverse environmental effects if all environmental considerations are taken into account and implemented.

14.2: Recommendation

The biodiversity in Sierra Leone is facing threat from both anthropogenic and environmental activities and this has exacerbated by the high demand of bush meat especially in the rural areas of Sierra Leone. For the purpose of this survey the following recommendations have been made to the Management of MFC (SL) Ltd Company.

- That further research should be done during the dry season to get a more robust data on other species of conservation concern
- That alternative livelihood options be created for the affected communities like animal husbandry, capacity building and a more inclusive approach
- A rapid stakeholder assessment is needed to identify the individual stakeholder group interests to avoid future conflicts, this is best achieved by creating a community affairs department in the company
- That detailed survey is done because there is still room for more species discovery.
- Carry out further surveys at different times of year to complete the avifaunal species list, evaluate the threats to species of conservation concern and estimate their population sizes.
- Put in place monitoring programs to assess the impact of all human activities on bird populations and associate local communities (especially hunters).
- MFC (SL) Ltd should hire an Environmental firm that will be charged with the responsibility of taking care of all the environmental aspect of their Project.

- It would be of great benefit if some land is left to cultivate aboriginal crops. This will encourage the birds and mammals which had abandoned the land to feed and nest there as native crops are what they are used to and depend on.
- It would be wise to protect the swamp areas which have not yet been affected. It was noted that during the bird count most birds were identified along these swamps.
- A repetition of the mammal survey during the dry season would be good

Finally, the ESIA Consulting team recommended that the Project should be granted an environmental permit whiles the Company is implementing their Environmental Management Plan of their agroforestry project within the Yoni Chiefdom in the Tonkolili District.

14.2: APPENDIX AND REFERENCES

APPENDIX 1

No.	FAMILY	SCIENTIFIC NAME
1	Sapindaceae	Blighia unijugata
2		Allophyllus africanus
3		Placodiscus attenuates
4		Nothospondias staudtii
5		Deinbollia grandifolia
6		Blighia welwitschii
7		Deinbollia cuneifolia
8		Placodiscus splendidus
9		Placodiscus pseudostipularis
10	Palmaceae	Elaeis guineensis
11	Asteraceae	Aspilia Africana
12		Chromolaena odorata
13		Vernonia conferta
14	Connaraceae	Cnestis ferruginea
15	Gulliferae	Allanblackia floribunda
16		Pentadesma butyracea
17		Allanblackia parviflora
18	Poaceae	Bambusa vulgaris
19		Axonopus africanaus
20		Anadelphia leptocoma
21		Axonopus compressus
22	Sterculiaceae	Sterculia tragacantha
23		Heritiera utilis
24		Cola chlamydantha
25		Cola acuminate
26		Cola lateritia
27	Rubiaceae	Morinda lucida
28		Nauclea diderrichii
29		Nauclea latifolia
30		Craterispermum laurinum
31		Morinda morindoides
32		Massularia acuminate
33		Amaralia sherbourniae
34		Vangueriopsis discolor
35		Sherbournia bignoniiflora
36		Hallea leadermanii
37		Samanea dinklagei
38		Dichrostachys glomerata
39		Pentaclethra macrophylla

40	Mimosaceae	Albizia adianthifolia
41		Canthomium artissimum
42		Parkia bicolor
43		Albizia zygea
44		Mimosa pudica
45		Piptadeniastrum africamum
46		Dichrostachys cinerea
47	Ebenaceae	Diospyros thomasii
48		Diospyros cooperi
49		Diospyros heudelotii
50		Diospyros gabunensis
51	Dilleniaceae	Tetracera alnifolia
52	Tiliaceae	Triumfetta tomentosa
53		Clappertonia icifolia
54	Passifloraceae	Smeathmannia pubescens
55	Zingiberaceae	Costus afer
56		Aframomum daniellii
57		Aframomum sceptrum
58		Aframomum exscapum
59	Moraceae	Morus mesozygia
60		Myrianthus arboreus
61		Myrianthus libericus
62		Millicia excels
63		Millicia regia
64		Myrianthus serratus
65		Ficus capensis
66		Antiaris Africana
67		Musanga cecropioides
68		Ficus exasperate
69		Ficus species
70		Ficus kamerunensis
71		Milicia excels
72		Ficus asperifolia
73		Ficus lutea
74		Ficus sur
75		Ficus umbellate
76	Rhizophoraceae	Anisophyllea laurina
77		Anisophyllea meniaudi
78		Rauvolfia vomitoria
79		Tabernaemontana crassa
80		Funtumia Africana
81		Tabernaemontana Africana

82	Apocynaceae	Holarrhena floribunda
83		Rauvolfia vomitoria
84		Strophanthus sarmentosus
85		Landophia calabarica
86		Tiliacora leonensis
87		
88	Hippocrateaceae	Salacia erecta
89		Salacia cornifolia
90		Salacia leonensis
91		Salacia staudtii
92		Salacia whytei
93	Meliaceae	Trichilia monadelpha
94	Caesalpiniaceae	Cassia alata
95		Daniellia thurifera
96		Amphimas pterocarpoides
97		Dialium dinklagei
98		Dialium guineensis
99		Detarium senegalense
100		Amphimas pterocarpoides
101		Anthonotha macrophylla
102		Cassia sieberiana
103		Cynometra leonensis
104		Mezoneuron benthamianum
105	Hypericaceae	Harungana madagascariensis
106		Vismia guineensis
107	Ixonanthaceae	Phylocosmus africanus
108	Anacardiaceae	Lannea nigritana
109		Pseudospondias microcarpa
110		Lannea nigritana
111		Pseudospondias microcarpa
112	Convolvulaceae	Ipomoea involucrate
113		Ipomoea digitata
114		Ipomea mauritiana
115	Simaroubaceae	Hannoa klaineania
116	Humiriaceae	Sacoglottis gabonensis
117	Arecaceae	Eremospatha macrocarpa
118		Cercest afzelii
119		Raphia hookeri
120		Raphia palm-pinus
121		Ancistrophyllum secundiflorum
122		Cleistopholis patens
123		Xylopia aethiopica

124	Annonaceae	Xylopia staudtii
125		Xylopia quintasii
126		Monodora tenuifolia
127	Papilionaceae	Erythrina mildbraedii
128		Baphia nitida
129		Pterocarpus mildbraedii
130		Pterocarpus santalinoides
131		Milletia lane poolei
132		Millettia warneckei
133		Calopogonium mucunoides
134		Centrosema pubescens
135		Amphimas pterocarpoides
136		Millettia pallens
137	Burseaceae	Canarium schweinfurthii
138		Dacryodes klaineana
139	Polygalaceae	Carpolobia lutea
140	Olacaceae	Coula edulis
144		Heisteria parvifolia
142		Strombosia pustulata
143	Sapotaceae	Chrysophyllum pruniforme
144		Chrysophyllum albidum
145		Chrysophyllum africanum
146	Myristicaceae	Pycnanthus angolensis
147	Verbenaceae	Vitex micrantha
148		Vitex grandifolia
149		Premna hispida
150	Ulmaceae	Trema guineensis
151	Marrattiaceae	Dicranopteris linearis
152		Marrattia fraxinea
153		Dicranopteris linearis
154	Dracaenaceae	Dracaena ovate
155		Dracaena cristula
156		Dracaena mildbraedii
157	Compositae	Vernonia conferta
158		Bidens pilosa
159		Ageratum conyzoides
160	Amaryllidaceae	Crinum natans
161		Crinum jagus
162	Dioscoreaceae	Dioscorea bulbifera
163		Dioscorea smilacifolia
164		Dioscorea minutiflora
165	Rutaceae	Zanthoxylum gilletii

166	Cucurbitaceae	Momordica cissoides
167	Flacourtiaceae	Homalium letestui
168		Homalium smythei
169		Homalium africanum
170	Clusiaceae	Garcinia smeathmannii
171		Pentadesma butyracea
172		Mammea africana
173		Allanblackia parviflora
174	Medusandraceae	Soyauxia floribunda
175	Samydaceae	Homalium smythei
176	Malvaceae	Sida linifolia
177		Sida acuta
178		Hibiscus acetosella
179		Hibiscus sterculiifolius
180		Sida corymbosa
181	Combretaceae	Terminalia ivorensis
182		Combretum racemosum
183		Strephonema pseudocola
184	Rhamnaceae	Maesopsis eminii
185	Cyperaceae	Scleria barteri
186		Scleria depressa
187	Bignoniaceae	Newbouldia laevis
188	Opiliaceae	Urobotrya afzelii
189	Octoknemaceae	Phyllocosmus africanus
190	Selaginellaceae	Selaginella myosurus
191		Selaginella vogelii
192	Medusandraceae	Soyauxia floribunda
193	Lecythidaceae	Napoleona heudelotii
194	Pandaceae	Microdesmis kaeyana
195	Chrysobalanaceae	Maranthes aubrevillei
196	Piperaceae	Piper guineense
197	Urticaceae	Urera obovota
198		Urera oblongifolia
199	Agavaceae	Dracaena elliotii
200	Leguminosae – papiliooideae	Eriosema arenicola
201	Myristicaceae	Pycnanthus angolenis
202	Solanaceae	Solamum verbascifolium
203	Loganiaceae	Anthocleista vogelii
204		Anthocleista nobilis
205	Rosaceae	Parinari excels
206	Irvingiaceae	Irvingia gabonensis
207		Ceiba pentandra

208	Bombacaceae	Bombax buonopozense
209	Euphorbiaceae	Margaritaria discoidea
210		Alchornea cordifolia
211		Macaranga barteri
212		Maesobotrya barteri
213		Bridelia micrantha
214		Hymenocardia lyrata
215		Manniophyton fulvun
216		Mareya micrantha
217		Uapaca heudelotii
218		Macaranga heudeloti
219		Microdesmis puberula
220		Macaranga heterophylla
221		Olfieldia Africana
222		Ricinodendron heudelotii
223		Anthostema senegalense
224		Tetrorchidium didymostemon
225		Discoglypremna caloneura
226		Phyllanthus muellerianus
227		Uapaca guineensis

APPENDIX 11

BOTANICAL SURVEY WITHIN YONI CHIEFDOM.

The table below shows the number of plant species that were found within Miro forestry company project areas /villages surveyed:

Chiefdom: Yoni.

NO	SPECIES	FAMILY
1	Blighia unijugata	Sapindaceae
2	Anthocleista vogelii	Loganiaceae
3	Parinari excels	Rosaceae
4	Irvingia gabonensis	Irvingiaceae
5	Ceiba pentandra	Bombacaceae
6	Margaritaria discoidea	Euphorbiaceae
7	Elaeis guineensis	Palmaceae
8	Allophyllus africanus	Sapindaceae
9	Alchornea cordifolia	Euphorbiaceae
10	Aspilia Africana	Asteraceae
11	Cnestis ferruginea	Connaraceae
12	Allanblackia floribunda	Gulliferae
13	Bambusa vulgaris	Poaceae
14	Sterculia tragacantha	Sterculiaceae
15	Morinda lucida	Rubiaceae
16	Macaranga barteri	Euphorbiaceae
17	Samanea dinklagei	Mimosaceae
18	Diospyros thomasii	Ebenaceae
19	Maesobotrya barteri	Euphorbiaceae
20	Tetracera alnifolia	Dilleniaceae
21	Triumfetta tomentosa	Tiliaceae
22	Smeathmannia pubescens	Passifloraceae
23	Nauclea diderrichii	Rubiaceae
24	Nauclea latifolia	Rubiaceae
25	Costus afer	Zingiberaceae
26	Myrianthus arboreus	Moraceae
27	Myrianthus libericus	Moraceae
28	Anisophyllea laurina	Rhizophoraceae
29	Rauvolfia vomitoria	Apocynaceae
30	Salacia erecta	Hippocrateaceae

31	Trichilia monadelpha	Meliaceae
32	Bridelia micrantha	Euphorbiaceae
33	Cassia alata	Caesalpiniaceae
34	Craterispermum laurinum	Rubiaceae
35	Harungana madagascariensis	Hypericaceae
36	Albizia zygia	Mimosaceae
37	Phylocosmus africanus	Ixonanthaceae
38	Dichrostachys glomerata	Mimosaceae
39	Millicia excels	Moraceae
40	Millicia regia	Moraceae
41	Hymenocardia lyrata	Euphorbiaceae
42	Manniophyton fulvun	Euphorbiaceae
43	Mareya micrantha	Euphorbiaceae
44	Tabernaemontana crassa	Apocynaceae
45	Lannea nigritana	Anacardiaceae
46	Ipomoea involucrate	Convolvulaceae
47	Morinda morindoides	Rubiaceae
48	Uapaca heudelotii	Euphorbiaceae
49	Hannoa klaineania	Simaroubaceae
50	Sacoglottis gabonensis	Humiriaceae
51	Pentaclethra macrophylla	Mimosaceae
52	Eremospatha macrocarpa	Arecaceae
53	Cleistopholis patens	Annonaceae
54	Erythrina mildbraedii	Papilionaceae
55	Chromolaena odorata	Asteraceae
56	Macaranga heudelotii	Euphorbiaceae
57	Baphia nitida	Papilionaceae
58	Vismia guineensis	Hypericaceae
59	Daniellia thurifera	Caesalpiniaceae
60	Microdesmis puberula	Euphorbiaceae
61	Canarium schweinfurthii	Burseaceae
62	Dacryodes klaineana	Burseaceae
63	Amphimas pterocarpoides	Caesalpiniaceae
64	Carpolobia lutea	Polygalaceae
65	Cola chlamydantha	Sterculiaceae
66	Coula edulis	Olacaceae
67	Chrysophyllum pruniforme	Sapotaceae
68	Dialium dinklagei	Caesalpiniaceae
69	Massularia acuminate	Rubiaceae
70	Pycnanthus angolensis	Myristicaceae
71	Macaranga heterophylla	Euphorbiaceae
72	Axonopus africanaus	Poaceae

73	Funtumia Africana	Apocynaceae
74	Vitex micrantha	Verbenaceae
75	Dialium guineensis	Caesalpiniaceae
76	Myrianthus serratus	Moraceae
77	Olfieldia Africana	Euphorbiaceae
78	Albizia adianthifolia	Mimosaceae
79	Ipomoea digitata	Convolvulaceae
80	Anthocleista nobilis	Loganiaceae
81	Xylopia aethiopica	Annonaceae
82	Heritiera utilis	Sterculiaceae
83	Ricinodendron heudelotii	Euphorbiaceae
84	Spondias mombin	Anacardiaceae
85	Trema guineensis	Ulmaceae
86	Salacia cornifolia	Hippocrateaceae
87	Salacia leonensis	Hippocrateaceae
88	Tabernaemontana Africana	Apocynaceae
89	Placodiscus attenuates	Sapindaceae
90	Dicranopteris linearis	Marrattiaceae
91	Dracaena ovate	Dracaenaceae
92	Dracaena cristula	Dracaenaceae
93	Dracaena mildbraedii	Dracaenaceae
94	Cercest afzelii	Arecaceae
95	Pterocarpus mildbraedii	Papilionaceae
96	Pterocarpus santalinoides	Papilionaceae
97	Nothospondias staudtii	Sapindaceae
98	Ageratum conyzoides	Asteraceae
99	Amaralia sherbourniae	Rubiaceae
100	Anadelphia leptocoma	Poaceae
101	Anthostema senegalense	Euphorbiaceae
102	Axonopus compressus	Poaceae
103	Bidens pilosa	Compositae
104	Crinum natans	Amaryllidaceae
105	Deinbollia grandifolia	Sapindaceae
106	Dioscorea bulbifera	Dioscoreaceae
107	Dioscorea smilacifolia	Dioscoreaceae
108	Vangueriopsis discolor	Rubiaceae
109	Tetrorchidium didymostemon	Euphorbiaceae
110	Zanthoxylum gilletii	Rutaceae
111	Blighia welwitschii	Sapindaceae
112	Holarrhena floribunda	Apocynaceae
113	Morus mesozygia	Moraceae
114	Homalium letestui	Flacourtiaceae

115	Garcinia smeathmannii	Clusiaceae
116	Canthomium artissimum	Mimosaceae
117	Homalium smythei	Samydaceae
118	Ficus capensis	Moraceae
119	Sida linifolia	Malvaceae
120	Sida acuta	Malvaceae

14.3: References

1. Allport, G., Ausden, M., Hayman, P. V., Robertson, P. & Wood, P. 1989. *The Conservation of the Birds of Gola Forest, Sierra Leone*. Study Report No. 38. Cambridge, UK: International Council for Bird Preservation.
2. Atkinson, P., Turner, P. A., Pockwell, S., Broad, G., Koroma, A. P., Annaly, D. & Rowe, S. 1996. Land-use and conservation in the Mount Loma Reserve, Sierra Leone. Report of the University of East Anglia–International Council for Bird Preservation–Fauna and Flora Preservation Society expedition to the Mount Loma reserve in north-eastern Sierra Leone (January–April 1992). University of East Anglia, UK. Unpubl. report.
3. BirdLife International. 2000. *Threatened Birds of the World*. Barcelona, Spain: Lynx Edicions & Cambridge, UK: BirdLife International.
4. BirdLife International. 2004. *Threatened Birds of the World 2004*. CD-ROM. Cambridge, UK: BirdLife International.
5. Borrow, N. & Demey, R. 2001. *Birds of Western Africa*. London: Christopher Helm.
6. Borrow, N. & Demey, R. 2004. *Field Guide to the Birds of Western Africa*. London: Christopher Helm.
7. Demey, R. 2007. Rapid survey of the birds of North Lorma, Gola and Grebo National Forests. *In*: Hoke, P., Demey, R. & Peal, A. (eds.). *A Rapid Biological Assessment of North Lorma, Gola and Grebo National Forests, Liberia*. RAP Bulletin of Biological Assessment 44. Washington, DC: Conservation International.
8. Demey, R. & Rainey, H. J. 2004. A preliminary survey of the birds of the Forêt Classée du Pic de Fon. *In*: McCullough, J. (ed.). *A Rapid Biological Assessment of the Forêt Classée du Pic de Fon, Simandou Range, South-eastern Republic of Guinea*. RAP Bulletin of Biological Assessment 35. Washington, DC: Conservation International.
9. Demey, R. & Rainey, H. J. 2005. A rapid survey of the birds of Haute Dodo and Cavally Classified Forests. *In*: Lauginie, F., Rondeau, G & Alonso, L. E. (eds.). *A Rapid Biological Assessment of Two Classified Forests in South-western Côte d'Ivoire*. RAP Bulletin of Biological Assessment 34. Washington, DC: Conservation International.
10. Demey, R. & Rainey, H. J. 2006. Rapid surveys of the birds of the Forêts Classées de Déré, de Diécké and du Mont Béro, Southeastern Guinea. *In*: Wright, H. E., McCullough, J., Alonso, L. E. & Diallo, M. S. (eds.). *A Rapid Biological Assessment of Three Classified Forests in Southeastern Guinea*. RAP Bulletin of Biological Assessment 40. Washington, DC: Conservation International.
11. Gartshore, M. E. 1989. *An Avifaunal Survey of Taï National Park, Ivory Coast*. Study Report No. 39. Cambridge, UK: International Council for Bird Preservation.

12. Gartshore, M. E., Taylor, P. D. & Francis, I. S. 1995. *Forest Birds in Côte d'Ivoire. A Survey of Taï National Park and Other Forests and Forestry Plantations, 1989–1991*. Study Report No. 58. Cambridge, UK: BirdLife International.
13. Nippon Koei UK. 2007. Completion of the Bumbuna Hydroelectric Project – Baseline Biodiversity Surveys. Baseline Bird Survey: Final Report. Unpubl. report.
14. Okoni-Williams, A. D., Thompson, H. S., Wood, P., Koroma, A. P. & Robertson, P. 2001. Sierra Leone. *In:* Fishpool, L. D. C. & Evans, M. I. (eds.) *Important Bird Areas in Africa and Associated Islands: Priority Sites for Conservation*. Newbury: Pisces Publications & Cambridge, UK: BirdLife International.
15. Rainey, H. J. & Asamoah, A. 2004. Rapid assessment of the birds of Draw River, Boi-Tano and Krokosua Hills. *In*: McCullough, J., Decher, J. & Kpelle, D. G. (eds.). *A Biological Assessment of the Terrestrial Ecosystems of the Draw River, Boi-Tano, Tano Nimiri and Krokosua Hills Forest Reserves, Southwestern Ghana*. RAP Bulletin of Biological Assessment 36. Washington, DC: Conservation International.
16. Stattersfield, A. J, Crosby, M. J., Long, A. J. & Wege, D. C. 1998. *Endemic Bird Areas of the World: Priorities for Biodiversity Conservation*. Cambridge, UK: BirdLife International.

1. Hillers A. 2009 Herpetological survey in Gola Rainforest National Park
2. Hillers A., M.O. Rodel 2007. A preliminary assessment of the amphibians of the Fonta Djallon, Guinea, West Africa, salamandra IUCN 2009.

3. http://www.IUCNredlist.org/amphibians

Begon M, Townsend C. R, Harper J .L (2006). From Individuals to Ecosystems. 4th Edition, Blackwell Publishing, U K. Pg 410.

Conway A. (2009). Pygmy hippopotamus (*Choeropsis liberiensis*) conservation on Tiwai Island, Sierra Leone. PhD Thesis progress report, University of Georgia, USA.

Conway A. (2011). Conservation of Pygmy hippopotamus (*Choeropsis liberiensis*) in Sierra Leone, West Africa. PhD progress field report March-July 2011. University of Georgia, USA.

Djossa B.A (2013). A survey report on Bat (Chirotera) study for the Bumbuna Hydroelectric project. Ministry of Energy and Power, Government of Sierra Leone.

Grubb, P. T.S. Jones, A.G. Davies, E. Edberg, E.D.Starin & Hill, J.E. (1998). Mammals of Ghana, Sierra Leone and the Gambia. *Trendrine St. Ives,* 1998.

Hillers A. (2009). Herpetological survey in the Gola Forest, South-eastern Sierra Leone. (August to September, 2009).Museum of Natural History, Berlin. Leibniz Institute for Research on Evolution and Biodiversity at the Humboldt University Berlin, Germany.

Kortenhoven A, Dotras L, Conteh J, Johnny J, Bakarr I, Kargbo , Konteh S and Kamara A (2008). Status and Biodiversity of Large Mammals in the Loma Mountain Non-hunting Forest Reserve. Loma Mountain Large Mammal survey.

Oates J. F (2010). Primates of West Africa, a field guide.

Aké Assi L., 2001. Flore de la Côte d'Ivoire : catalogue systématique, biogéographie et écologie. I. *Boissiera* **57**, 396 p.

Aké Assi L., 2002. Flore de la Côte d'Ivoire : catalogue systématique, biogéographie et écologie. II. *Boissiera* **58**, 401 p.

Cain S. A., de Oliveira Castro G. M., Purça Pires J. & N. T. Da Silva, 1956. Application of some phytosociological techniques to brazilian rain forest. *Amer. J. Bot*. **43**: 911-941.

Cole N. H. A., 1968. Climate, life forms and species distribution on the Loma Montane grassland, Sierra Leone. *Bot. J. Linn. Soc.*, **69**: 197-210

Cottam G. & J. T. Curtis, 1956. The use of distance measures in phytosociological sampling. *Ecology***37**: 451-460.

Hawthorne W. D. & C. Jongkind, 2006. Woody plants of Western African Forests. A guide to the forest trees, shrubs and lianes from Senegal to Ghana. Kew Publishing, 1023 p.

Kouamé F. N., 1998. Influence de l'exploitation forestière sur la végétation et la flore de la Forêt Classée du Haut-Sassandra (Centre-Ouest de la Côte-d'Ivoire). Thèse Doct. 3e Cycle, UFR Biosciences,Univ. Cocody-Abidjan, 227 p

Lamprecht H., 1962. Ensayo sobre unos metodos para el analisis estructural de los bosques tropicales. *Acta Ci*. *Venez.* **13**: 57-65.

Lebbie A. R., 2008. Rapie Assessment of Flora of Loma Mountain.

Lebrun J.-P. & A. L. Stork, 1991. Énumération des plantes à fleurs d'Afrique Tropicale: généralités et *Annonaceae* à *Pandaceae*. Vol. I, CJB, Genève, 249 p.

Lebrun J.-P. & A. L. Stork, 1992. Énumération des plantes à fleurs d'Afrique Tropicale: *Chrysobalanaceae* à *Apiaceae*. Vol. II, CJB, Genève, 257 p.

Lebrun J.-P. & A. L. Stork, 1995. Énumération des plantes à fleurs d'Afrique Tropicale. Monocotylédones: *Limnocharitaceae* à *Poaceae*. Vol. III, CJB, Genève, 341 p.

Lebrun J.-P. & A. L. Stork, 1997. Énumération des plantes à fleurs d'Afrique Tropicale. Gamopétales :*Ericaceae* à *Lamiaceae*. Vol. IV, CJB, Genève, 712 p.

Loizeau P.-A., 1992. La diversité. Exemple des forêts denses humides amazoniennes. *Sausserea* **23**: 49-82.

www.iucnrelist.org