THE REPUBLIC OF UGANDA

Ministry of Agriculture, Animal Industry and Fisheries
Vegetable Oil Development Project

ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED OIL PALM PROJECT, BUGALA ISLAND, KALANGALA DISTRICT

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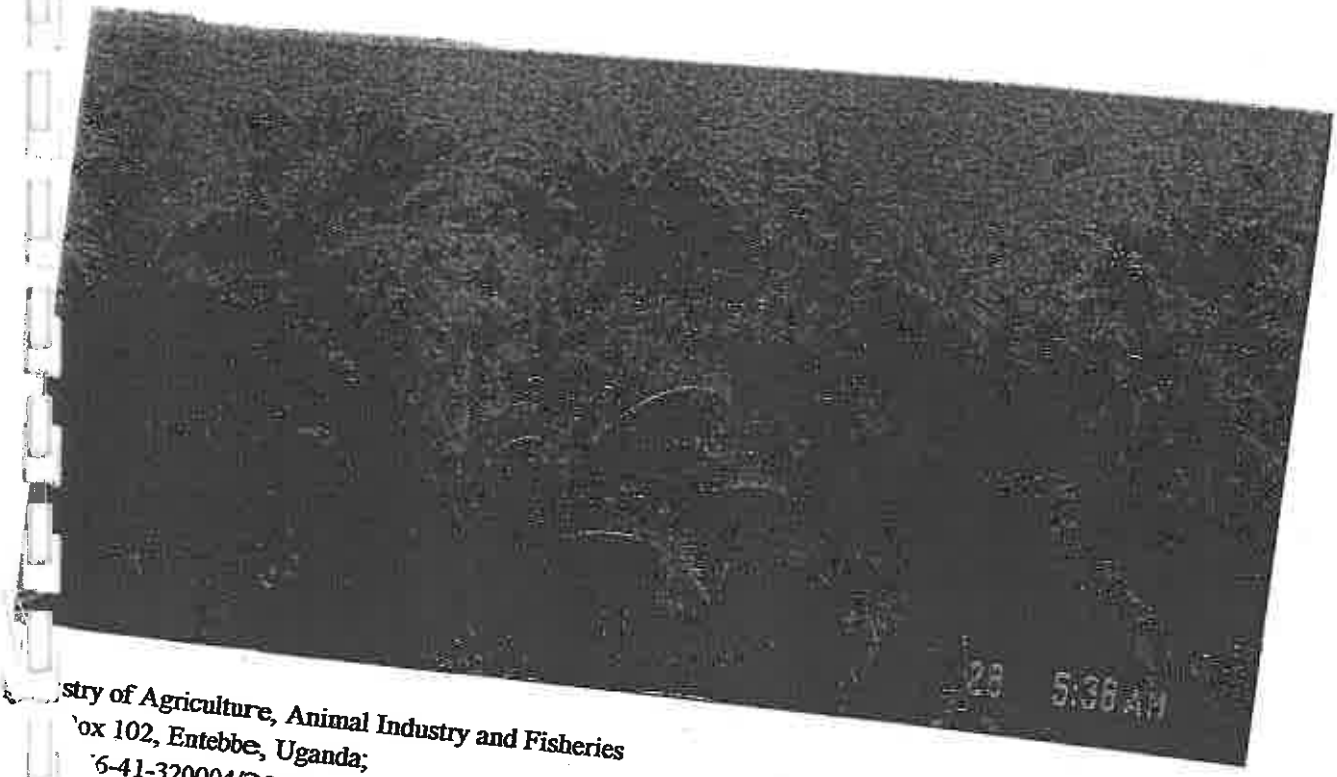

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1.0 INTRODUCTION

This is a summary of a report, called an Environmental Impact Statement (EIS) that presents the results of an assessment of the environmental implications of a proposed Oil Palm Development Project (OPDP), on Bugala Island, Kalangala District. The Oil Palm Development Project (referred to, for reasons of convenience, in this document as the Oil Palm Project) is a component of the Vegetable Oil Development Project (VODP) implemented by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF).

This EIS has been prepared as part and parcel of the project planning and design process for the development, to be jointly submitted by the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) and Bidco Oil Refineries Limited to National Environment Management Authority (NEMA) for review of its environmental implications and subsequent approval. The Oil Palm Project will comprise an oil palm plantation, oil mill, seedling nursery and related infrastructure including internal roads for collection of fresh fruit bunches (ffb), housing for workers, schools, health facilities, and electricity Large-scale agriculture such as the oil palm project is provided for in Statute Supplement No. 3, (1995) and listed within Schedule 3 of the National Environment Statute (NES) (1995); as requiring environmental impact assessment (EIA) EIA for roads and food processing plants is also provided for in Schedule 3 Sections 3 and 9 of the NES respectively. This EIS has been therefore prepared in accordance with the requirements of the NES. It is the opinion of the developer that sufficient and relevant information on the development has been provided to allow NEMA and the Lead Agencies to 'establish whether or not the activity is likely to have significant impact on the environment' (NEMA 1997).

1.1 PROJECT BACKGROUND

The Oil Palm Project is Government of Uganda's effort to reduce dependence on vegetable oil imports by encouraging domestic production of oil-bearing crops. Despite Uganda's suitable climate, soil and abundant natural resource base, it imports more than 70% of its vegetable oils requirement worth about USD60 million annually

The project will address rural poverty and increase rural incomes through involvement of small holders in production of oil-bearing crops, cottage processing and fair marketing. In addition, the project will address the health problems of the population through increased vegetable oil intake. Uganda has among the lowest vegetable edible oil intake levels, reported to be 2.3kg/per capita,

which is lower than the minimum recommended by World Health Organisation (WHO) of 3.3 kg per capita; and of the world average of 7 kg per capita.

1.1.1 The Oil Palm Project

GoU opted to develop oil palm in some suitable parts of the country because it is estimated that over 75% the country's vegetable oil imports is palm oil and its derivatives.

1.1.2 Efficient land utilisation

Oil palm is reported to produce over four times more oil per unit area per year than other oil seed crops being cultivated today; refer to average productivity of various major oil crops table 1 in main report.

1.1.3 Project objectives

The oil palm project seeks to increase domestic vegetable oil production with particular emphasis on the participation of smallholders and private sector processors.

Specifically, the project seeks to:

- Reduce poverty and increase farmer income by involving smallholder growers in oil palm industry.
- Facilitate the enabling environment to attract private sector investment in oil palm development with a view to reducing imports of vegetable oil and effecting substantial savings in foreign exchange.
- Promote private sector agro-industrial investment through the introduction of industrial oil processing mills with high environmental standards.
- Improve efficiency and impact of supporting services through support for research and extension.
- Promote and facilitate the interaction between the interested parties through the creation of a national industry based and eventually, industry financed consultative body that would advise government on the sub-sectors development priorities.

These objectives are to contribute to the broader sectoral objective of increased agricultural growth, and diversification of the economy as enshrined in the government's Plan for Modernisation of Agriculture (PMA).

1.1.4 Project funding and management

The oil palm project is to be co-implemented with major private investment from Bidco Oil Refineries Limited and its partners from Malaysia and Indonesia Government of Uganda will finance the oil palm development for smallholders and facilitate the enabling environment whilst its partners will finance the nucleus estate and oil mill, and provide technical assistance. World Bank is supervising the project on behalf of IFAD as a cooperating institution.

The total project funding is about USD 155 million, with the following components:

GoU	- USD 12 million
IFAD	- Ushs. 19.9 million
Private Sector	- USD 120 million
Farmers	- USD 3.16 million

1.2 REASONS FOR LOCATING THE PROJECT IN KALANGALA

1.2.1 Climatic considerations

Climatic conditions on Bugala Island, the largest of the Ssese Islands, are close to the optimal conditions for oil palm production; refer to section 1.3.1 of the EIS main report for details.

1.2.2 Soils and geomorphology

While oil palm can be grown successfully under a wide range of soil conditions, well drained soils with adequate water holding capacity and texture are preferred A flat, or gently undulating topography is desirable.

From soils surveys carried out on Bugala Island, the soils are suitable for oil palm except along the hilltops. Current farm trials of about 60 hectares scattered on the island have shown good yields, with about 11 tonnes of fresh fruit bunches per hectare at the age of 6–8 years (DAO, Kalangala)

1.2.3 Current land use and availability

Kalangala is one of the least populated districts in the country On Bugala Island, there are large areas of unoccupied land From observations most people live in fishing villages along the lakeshores. All the land acquired for the project has no settlements

1.2.4 Stimulation of development

The proposed project is a deliberate development programme by GoU, intended to stimulate the development process in Kalangala District. Since Tsetse fly infestation in the early 1900s, there has not been any serious development entered by government or private sector on the Island. The project is to develop oil palm by the nucleus estate, smallholders and out growers so that, the combined size of the plantation would enable an industrial and economic size palm oil mill to process the produce efficiently, economically and ensure high returns on investment to both small holders/out growers and the private investor, with high environmental standards.

This therefore, means, attempts to locate this project in any other part of the country would mean denial of development to Kalangala people.

1.3 PREVIOUS ENVIRONMENTAL IMPACT ASSESSMENTS

Prior to this EIA, the project has earlier gone through two successful EIA studies since its inception. GoU/IFAD/WB undertook the initial EIA in 1995 and GoU carried out the second in 2000.

The 1995 EIA study was conducted in accordance with IFAD's Administrative Procedures for Environmental Assessment with the then Government of Uganda EIA processes and procedures and was carried out to ensure that the proposed project met the requirements of the National Environment Statute 1995 (IFAD Appraisal Report, Volume II, Working Paper No.3).

The 2000 EIA was carried out under the premise that the project was to be implemented partly in degraded forest reserves and mostly on former public lands. The plan to use degraded forest reserves was due to insufficient land being available for the project and this therefore, necessitated an EIA to be carried out, focusing on anticipated change in land use from forest reserves to oil palm plantation.

Despite NEMA's conditional approval of 2001, based on advice from the World Bank, GoU decided not to implement the project in the degraded forest reserves. Instead alternative land was identified for the project.

Government decided to acquire private and former public lands outside gazetted areas and vest the ownership of such land with Uganda Land Commission, for the purpose of oil palm development.

This EIA focuses on the development of oil palm on 6,500 hectares of acquired private land and public lands as nucleus estate and an additional 3,500 hectares to be raised by outgrowers/smallholders. The oil palm project in Bugala will no longer require any reserve forest to be degazetted, nor will any such land be used for the project.

2.0 LEGAL FRAME WORK

The proposed oil palm development has been designed to fully comply with national environmental codes and legislations in Uganda and with the World Bank's environmental and social safeguard policies. This chapter sets out the legal framework that have guided the EIA for the oil palm development, including World Bank policies and Uganda's legal requirements on environmental impact assessment.

2.1 WORLD BANK SAFEGUARD POLICIES

The oil palm project will be undertaken by a private developer (BIDCO) and smallholder farmers supported by the GoU and IFAD, which aim to address rural poverty and increase rural incomes through involvement of small holders in production of oil palm. The project is managed and supervised by the World Bank on behalf of IFAD, as a cooperating institution. The oil palm project is anticipated to have mostly beneficial impacts, as its main objective is to increase domestic vegetable oil production with particular emphasis on the participation of smallholders and private sector. This objective is to contribute to the broader sectoral objective of increased agricultural growth, import substitution and diversification of the economy as enshrined in the government's Plan for Modernisation of Agriculture (PMA).

Due to the nature of the project, which involves natural habitats, transboundary/international water body concerns, the proposed project has been rated Category B under the World Bank's policy on environmental assessment (OP 4.01), requiring a full EIA. The EIA is required to assess the potential impacts associated with the project. In addition to the OP 4.01, the oil palm project has also triggered a number of other safeguard policies including Natural habitats (OP 4.04, BP 4.04), Pest Management (OP 4.09) and Projects in International Waters (OP 7.50, BP 7.50). Reasons for triggering the various safeguard policies are detailed in sections 2.1.1, 2.1.2, 2.1.4 and 2.1.5 of the EIS main report

2.2 UGANDA'S LEGISLATION FOR ENVIRONMENTAL ASSESSMENT

The preparation of this EIS has taken into account all the requirements for environmental assessment under Uganda's law, mainly under the National Environment Statute (1995). Other laws that have been considered include the Water Statute 1995, Public Health Act (1964), Factories Act (1964), Land Act (1998) and National Forestry and Tree planting Act (2003).

Policies considered relevant to the project and have been taken into consideration include the Wetlands Policy (1995) and the Uganda Forestry Policy (2001).

Details of the laws and policies are provided in Section 2 of the EIS main report.

3.0 PROJECT DESCRIPTION

3.1 INTRODUCTION

This section describes the oil palm project components, including access around the site, nursery development nucleus estate, oil mill processes, smallholder/outgrowers plantation development, materials to be used and the entire operation phase

3.2 Project implementation strategy

The mode of implementation of this project will be based on the already well established, tested and environmentally friendly model used in the Indonesian oil palm industry. A group well versed with this model will be involved in the project set-up.

3.3 THE PROJECT

The Oil Palm Project is to be undertaken on Bugala, the largest of the Ssese Islands, a group of 84 islands located in the North-western part of Lake Victoria, just south of the Equator. Bugala is about 7 km from the western shore and about 45 km southwest of Entebbe. The island represents 56% of the total land area of the Ssese Islands, which administratively constitute Kalangala District. The district is named after the town of Kalangala, the main settlement and the site of district government, on Bugala Island. Bugala and the other Ssese Islands have not received any substantial investment in development.

The Oil Palm Project is an undertaking of the GoU and private sector, specifically Bidco Oil Refineries limited. The project will facilitate development of 6,500ha oil palm nucleus estate financed by Bidco. Further development of 3,500 ha of oil palm will be carried out by out-growers/small-holders, with support from IFAD and GoU.

3.4 THE NUCLEUS ESTATE

The nucleus estate will comprise of a nursery, an oil mill, oil palm plantation, plantation roads and social infrastructure including schools, a health centre and community hall. Further, the nucleus estate will provide the following functions

- Provision of technical assistance.
- Provision of selected high yielding planting material and other agricultural inputs;

- Purchase of oil palm fresh fruit bunches
- Processing of fresh fruit bunches;
- Marketing of oil; and
- Training of farmers and staff

Approximately 1,500 ha of land will be put under oil palm in the second year. It is projected that over a period of 10 years 2000 people will be employed in Bugala.

3.5 THE SMALLHOLDER FARMERS

The smallholders will each cultivate individually up to 3ha of oil palm. A total of 3,500 hectares of oil palm is to be raised by small holders. The holdings will be grouped in blocks as much as possible in order to facilitate supervision of work and fruit collection. The smallholders/outgrowers will be fully involved in the grouping of holdings to ensure their ideas are incorporated into the design at an early stage.

The participating farmers are expected to meet the following conditions:

- Possession of title to the land or a certificate of occupancy.
- Preparedness to pledge the title/certificate of occupancy against development/loan cost for the oil palm development;
- Preparedness to deposit the title with the Oil Palm Growers Trust, the organisation responsible for loan recovery;
- Preparedness to carry out the technical advice given by the nucleus estate;
- Preparedness to supply all fruit to the nucleus unit at a price fixed by the pricing committee.
- Land offered for development must be of acceptable agronomic standards and accessible, and
- Authorise deductions at source by the nucleus estate for purposes of loan recovery

3.5.1 Support for smallholder production

Smallholder farmers will be supported by GoU and IFAD. The farmers will access a long-term production credit from IFAD loan funds. Farmers will repay the loan through the sale of their

fresh fruit bunches. Repayment will commence in project year six, after planting and end in about 7 years. The economic life of oil palm is 25 years, although some palms can live for many more years.

3.5.2 Smallholder role in the oil palm company

Bidco and her partners, together with smallholder farmers participating in the project will form the oil palm company. The smallholder farmers will have a 10% share in the company. Smallholder equity share will be on the basis of land availed to the project and equipment to be used by the farmer. The smallholders will be represented on the Board of Directors of the company to ensure their investments are protected

3.5.3 Oil palm Growers' Trust

The smallholders will organise themselves to form the Oil Palm Growers' Trust (OPGT) to ensure a strong voice. The OPTG will be represented on the Board of Directors of the company and on the pricing committee that will be set up. Production credit will be availed and recovered through the OPGT

3.6 THE NURSERY

Oil palm is propagated through seeds. Seeds will be procured as germinated oil palm seeds, to be imported from Malaysia and Indonesia. A pre-nursery of 50 ha will be established at Bwendero, under overhead shade because of the intense solar radiation in Bugala

Water for nursery irrigation will be obtained from the Nalusegenya stream flowing adjacent to the nursery area. The stream has a discharge of 6 litres per second

It is anticipated that seedlings will be raised for field planting within 9-12 months from seed planting

Details on nursery management including polybag requirements, seed planting, nursery watering, nursery manuring, pest and disease control, nursery weeding, transplanting doubletons and nursery culling/selection are provided in Section 3.6 of the EIS main report

Further, details of Oil Palm field planting including land clearing, lining, holing, cover crops, field planting, upkeep of immature and mature oil palm, Ablation/castration, mulching, harvesting pruning and pests and diseases are discussed under Section 3.7 of the EIS main report.

3.7 THE OIL MILL

An oil mill will be installed on the nucleus estate at Bwendero, approximately 1km from the Lake Victoria shore and about 200meters from the main road The mill is proposed to handle ffb from both the nucleus estate and out growers. Inputs into the mill, including fuel and water requirements, will be about 5% to 10% of ffb processed

Water will be obtained from the Nalusegenya stream owing through the nucleus estate Agricultural waste from the processing of ffb in the mill, especially from sedimentation tanks, will be used as fuel and fertilisers.

The mill capacity will initially be 30 tonnes per hour. This will be expanded to 60 tonnes per hour with increased production of ffb over the years. Facilities at the mill will comprise a weigh bridge, CPO loading unit, CPO storage, ffb offloading platform, ffb cage system, steriliser, fibre collection unit, boiler and co-generation, oil mill, water treatment tanks, incinerators and effluent treatment plant as well as an administration and security units.

The processing of fresh fruit bunches is discussed in section 3.8.4 of the EIS main report.

3.8 ROADS/COMMUNICATION

Three categories of roads have been proposed for construction on Bugala Island. These include:

- Link roads - these will link the small growers, outgrowers nucleus estate and the mill to the main arterial roads in order to facilitate plantation activities and the collection of palm fruits for transportation to the mill
- ffb roads – these roads will be constructed within the oil palm plantations only and based upon an economic carrying distance of 200m for ffb The density of plantation roads will be 25m per ha
- Access road to the mill

The description and design standards of the roads are provided in section 3.9.2 of the EIS main report

4.0 ENVIRONMENTAL ASSESSMENT

4.1 IMPACT ANALYSIS

Potential environmental impacts of the oil palm project are noted to arise from use of agrochemicals, processing plant/oil mill effluent, solid waste management and air pollution from processing plant. Impact analysis was carried out focusing on the impact of the project activities on the ecological and socio-economic setting of Bugala Island. Attention was paid to vegetation removal, hydrology, fauna, limnology and fisheries and agro-economy

4.2 USE OF AGROCHEMICALS

Fertiliser application

Potassium and magnesium will be used to provide the nutritional requirements of the palm trees given the soil condition prevalent in Bugala. Application of fertiliser will be minimal and shall be used in conformity with the soil analytical recommendation by Kawanda Agricultural Research Institute.

Based on an annual fertiliser program fertiliser will be thinly sprayed at the base of palm tree using a tractor. The roots of palm trees are spread close to the ground surface. This will help fast uptake of the applied fertiliser and avoid fertiliser getting into runoff.

Herbicide application

Use of herbicides will be minimal and when necessary during the immature stage of the palm trees. glyphosate will be applied in interlines to spot spray grasses. In view of the availability of manual labour in Bugala, strip weeding during the mature stage will not be necessary.

The use of fungicides might be necessary at pre-nursery and nursery stage to control leaf diseases In that case dithane M45 is recommended at a monthly frequency depending on the incidence of Cercospora. The use of insecticides may be required to combat crickets (*Zonocerus variegatus* sp) although the incidence is not expected to be significant. Given the climatic pattern of the area, no blast at nursery stage is expected In the event blast does occur, systemic insecticide will be used However, the entire surrounding of the pre-nursery and nursery should be kept clean weeded in order to prevent the development of *Recilia mica* (Homoptera)

The limited use of fertilisers will improve soil conditions and plant growth. The carefully designed integrated pest management program (Appendix 2 of the EIS main report) and the

In order to avoid any accidental release of effluent a stand by empty pond will be constructed to receive any effluent that leaves the mill premises accidentally. In this way, no effluent will be released into any stream, river or lake.

4.3.3 Solid waste management

The plant will be designed to produce and use steam and electricity from solid waste such as empty fruit bunches. The total caloric value of these products represents approximately 3 million KCal tonne of ffb processed. This amount of energy is sufficient to run the plant independently and meet electricity requirements elsewhere. The ashes produced after incineration of the fibres, shells and stalks are recovered and used as fertilisers. They cover approximately 50% of the fertiliser requirements of the plantations. Ashes are rich in K_2O (25%), MgO (5%), CaO (10%) and some oligo-elements.

The emission of smoke could be a minor source of pollution. In order to obtain a perfect combustion the boiler furnace will be equipped with an air injection device to achieve complete combustion; thus reducing smoke emission to a minimum. Scrubbers will be incorporated into the chimney to eliminate the occurrence of unburned substances.

Empty fruit bunches can also be returned to the field to act as mulch if needed.

4.3.4 Oil mill energy production

All process waste will be burned in the boiler for the production of steam used for the generation of electricity and processing of fruit. Apart from fibres, empty bunches are to be pressed and munched to augment fuel supply. Palm kernel will be cracked and shells used to further increase fuel supply. The boiler will therefore be designed to consume fibres and shells and eventually palm kernel cake. The furnace will have tilting grids to enable continuous functioning and an ash extraction device. Ashes will be recovered for recycling into the plantation as fertiliser.

The minimum calorific value of all by-products including palm kernel cake amounts to minimum 1,000,000KCal per tonne of ffb processed. This amount of energy is sufficient to produce approximately 1 tonne of steam or 50KW of electricity. If properly designed and managed, the mill will produce about 340KW of electricity per hour throughout the year when the plantations reach full maturity.

4.4 VEGETATION

The land cover/use on Bugala Island consists of secondary forest alternating with subsistence farmland, grasslands, woodlands, bush land and wetlands. The vegetation of Bugala Island can be distinguished into four zones including upper forest, grasslands; lakeside forest and aquatic vegetation. A summary of the cover types by percentage is presented in table 5 of the EIS main report.

As part of environmental assessment of the oil palm project, a vegetation survey was undertaken in Bugala.

The specific objectives of this vegetation survey were to:

- assess the species diversity in the project areas and its environs and the likely impacts as a result of a changed land use
- examine the conservation and sustainable utilisation vis-à-vis the proposed land use changes
- identify conservation options available for forest reserves to ensure the continued existence of species of special conservation and economic importance.
- identify issues that should be considered in the environmental and forest management to ensure minimum adverse impacts of oil palm production in project sites.

4.4.1 Results

4.4.1.1 Floristics

A total number of 178 observed species were recorded on transects; an additional 8 species in grasslands through opportunistic recordings. These belonged to 62 families and 146 genera. Of these, 9 families had 5 species or more as shown in table 7 in the EIS main report. Rubiaceae was the most speciose with 14 species followed by Euphorbiaceae (13); Apocynaceae (10); Poaceae Moraceae and Aspleniaceae with 9 species each.

4.4.2 Impacts

Potential impacts of the oil palm project activities are typical of projects that involve clearing of indigenous vegetation. In the case of Bugala Island, potential impacts will be short lived given the proposed mitigation measures. Potential impacts and mitigation measures are discussed in detail in Section 4.4.7 of the EIS main report. Below is a tabulated summary of the potential impacts

and proposed mitigation measures. Further, institutions responsible for implementation of mitigation measures are included.

Table 1: Potential impacts and Proposed mitigation measures and responsible institutions/agencies

Potential Impacts	Mitigating measures	Implementing Institution
Loss of existing natural vegetation	▪ Setting up woodlots for energy needs ▪ Phased clearance of natural vegetation ▪ Establishment of oil palm plantation (tree cover will add to forest cover) ▪ Gazetted forests will not be converted ▪ Planting cover crops	▪ District Environment Office ▪ District Agriculture Office ▪ District Forest Office ▪ Developer
Destruction of environmentally sensitive areas such as swamp forests	▪ River banks, lakeshores left intact ▪ Location of the factory to avoid water pollution ▪ Treatment of oil mill effluent	▪ District Environment Office ▪ District Forest Office ▪ Developer
Disposal of woody debris	▪ Wood from species such as *Uapaca guineense* and *Maesopsis eminii* will be converted into timber for construction ▪ Other debris will be used as compost	▪ District Environment Office ▪ District Agriculture Office ▪ District Forest Office ▪ District Engineering Department
Decline in timber production	▪ Sustainable harvesting regimes in production zones in forest reserves to ensure continued timber supply ▪ Some private forest will not be converted hence will continue to supply timber	▪ District Environment Office ▪ District Forest Office ▪ NEMA
General decline in private forest cover leading to reduced local availability of forest products	▪ Forest reserves to supply some needs under the collaborative forest management approach ▪ Utilisation of other private forest ▪ Encouraged reservation of trees in farmland ▪ Agroforestry programmes ▪ Afforestation programmes	▪ District Environment Office ▪ District Forest Office ▪ District Agriculture Office
Degradation of soil from erosion, and removal of vegetation cover	▪ Temporary erosion control measures: contours, mulching of exposed areas. ▪ Permanent erosion control measures: reserve forest patches in erosion prone areas; plant with *Paspalum notatum* on sides of tracks and roadsides; plant cover crop e.g. *Calliandra* or *Pueraria* that are useful as mulch and fodder ▪ Closed canopy oil palm crop should reduce erosion to minimal levels in the long run	▪ District Environment Office ▪ District Forest Office ▪ District Agriculture Office

4.5 FAUNA

A number of biodiversity surveys have been carried out in the Ssese Islands over the past century, but there has not been any consistent monitoring programme. This section features results of some of the major surveys focusing on avians, mammals, and butterflies and, to a lesser extent, amphibians and reptiles. Impacts of project activities on fauna have been identified and mitigation measures proposed.

4.5.1 Mammals

The Ssese Islands are not particularly known for a rich mammalian diversity, though there have been records of important endemic species on the Islands. Of the 13 (see table 12 in the EIS main report) species recorded *Pelomys isseli* is of special interest as a Ugandan endemic only known to occur in the Ssese Islands. Another important species is the sitatunga, *Tragelaphus spekei spekei*. The presence of the Vervet monkeys (*Cercopithecus aethiops*) is notable and these could easily be a serious pest problem. Hippos (*Hippopotamus amphibious*) are occasionally sighted at the lakeshores.

4.5.2 Butterflies

A total of 122 species of butterflies comprising 5 families have were recorded in the Ssese Islands. Butterfly species of special interest in the Ssese Islands include the nymph *Acraea simulata*, an extremely uncommon and little known butterfly, endemic to Uganda and specifically to the Ssese Islands. Two other subspecies endemic to the Ssese Islands include *Thermoniphas togara bugalla* and *Acraea epaea angus faciata*. Other species of restricted range and of rare occurrence are discussed in Section 4.5.2 of the EIS main report.

Butterflies associate with particular plant species for breeding, feeding and habitation. They could thus be affected in a similar way as the mammals due to habitat alteration. For some species the effect could be more severe, especially the endemic and close forest specialists. However many of the butterfly species on the island are adaptable and the ones of special conservation concern are protected in the Forest Reserves that will not be taken up by the project.

4.5.3 Amphibians

Amphibians are known to be good bio-indicators because they often respond to environmental changes probably more rapidly than any other taxon. They can therefore serve as early warning

indicators of environmental degradation. Seventeen amphibian species have been recorded in the Island mainly along the lake shore. Only the common toad *Bufo regularis* has been regularly encountered in the forest away from the water edge. Habitats utilised by amphibians in Bugala are outside the project area besides most of the species encountered are also found in water-bodies on the mainland.

4.5.4 Reptiles

Most reptiles, unlike amphibians, are highly mobile and are diversified in habitats. They can be encountered in aquatic habitats, shorelines, rock outcrops, trees and bushes and on any slopes of the terrain. The more specialised in habitat use such as crocodiles, monitor lizards and water snakes, are good for monitoring changes in habitat due to human activity.

Except for species such as the green water snake and the water cobra, most of the species recorded (see Table 14 in the EIS main report) were terrestrial, and are adaptable to a wide variety of habitat types. Though it would be useful to monitor the response of all species to change in land use, the species that would probably be mostly affected by agricultural activity, especially if pesticides are used on a large scale would be the aquatic species. All the reptile species recorded above widely spread throughout the mainland

Impacts on mammals, butterflies, amphibians and reptiles are tabulated below.

Table 2: Potential impacts and Proposed mitigation measures and responsible institutions/agencies

Potential Impact	Mitigation	Implementing Institution
Loss of habitat for mammals	▪ Phase vegetation clearing to allow for adaptation of certain species	Bidco
Behavioural change leading to change of species into pests on palms	▪ Development and Implementation of a comprehensive pest control programme; ▪ The lake shores and associated vegetation should be preserved.	Bidco, UWA
Loss of species due to pesticide/herbicides use	▪ Use of integrated pest management ▪ Protection of key habitat areas from pesticide/ herbicide exposure	Bidco

4.5.5 Avifauna

4.5.5.1 Study area

Some of the habitat areas in Bugala form important bird habitats that include large waterbird congregation. The Lake Victoria biome contains 12 characteristic bird species three of which occur at Bugala Island, namely: Black-lored Babbler (*Turdoides sharpie*), Red-chested Sunbird (*Nectarinia erythrocerca*) and Northern Brown-throated Weaver (*Ploceus castanops*). Bugala Island is dominated by birdcalls of species such as Tambourine Dove (*Turtur tympanistria*), Little Greenbul (*Andropadus virens*), Common bulbul (*Pycnonotus barbatus*), White-spotted Crake (*Sarothrura pulchra*), Paradise Flycatcher (*Terpsiphone viridis*), Yellow-breasted Apalis (*Apalis flavida*) and Western Black-headed Oriole (*Oriolus brachyrhynchus*).

The full list of 75 bird species was recorded in the study area and the surrounding areas of the project as presented in Appendix 7 of the EIS main report.

Of the 60 bird species recorded during Timed Species Counts (TSCs) (see Appendix 7 in the EIS main report), the majority (61%) were uncommon, 18% were frequent whereas 21% were common.

Out of the 75 bird species recorded during this study, none is endemic or of global conservation concern. The seven species listed in the East African Regional Red List of Birds are listed in table 15 of the EIS main report

4.5.5.2 Impacts

Potential impacts of project activities on avifauna are discussed in detail in section.

*Table 3: **Potential impacts and proposed mitigation measures and responsible institutions***

Potential Impacts	Mitigation measures	Implementing Institution
Loss of habitat	Develop outside Important Bird Areas	Bidco
Soil erosion and siltation	Leave a buffer zone of 200m between the development and the lake	Bidco

4.6 HYDROLOGY

4.6.1 Water resources

Water sources on Bugala Island are numerous and comprise protected and unprotected springs; protected shallow wells; gravity water systems; roof rainwater harvesting; Lake Victoria; boreholes and streams. A summary of the location of water sources is provided in table 16 in the EIS main report.

The average safe water coverage in the district is 47 %. Most of these water sources (springs, shallow wells, gravity water system and streams) are connected to the unconfined aquifers, which depend heavily on ground water recharge. The shallow wells are 3-5 m deep and the boreholes are about 30 m deep. This suggests the unconfined aquifers can be between less than 1 m to several m deep depending on the location; near the shores or near the ridge.

Impacts of development on hydrology are tabulated below. Details of hydrological analysis are provided in Section 4.6.3 of the EIS main report.

Table 4: Potential impacts, mitigation measures and implementing institution

Potential impacts	Mitigation measures	Implementing Institution
Lowering of water table	Provision of boreholes Utilisation of lake water	Bidco District local government
Climatological change (strong wind and erosion)	Retain forest cover along lake shores, streams and head waters	Bidco
Soil erosion and runoff	Incorporation of good mechanical and agronomic soil and water conservation systems	Bidco

4.7 AQUATIC ECOSYSTEM AND FISHERIES

4.7.1 Aquatic habitat types

Bugala Island has generally straight shore with wide, open bays. The north to south orientation of the eastern arm of the island exposes its eastern shores to the wind effects of the prevailing South East Trade winds (SET). The exposure is, however, considerably reduced towards the south by the other islands of the Ssese group. The northern shoreline of the entire island is exposed to the open lake with generally weaker local windstorms. Extensive forest cover especially along the lakeshore shelters the inshore zone of the island from offshore winds. The above features contributed to the evolution of the habitats of the inshore aquatic ecosystems and their characteristic biota including fish.

Results of baseline water quality parameters around the shores of the oil palm project area (see table 22 and 23 of the EIS main report) reflect a healthy ecosystem rich in oxygen and having a generally desirable mix of nutrients.

Baseline data on the species richness and relative abundance of the phytoplankton community along the shores of the proposed Oil Palm nucleus estate is detailed in table 24 of the EIS main report. The preponderance of cyanobacteria over green algae and the diatoms is a reflection of the tendency to eutrophication in some parts of Lake Victoria

Baseline data on species richness and relative abundance of the zooplankton community along the shores of the proposed oil palm nucleus estate are detailed in table 25 of the EIS main report. A total of 23 species of zooplankton was recorded.

Baseline data on species richness and relative abundance of the macro-invertebrate community along the shores of the proposed oil palm nucleus estate on Bugala Island are detailed in table 26 of the EIS main report. 12 species of macro-invertebrates were recorded.

A total of seven fish species belonging to three families were recorded during the survey (see details in table 27 of the EIS main report). *Lates niloticus* was the most abundant both by number and weight. Fish species richness and relative abundance recorded tentatively demonstrate the expected dominance of young *L. niloticus* in the experimental area

Overall the aquatic ecosystems in the areas sampled were considered relatively healthy. The preponderance of *L. niloticus* in the fishery explained the low number and variety of haplochromines, which are the preferred food of the adult predator *L. niloticus* is also often blamed for the serious decline of indigenous fishes such as *B. docmac*, *C. gariepinus* and *P. aethiopicus* in the commercial catches

No endangered or threatened taxa (on the IUCN Red List) were found

4.8 SOCIO-ECONOMIC EVALUATION

4.8.1 Method of study

Socio-economic evaluation was progressed through interviews with individuals, interest groups, and organisations in Bugala and elsewhere. The list is given in Appendix 8 of the EIS.

4.8.2 Background

4.8.2.1 Population

The population of Bugala Island consisting of 3 sub-counties stands at 17,312 while that of the entire Kalangala District is 36, 661 according to the 2002 population census. A breakdown of the population is given in table 30 of the EIS. The population structure of the district is further broken down in table 31 of the EIS main report. It was noted that 45% of the population in Kalangala District falls between 20-45 years. This translates into a work force of 17,000 that satisfies the labour requires of the oil palm project projected at 2000 individuals. However, adequate skilled labour may not necessarily be available on Bugala, given the low educational levels on the island. Other districts might be relied upon for some skilled labour.

A total of about 2000 people (males and females) have registered to participate as smallholders.

4.8.2.2 Economic activities/employment

The population on Bugala Island is largely employed in the fishing, pit sawing and agriculture sectors. Individuals in the agriculture sector are mainly subsistence farmers. Coffee is also grown for cash

4.8.2.3 Land tenure system

The current land tenure system in the area includes leasehold, public and private mailo land. The majority of the residents in the area do not have land titles but are 'Bonafied occupants' (have occupied and utilised or developed land unchallenged by the registered owner or agent of the registered owner for twelve years or more or) Bonafied occupants can transact business by using land as security

4.8.3 Issues identified

4.8.3.1 Land consolidation

Consolidation of smallholder plots might be preferred in order to enhance yields through efficient management. This will ensure easy manoeuvring equipment, provision of extension services to small holders by management of the nucleus estate, and collection of fresh fruit bunches. Consolidation of smallholder plots will involve voluntary acceptance by individuals o vning plots available for oil palm development. Homesteads will not be moved/relocated in the pr cess of the loose consolidation of the plots

The present settlement structure on Bugala Island that is characterised by settlements along roads and on the lakeshore easily suits land consolidation; and contagious blocking with the nucleus estate

4.8.4 Impacts

Both negative and positive impacts of the oil palm project on the socio-economic setting on Bugala Island were identified and mitigation measures proposed. Negative impacts include increased pressure on food and energy resources, strain on social services (water, medical facilities), housing and working arrangements (during construction of roads and other infrastructure) and social dynamics (HIV/AIDS prevalence). Positive impacts include increased employment opportunities, increased income levels, increased investment, improved living standards, and increased revenue for local government and development of infrastructure. Sections 4.8.4 and 4.8.5 of the EIS main report provide details of impacts and mitigation measures respectively.

Below is a tabulated summary of socio-economic impacts and mitigation measures associated with the oil palm project.

Table 5:- Potential socio-economic impacts, mitigation measures and implementing institution

Potential Impact	Mitigation measure	Implementing Institution
Increased pressure on food and energy resources	Development of bye-laws on food production.	District local government
	Improvement of agricultural extension services to ensure	

	higher yields;	
Strain on social services (water, medical facilities)	Plan for a hospital to handle more serious cases in the long term; Construct a health unit within the nucleus estate to handle cases requiring first aid. Provide additional safe water sources.	District local government Bidco
Housing and working arrangements (during construction of roads and other infrastructure)	Provide temporary housing for staff, especially in the initial stages of the project.	Bidco
Social dynamics (HIV/AIDS prevalence)	InitiateHIV/AIDS programmes	District local government Bidco

4.9 AGRO-ECONOMY

4.9.1 Farming systems on Bugala Island

The farming system on Bugala Island is typically of a subsistence nature. There is no evidence of large-scale production. Intercropping is predominant where a number of crops are grown on the same piece of land. The typical average land per family is between 1-5 hectares. Majority of farmers grow cassava for home consumption, but when there is surplus it is sold in unprocessed form. Bananas are usually intercropped with coffee, or in some cases mixed with other annual crops such as beans and yams. Maize and beans are intercropped with sweet potatoes while a small portion of land is devoted to horticultural crops such as cabbages and tomatoes for sell. The coffee plantations seem to have been abandoned as evidenced by the uncared-for trees. Some farmers keep a few chickens or goats and those better off keep a cow.

With the implementation of the project, it is envisaged that the culture of intercropping will have to be modified, in view of the new knowledge acquired.

4.9.2 Economic assessment of standing land values in the project area

Most of the land acquired for the oil palm project is marginal land with regard to its use. Much of it is grassland where a few livestock graze. Other than grazing, the land acquired does not have visible economic activities being undertaken. Therefore, there will be no opportunity costs in turning this land over to palm growing. Indeed, palm production is going to increase the value of the land from UShs. 246,000 paid per hectare by the government to purchase it. The same hectare of land will appreciate to UShs 1,151 288 per hectare in 8 years' time. Further more with oil palm project, one hectare will earn an out grower UShs 3,420,000 in the same year. Thus the land will be utilised better under oil palm than leaving it idle.

4.9.3 Cost/benefit analysis of oil palm growing vis-à-vis other economic activities

4.9.3.1 Economic activities

The main economic activities on Bugala Island include fishing, pit sawing and agriculture. Ninety percent of inhabitants rely on agriculture as revealed by the 2002 population census findings. The fishing activity comes second providing 2000/- (approximately 1USD) a day. Fishing is therefore not a viable alternative since the same calibre of people may expect to earn Ushs 4,000/ per day in oil palm sector (DAO, Kalangala, pers comm).

Tourism that was thought to contribute to the economy of Kalangala District has not been developed fully. The infrastructure including roads, hotels are not adequate for this sector to flourish. However with the oil palm project the road infrastructure will be developed leading to increased possibilities of tourism. However it should be noted that the oil palm project alone cannot do enough to enhance tourism. Other factors such as training personnel, development of beaches, advertising in local and international media would further boost the tourism industry.

4.9.3.2 Analysis of profitability

In order to analyse profitability of oil palm, alternative crops currently grown including cassava, coffee and beans were taken into consideration. It was noted that oil palm has the highest output input ratio, coffee has the lowest gross margin and moreover negative. See table 33 and Appendix 9 in the EIS main report for details.

Both gross and net margins with the project, irrespective of the level of performance, are higher. The return to family labour is also higher with the project. Moreover, the crop by its nature will give a consistent income through out the year to the farmer.

4.9.4 Opportunities in production of oil palm by out growers

Opportunities for oil palm production to outgrowers include a ready market for the crop, production credit for oil palm provided by Bidco, access to technical knowledge in raising oil palm from the nucleus estate through training and provision of elite planting materials. hare in the oil palm company by outgrowers and those working at the estate, participation in the oil palm pricing, corporation through oil palm growers trust and acquiring of legal ownership of land by the outgrowers.

Ecological/Environmental benefits

- Reduction in pressure on the lake due to alternative source of income
- More forest coverage due to oil palm production. Most of land acquired is grassland

Economic benefits

- Saving of foreign exchange

It is estimated that Uganda imports vegetable oils worth about USD 60m of which 75% is palm oil.

At peak production, it is expected the Bugala project alone, will produce about 40,000 tonnes crude palm oil per year, which is equivalent to between USD 14,000,000 to USD 20,000,000 per year.

- Importation substitution

Expected production per year is ffb (tonnes): UShs 180,000/=, palm oil (tonnes): UShs 37,800/=, palm kernels (tones) UShs 7,200

During the project period of 25 years the project will produce 721,680 million tonnes of CPO and 135,996 million tonnes of palm kernels (85,914.28 tonnes of palm kernel oil). This is equivalent to USD 411,357,600 from CPO (at USD 570 per tonne) and; and USD 48,971,139.6 from palm kernel oil

- Improved infrastructure

- Employment
- Settled population due to agriculture
- Alleviation of poverty in rural areas. A total of 3500 families (households) will directly benefit from the project. At peak production, about 190 tonnes of ffb per hectare will be produced, estimated at UShs 3,420,000/= gross revenue or USD 90 per tonne.

Not only Bugala, but also the rest of Uganda should experience improved quality oil on the Ugandan market.

4.9.5 Bottlenecks anticipated

A few drawbacks to the oil palm project include lack of technical knowledge by the outgrowers due to the novelty of the project and keeping up with the payment of credit sourced from the company.

4.9.6 Non-quantified effects of the project

The non-quantified effects are mainly due to externalities. For instance, those people who will participate directly in the project will benefit directly through increased income. The families of the participants will however benefit indirectly. The income received by the participants, particularly if they happen to be heads of households, will assist in the purchase of the household requirements such as food and clothing. Furthermore, the income could be used to improve housing and pay school and medical fees. In this way, the income realised will have a multiplier effect in the economy and in the long run improved welfare of the community. The project is, therefore, expected to have far reaching positive impacts on the communities

4.9.7 Estimates of employment opportunities created by the project

The project is expected to generate employment opportunities at all levels ranging from unskilled to skilled labourer. Personnel will be required for field supervision, management, factory work, and road workers. See breakdown of personnel in table 34 of the EIS main report. Overall, it is expected that the project will generate employment for 2,000 persons earning at least UShs 2,112 billion (USD1, 056 million) per year

4.9.8 Impact of oil palm on other farming activities

Since 90 per cent of the people of Kalangala are engaged in farming activities, growing of Oil Palm is likely to have a very wide impact. In one of the meetings held with a group of farmers in

Kizira village, some of them indicated that if the project were to be implemented, they would shift from growing coffee to oil palm growing. Some, especially the youth, are willing to leave fishing because they felt that the lake has been over exploited. Others felt that the project would bring a lasting solution to the monkey menace and the problems of other pests and rodents due to the intensive nature of oil palm growing.

It is also expected that those farmers who may not participate in oil palm cultivation would benefit in a number of ways. In the first instance, the subsistence farmer is likely to abandon traditional methods of farming in response to the new opportunities that will come with the oil palm project. There is likely to be an increased demand for food stuff, which would have to be met from increased production. Other positive externalities will include, increased purchasing power and a stimulus for the market economy.

4.9.9 Indicators

This project is expected to have far reaching effects on the island. Some of the effects are quantifiable but others are not. This section has concentrated on quantifiable indicators, which can easily to be monitored. The project is expected to have an impact on poverty through employment opportunities such as education, health, infrastructure improvement and food production. See table 35 in EIS main report for details.

4.9.10 Conclusion

The foregoing analysis shows that oil palm represents a much more competitive alternative to existing crops on the Island, creating a major source of employment for the local population with all the attending multiplier effects.

4.10 ECONOMIC ASSESSMENT OF THE ENVIRONMENTAL IMPACTS

4.10.1 Introduction

The project will affect a heterogeneous land use land cover type including crop, forest vegetation and grassland. The environment and natural resource costs of establishing the oil palm estate will therefore be a sum to al of a number of cost elements including (i) the direct loss of standing tree biomass, (ii) loss of tourist attractions and the implied loss of eco-tourism revenue, (iii) loss of carbon sequestration and biodiversity values and, (iv) loss of the community use value of the area including loss of firewood, herbal medicines, wild meat, fodder and thatch. This study involved an estimation of the above losses and their cost-benefit implications.

4.10.2 Economic value of environmental impacts

The proposed project will affect a varied landscape ranging from closed *Piptadeniastrum-Uapaca* medium altitude moist evergreen forests, open moist savanna grasslands, swamp forests, and mixed crop-forest vegetation. These various landscapes provide important sources of sawn timber, various community uses, and biodiversity and carbon sequestration values.

Computation of loss in timber production estimated at 554 hectares revealed a figure amounting to Ushs 14.65 billion.

Community derived value from environmental resources with regard to firewood, building poles, wild game, honey, thatch and non-timber forest products was estimated at Ushs 156,672,000 per year. The loss of this value is estimated for 1,088 households in the impact area.

Biodiversity loss was estimated at Ushs 5.3 billion; while the biodiversity loss was estimated at US $ 5,326,400.

Details on the computation of the above values are provided in sections 4.10.2.1 to 4.10.2.5 of the EIS main report.

Conclusion

In light of the economic benefits to be accrued from the oil palm project as sighted in the economic assessment section of this report. It is imperative that the project is beneficial to the economy in Kalangala district in particular and the country as a whole. With implementation of the mitigation measures sighted under the various environmental components the oil palm project will reduce on environmental loss and be environmentally acceptable.

5.0 ENVIRONMENTAL MONITORING PLAN

A number of mitigation measures were recommended in under the impact analysis section. Mitigation measures were proposed under each of the environmental components discussed which when implemented will eliminate or reduce to acceptable levels the negative environmental impacts of the project. In order to assess the effectiveness of these measures, or to identify further corrective action and to detect any impacts that may not have been identified during the EIA process, it is essential that an Environmental Monitoring Plan (EMP) for the project be implemented. This is also one of the Uganda National Environment Statute (1995) and World Bank requirements.

This EMP define the scope and schedule for monitoring, assigns responsibilities for each of the monitoring activities and provides cost estimates so that the plan will receive funding along with the other investment components.

The EMP is provided in a tabular form below.

Table 6: Baseline monitoring requirements

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
AQUATIC ECOSYSTEM			
Habitat characterisation	One characterisation Survey	Only once	Only once, before beginning of the project
Water quality	Sampling & chlorophyll-a analyses	Quarterly for 12months	
Phytoplankton & invertebrate ecology	Diversity & abundance measurement	Quarterly for 12months	
Fisheries biology and production	Fishery biology & yield assessment surveys	Quarterly for 12months	
VEGETATION/ECOLOGY			
Conservation Status of "interest" flora	Continued and directed surveys in pristine sections of forests	Collection of voucher specimens of interest species for confirmation of identifications at herbarium	As deemed appropriate
HYDROLOGY			
Water Level in wells and streams and Ground water	Monitor water levels in wells and streams and ground water	Measure levels of water in wells, bore holes, and streams and observation wells	Daily until beginning of construction

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
Yields / Flow rates	Monitor trends of the yields and flow rates	Measure shallow well, spring and bore hole yields and stream flow rates	Weekly until the beginning of construction
Water quality	Monitor water quality in the wells, streams springs and the lake	Collect samples from the streams, wells springs and the lake and analyse for TSS, SS and nutrients, pH	Monthly until the beginning of construction
Fish species, number and catch	Monitor the trends in fish species, number and catch and restock where necessary	Fish stock survey. Fish catch evaluation	Weekly until beginning of construction
AVIFAUNA			
Avifauna of Outer Ssese islands	A survey of avifauna of other islands that form part of Kalangala District	Detailed TSCs, mist-netting and point counts should be carried out at representative habitats and various sites within the remaining islands.	Four days a month for eight months before clearing stage.
LAND USE/COVER			
Decline in natural habitats such as forest, wetlands	Accurate information on extent and quality of representative habitats	Satellite/aerial photographs	Every 2 years

Table 7: Monitoring requirements during establishment

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
Mammals			
Loss/conversion of habitat	Some areas of natural habitat types need to be maintained in the plantation area	Species composition and relative abundance need to be monitored in both the converted areas and in the natural areas	At least twice before start of project, and thereafter once every six months (dry and wet season).
Some mammals potentially pests	Pest-control strategy needs to be worked out in conjunction with UWA and the Local Government	Specific monitoring should be focused on the plantation/crops for any crop-raiding by mammals	Twice a year, during growing and harvest/ripening season
Butterflies			
Loss/conversion of habitat	Habitat for endemic/restricted range species should be protected where it is established the species exist in the project area	Species composition in different habitats needs to be monitored with specific focus on endemic and restricted range species	Twice before habitat conversion, and thereafter twice
Poisoning in case of pesticide use	Use of pesticides should be limited especially in areas where restricted range or endemic species occur	Survey should be conducted on general species composition and relative abundance before and after	Twice every year

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
	endemic species occur	any use of pesticides	
Amphibians and reptiles			
Loss/conversion of habitat	Habitat integrity especially at the lakeshores need to be protected	Species composition and distribution need monitoring before and during the project period	Once before project starts, at least twice a year during project period
Alteration of habitat quality	Monitoring of habitat quality especially hydrology, vegetation and water level in semi-aquatic habitats	Habitat quality needs to be determined before start of project and constantly during project period	Once before start of Project, and once every year during project period.
INDUSTRIAL CHEMISTRY/ OCCUPATIONAL HEALTH			
Accidents and ill-health while clearing land	Appropriate tree felling methods (power-saws etc): use of trained personnel and appropriate farm machinery (trained tractor drivers and maintained tractors)	Record – keeping of accidents and maintenance records. Inspection of tools, records of ill-health	Weekly
Degradation of air quality	Prevent dust emissions: plough field – wet soil conditions preferred.	Visual assessments of air quality; and dust on crops personal air sampling if necessary	Daily visual assessment; weekly collection of complaints
Noise from farm machinery	Timing of noisy activities during field clearing and ploughing	Monitor working hours; monitor residents complaints	Daily checks, weekly collection of complaints
Field planting	Proper dispensing of rock phosphate from store to field; collection of polythene bags holding seedlings before holing proper disposal of polythene bags	Physical and visual checking	Throughout field planting operations
Upkeep of immature & mature oil palm (use of herbicides)	Controlled use (dispensing etc) of paraquat dichloride and glyphosate; Use of safety gear while carrying out circle spraying in nucleus estate. Personal hygiene practice. Training	Determination of total cholinesterase level among sprayers	Every 6 months
Removal of young male and female inflorescences (Ablation/Castration)	Regular removal by hand gloves initially and use of ergonomic chisel for adult plants	Checking on gloves and inspection of chisels	Monthly
Harvesting/pruning	Use of ergonomic knives firmly fixed on poles for cutting fronds, and stacking	Maintenance and inspection of tools record keeping of ill-health	Monthly

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
	fronds in designated areas		
During construction of oil mill			
Access to site	Constructions of safe means of access	Monitor routes and construction equipment	Daily
Falls and ill-health during construction	Proper excavation methods. Use of scaffolds and safe means of access; Proper use of raising and lowering equipment-mechanical; Provision of first-aid and all necessary personal protective equipment	Systematic keeping of all records and daily activities, accidents and maintenance of personal protective equipment	Daily at commencement then weekly till end of construction.
Construction Noise	Timing of noisy activities	Monitoring working hours; monitoring residents' complaints.	Weekly checks on working hours and monthly collection of ill-health records
Access to site	Constructions of safe means of access	Monitor routes and construction equipment	Daily
Falls and ill-health during construction	Proper excavation methods; Use of scaffolds and safe means of access; Proper use of raising and lowering equipment-mechanical. Provision of first-aid and all necessary personal protective equipment	Systematic keeping of all records and daily activities, accidents and maintenance of personal protective equipment	Daily at commencement then weekly till end of construction.
Construction Noise	Timing of noisy activities	Monitoring working hours; monitoring residents' complaints	Weekly checks on working hours and monthly collection of ill-health records
AQUATIC ECOSYSTEM			
Water quality, phytoplankton & invertebrate ecology	As above without habitat survey	Monthly for at least 12 months	
Fisheries biology and production	As above without habitat survey	Monthly for at least 12 months	
SOCIO-ECONOMIC			
Food shortage	• District to encourage community to produce more • Improved agricultural extension services	• Number of campaigns for grow more food crops	
	• By law on minimum	• By laws	

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
	household food production		
	• Land allocated for food crop production • Intercropping of food crop with oil palm trees	• Visual inspection	
Strain on medical services	• Establish medical unit in the nucleus estate • Providing mobile medical facilities • Strengthening medical facilities near the project area	• Medical facility observed at the nucleus estate • Mobile medical facilities observed • Medical facilities near project area have drugs, basic equipment and trained basic staff	
Increase in incidence of HIV /AIDS	• Projects starts HIV/AIDS in the workplace programme • District expands HIV/AIDS programme to the project area	• Number Project HIV/AIDS education and awareness materials and campaigns • District HIV/AIDS campaigns and materials • Incidence of people diagnosed with HIV/AIDS in the nearby health units • Number of HIV/AIDS death cases in health units	District Authorities, BIDCO
Increased sanitation / hygiene related diseases	• Hygiene and sanitation campaign programmes by project / district • Increased safe water coverage	• Hygiene and sanitation awareness materials • Observation of good practices of hygiene and sanitation • % Increase in safe water coverage. • Number of hygiene and sanitation campaigns • Number of incidences and death cases due to hygiene and sanitation related diseases	
Increased cases of criminals, prostitutes, alcoholism	• Establish recreational facilities • Establish a police post • Encourage income generating activities for those not participating in the project	• Observation of recreational facilities • Observation of a police post • Number of men and women engaged in income generation activities but are not participating in the project activities.	
Depletion of energy resources /increase in	• Establish awareness programmes on energy	• Observation of energy saving cook stoves	

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
charcoal burning	saving cook stoves	• Number of awareness campaigns and awareness material on energy saving devices/ cook stoves	
VEGETATION/ ECOLOGY			
Woody debris disposal	Conversion of woody debris into timber, fuel wood or charcoal	Ensure proper disposal of woody debris as suggested	Every 2 months
Sensitive natural systems e.g. riverine forests	Should be preserved in their pristine state	Ensure regular checks on workers to ensure they don't cut down such areas.	As the project goes on
Soil erosion Control	Reduce erosion to minimum levels thru planting *Calliandra* and *Pueraria* as cover crop or *Paspalum* on road sides	Visual and on-spot inspection of project area	Every 2 wks
Removal of existing natural vegetation	Slow and gradual process to reduce adverse environment effects	Ensure close supervision of exercise	As the processes go on
Decline in timber production	Encourage forestation initiatives among the local people. Ensure sustainable utilisation of forest resources from production zones of forest reserves under FD	Ensure people pick up recommended forestation programmes in order to be able to meet their energy requirements.	As the project goes on
HYDROLOGY			
Water Resources	Provide alternative supplies to well, spring and steam where necessary	Monitor quality and yield of alternative supplies; monitor yields/flow rates, water levels, of original water sources and ground water levels, keep complaint records	Weekly
Water Quality/release of suspend matter from soil erosion	Settlement ponds, containment	Visual checks and laboratory measurements of suspended matter	Daily visual inspection, weekly laboratory sample analyses upstream and down stream
Water quality Contaminant spills run off	Containment good handling practices	Visual and laboratory checks of downstream water quality, inspection of handling practices and storage facilities	Daily visual inspection of oil, fuel and grease, weekly laboratory checks for oil, fuel grease, acids and other chemical.
Fish stock, numbers and catch	Monitor and restock where necessary	Fish stock survey Fish catch evaluation	Weekly

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
AVIFAUNA			
Relative abundance & species richness	Survey of key species	Mist-netting, TSC & visual observation	Every six months
Release of suspended solids	Construction of Settlement ponds & ditches, no clearing vegetation along the lakeshore	Visual checks and laboratory measurement of suspended matter; presence of water birds	Monthly samples
Degradation of habitats	Controlled & systematic habitat clearance	Habitat patches & corridors to be monitored	Visual assessments & collection of complaints.
Breeding colonies of birds	Implement mitigation measures	Monitor breeding pairs and nests in the breeding grounds	Every six months
LAND USE/COVER			
Large scale clearance of private forests	Establishment of other similar areas of forest elsewhere	Satellite/aerial photographs	Annual
Loss of wetland areas	Avoidance of wetland area; 200m strip left intact at the lake shoreline, a 30m strip at riverbanks .	Satellite/aerial photographs	Annual

Table 8: Monitoring requirements during operational phase

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
INDUSTRIAL CHEMISTRY/OCCUPATIONAL HEALTH			
Noise	Monitor noise levels, working hours and complaints, use of hearing protective devices, preventive maintenance of equipment	Some level meter	Monthly; audiometric testing annually
Air quality	Use of appropriate dust masks. Priority given to technical control of dust generated i.e., efficiency and effectiveness of fans cyclones etc	Personal dust samplers	Annually, including lung function testing (vitalography) if necessary
Traffic safety	Defined routes and speed limits	Visual checks of driver behaviour, accident record	Maintenance and accident records. Random checks of drive behaviour
Boiler plants	Upwind from sources of flames, separation from hazardous areas. Statutory examination and	Inspection following maintenance	During installation weekly and keeping of records

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
	certification.		
Waste-water treating facilities	Peripheral location: down mind from concentration of people	Inspection of plant lay out design	Before constructions and monthly
Storage tanks	Separation of tanks from each other tanks from other facilities	Inspection of plant layout - design stage.	Prior to construction and monthly
Pipe alleys	Looped arrangement of fire fighting water, cooling tower, boiler fed water and water steam	Inspection of plant lay-out	Prior to cons traction
Electrical power lines	Below ground if possible avoid passing over facilities looped arrangements for critical user.	Inspection of installation drawings	Prior installation and weekly, or monthly.
Fire hydrants or monitors, safety showers, hose carts; other fire fighting equipment.	Close but not too close to the hazardous areas; no obstruction for monitors; good path for retreat.	Visual and critical inspections and examinations	Monthly for the hydrants annually for fine extinguishers, randomly for readiness and fitness
Water quality contaminant spills/run off	Containment: good handling practices	Laboratory checks of water quality including final effluent release from sedimentation pond	Weekly at beginning then monthly for all necessary characteristics others tests on ad hoc basis.
AGRO-ECONOMICS			
Poverty reduction through increased employment opportunities	Survey on • Number of people formally employed • Increased income	Survey	2nd year, once
Poverty reduction through agriculture	Survey on • Number of people in agriculture • Rate of monocropping • Modernisation of farms • Number of farmers growing palm oil		4th year, once 7th year, once
Impact on livelihoods	Survey on • Number of people engaged in fishing sector	District Authorities	

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
Enhanced health services	Survey on • Number of health centres • Number of dispensaries • Number of trained personnel	District Authorities	
Improvement in education services	Survey on • Increased level of literacy • Increased no of primary and secondary schools	District Authorities	
AQUATIC ECOSYSTEM			
Monitoring during first two years of oil palm plantation development Water quality Phytoplankton & Invertebrate Ecology Fisheries biology and production	As above	Quarterly for 24 months	
Monitoring during palm oil production Water quality Phytoplankton & Invertebrate Ecology Fisheries biology and Production	As above	Monthly till production peaks	
Factory effluents	Factory effluent monitoring		
VEGETATION/ ECOLOGY			
Sensitive natural systems e.g. riverine forests	Should be preserved in their pristine state	Ensure regular checks on workers to ensure they don't cut down such areas.	As the project goes on
Soil erosion control	Reduce erosion to minimum levels through planting *Calliandra* and *Pueraria* as cover crop or paspalum on road sides	Visual and on-spot inspection of project area Planting of cover crops	Every 2 weeks
Decline in timber production	Encourage forestation initiatives among the local people. Ensure sustainable utilisation of forest resources from production	Ensure people pick up recommended forestation programmes in order to be able to meet their energy requirements.	As the project goes on

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
	zones of forest reserves under FD.		
HYDROLOGY			
Water Resources	Monitor and provide alternative supplies to well. spring and steam where necessary	Monitor yields/flow rates. water levels. of original water sources and ground water level: keep complaint records	Weekly
Water quality/release of suspended matter from soil erosion	Settlement ponds: containment. during the first year until situation reverts to normal	Visual checks and laboratory measurements of suspended matter	Monthly laboratory sample analyses upstream and down stream
Water quality: Contaminant spills/runoff	Containment. good handling practices	Visual and laboratory checks of downstream water quality; inspection of handling practices and storage facilities	Daily visual inspection of oil, fuel and grease; Monthly laboratory checks for oil, fuel, grease, acids and other chemical;
Fish stock. numbers and catch	Monitor and restock where necessary	Fish stock survey: Fish catch evaluation	Monthly in the first two years thereafter quarterly
AVIFAUNA			
Avitourism	Implement Tourism action plan	Monitor tourist number in Bugala Island & calculate annual tourism revenue	Tourist records to be kept by month
Use of pesticide	Controlled use of pesticides	Monitor bird poisoning: relative abundance	Daily observation
Public Education Programmes	Sensitising local communities	Good environmental practises by the communities	Every three months
LAND USE/COVER			
Large scale clearance of private forests	Establishment of other similar areas of forest elsewhere	Satellite/aerial photographs	Annual
Loss of wetland areas	Avoidance of wetland area	Satellite/aerial photographs	Annual

Monitoring agencies and cost estimates

Table 9: Responsibilities and cost estimates for monitoring programme

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
Mammals			
Loss/conversion of habitat	Species composition and relative abundance in both the converted	Forest Department/UWA,	5,000/year

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
	areas and natural areas	BIDCO	
Some mammals potentially pests	Specific monitoring should be focused on the plantation/crops for any crop-raiding by mammals	MAAIF. UWA. Local Govt	2,500/year
Butterflies			
Loss/conversion of habitat	Species co: position in different habitats, v : h specific focus on endemic and restricted range species	Forest Dept., MAAIF. UWA	4,000
Poisoning in case of pesticide use	Survey on general species composition and relative abundance before and after any use of pesticides	MAAIF. UWA. Forest Department. BIDCO	
Amphibians and reptiles			
Loss/conversion of habitat	Species composition and distribution before and during the project period	Forest Dept., UWA. Developer. Consultant	4,000
Alteration of habitat quality	Habitat quality needs to be determined before start of project and constantly during project period	MAAIF. Directorate, Wetlands Inspection Division/MWLE	
AGRO-ECONOMICS			
Poverty reduction through increased employment opportunities	• Number of people formally employed • Increased income	District Authorities	1,800
Poverty reduction through agriculture	• Number of people in agriculture • Rate of monocropping • Modernisation of farms • Number of farmers growing palm oil	District Authorities	1,800 x 2 = 3,600
Impact on livelihoods	• Number of people engaged in fishing sector	District Authorities	
Enhanced health services	• Number of health centres • Number of dispensaries • Number of trained personnel	District Authorities	
Improvement in education services	• Increased level of literacy • Increased no of primary and secondary schools	District Authorities	
AQUATIC ECOSYSTEM			
Habitat characterisation	One characterisation survey:	FIRRI	500

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
Water quality	Sampling & chlorophyll-a analyses.	FIRRI	10,000
Phytoplankton & invertebrate ecology	Diversity & abundance measurement	FIRRI	3,000
Fisheries biology and production	Fishery biology & yield assessment surveys	FIRRI	12,000
Water quality Phytoplankton & invertebrate ecology	As above without habitat survey	FIRRI	100,000
Fisheries biology and production	As above without habitat survey		
Monitoring during first two years of oil palm plantation development • Water quality • Phytoplankton & invertebrate ecology • Fisheries biology and production	As above	FIRRI	50,000
Monitoring during palm oil production • Water quality • Phytoplankton & invertebrate ecology Fisheries biology and production	As above	FIRRI	Approx. 200,000
Factory effluents	Factory effluent monitoring	FIRRI	
SOCI-ECONOMIC			
Increased cases of criminals, prostitutes, alcoholism	• Establish affordable recreational facilities • Strengthen police/law enforcement units • Encourage income generating activities for those not participating in the project	District Authorities, BIDCO, VODP	20,000
Depletion of energy resources /increase in charcoal burning	• Establish awareness programmes on energy saving cook stoves.	District Authorities, BIDCO	2,000
Increased HIV/AIDS infection	• Strengthen the district HIV AIDS programme • Establish workplace HIV /AIDS programme	BIDCO	15,000

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
Increased hygiene and sanitation diseases	• Hygiene and sanitation campaigns	2,000	District
	• Increase safe water sources	65,000	GOU
Strain on medical services	• Mobile medical units	VODP	-
	• Strengthened medical services	District /GOU	
	• Establish more medical units	GOU	
Food shortage	• Improved agricultural extension services	District	5,000
	• Grow more food campaign	District / VODP	
VEGETATION/ ECOLOGY			
Woody debris disposal	Ensure proper disposal of woody debris as suggested	Forest Department (FD); District Environment Office (DEO)	8,000
Sensitive natural systems e.g. riverine forests	Ensure regular checks on workers to ensure they don't clear such areas	BIDCO, District Agriculture Office (DAO), District Environment Office (DEO)	2,000
Soil erosion Control	Visual and on-spot inspection of project area	DAO & DEO	2,000
Displacement of existing land cover	Ensure close supervision of exercise	DAO & DEO	2,000
Decline in timber production	Ensure afforestation programmes in order to meet energy requirements	FD & DAO	5,000
LAND USE/COVER			
Decline in natural habitats such as forest, wetlands	Accurate information on extent and quality of representative habitats	Forest Department, District Authorities, NEMA	2,000/2years
HYDROLOGY			
Ground Water table	Measure Ground water levels	BIDCO	500*12 = 6,000
Well, spring and stream water levels	Measure water levels in the wells and streams	DWD WRAP, Entebbe	500*12 = 6,000
Water quality	Sampling and measurement of TSS, nutrients, soil particle sizes, visual SS assessment and laboratory analysis	DWD WRAP, Entebbe	1,000*12 = 12,000
Yields	Discharge rates and levels in springs and wells	BIDCO	500*12 = 6,000
Conservation structures	Visual assessment of	District Agricultural	100*12 = 1,200

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
	performance of system, dimension recording	Office Kalangala	
Stream flow	Discharge measurement of streams	BIDCO	500*12 = 6,000
Fish stock, numbers and catch	Monitor the trends in fish spices, number and catch	Fisheries Department, Entebbe	300*12 = 3,600
AVIFAUNA			
Avifauna of other Ssese Islands	Detailed TSCs, Mist-netting and point counts should be carried out at representative habitats and various sites within the remaining Islands.	MUIENR, Nature Uganda, Environmental Officer	20,000
Relative abundance & species richness	Mist-netting, TSC & visual observation	MUIENR/Forest Department.	8,000
Release of suspended solids	Visual checks and laboratory measurement of suspended matter; presence of water birds	DWD WRAP,	3,000
Degradation of habitats	Habitat patches & corridors to be monitored	MUIENR, NEMA, Nature Uganda, Forest Department	2,000
Breeding colonies of birds	Monitor breeding pairs and nests in the breeding grounds	Nature Uganda, MUIENR	4,000
Avitourism	Monitor tourist number in Bugala Island & calculate annual tourism revenue	UTB, Nature Uganda	2,000
Use of pesticide	Monitor bird poisoning; relative abundance	Environmental Manager, NEMA, Ministry of Agriculture, WARM	5,000
Public Education Programmes	Good environmental practises by the communities	NEMA, Environmental Manager, District Environment Officer	50,000
GENERAL			
Environmental impacts of roads development	EIA for roads development	BIDCO	20,000
Environmental impacts of powerlines installation	EIA for powerlines	BIDCO	20,000
Effective implementation of Environmental Management Plan	Employ environmental manager	BIDCO	24,000 per year

THE REPUBLIC OF UGANDA

Ministry of Agriculture, Animal Industry and Fisheries
Vegetable Oil Development Project

ENVIRONMENTAL IMPACT STATEMENT

FOR THE PROPOSED OIL PALM PROJECT, BUGALA ISLAND, KALANGALA DISTRICT

October 2003

VOLUME II: MAIN REPORT

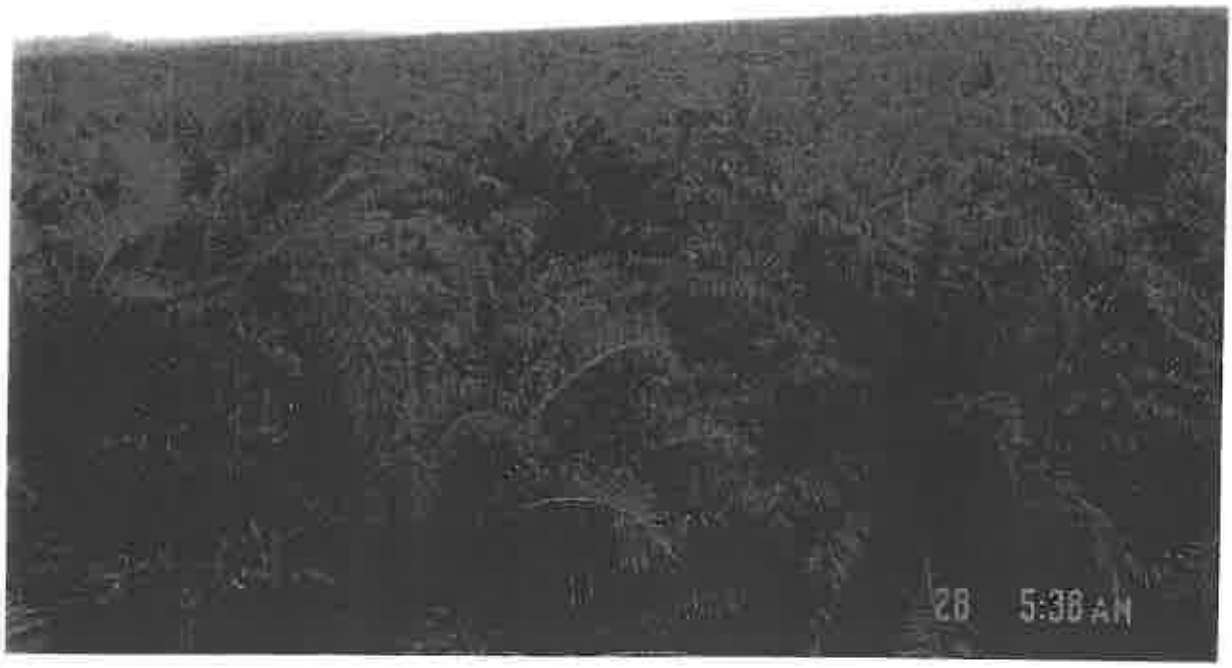

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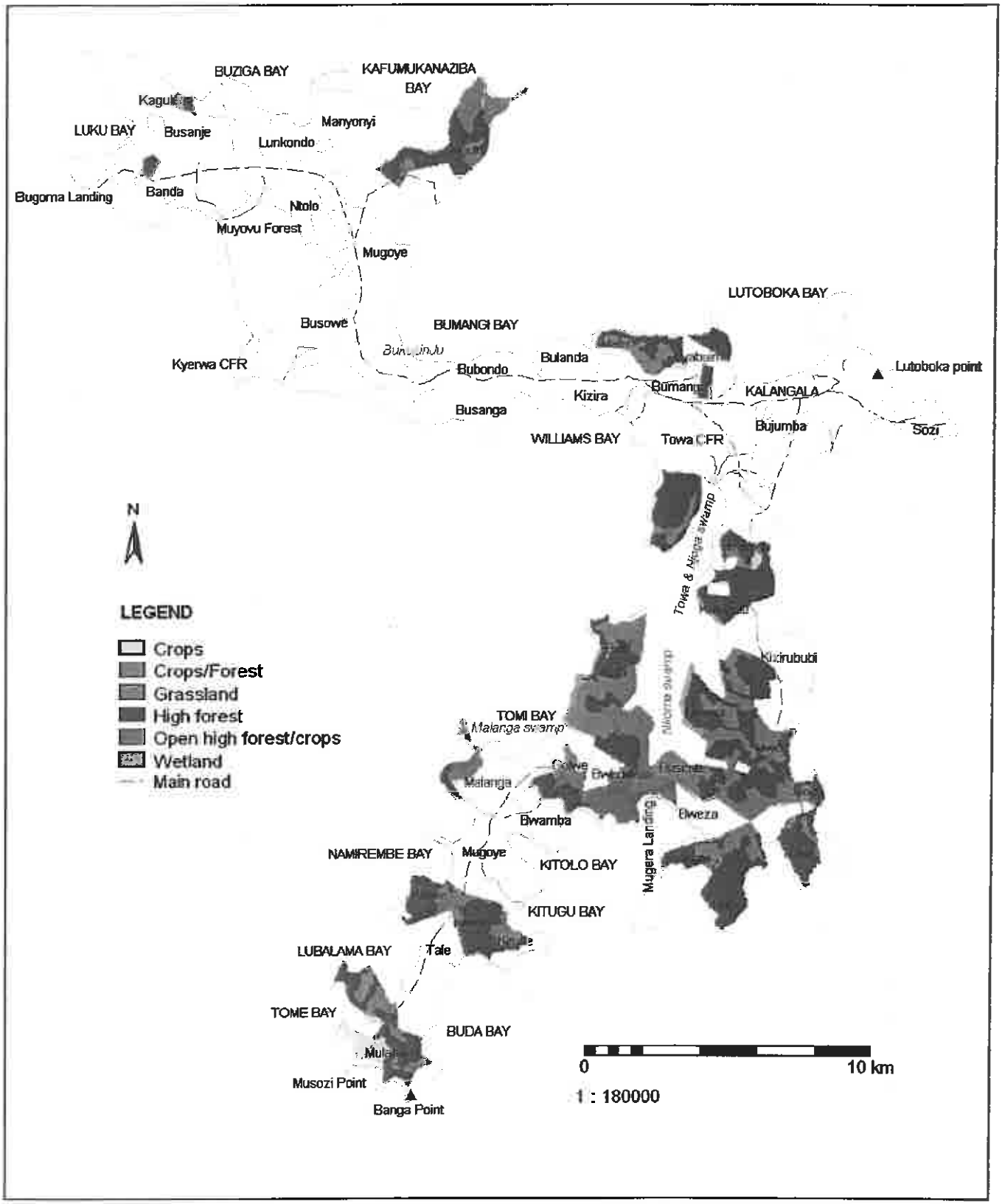
Figure 9: Map showing land use/cover of areas for oil palm development



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Many thanks go to all those who contributed in various other ways to the successful completion of this assessment.

LIST OF ABBREVIATIONS

BIDCO	BIDCO Oil Refineries Limited
CAO	Chief Administrative Officer
CPO	Crude Palm Oil
CSERGE	Centre for Social and Economic Research on the Global Environment
DAO	District Agriculture Officer
DEO	District Environment Officer
DWD WRAP	Directorate of Water Development Water Resources Assessment Programme
DWD	Directorate of Water Development
EACL	Environmental Assessment Consult Limited
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
FD	Forest Department
ffb	fresh fruit bunch
FIRRI	Fisheries Resource Research Institute
GIS	Geographical Information System
GPS	Geographical Positioning System
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
LC	Local Council
LVEMP	Lake Victoria Environment Management Programme
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MFPED	Ministry of Finance, Planning and Economic Development
MOWTC	Ministry of Works, Transport and Communication
MUIENR	Makerere University Institute of Environment and Natural Resources
MWLE	Ministry of Water, Lands and Environment
NEMA	National Environment Management Authority
NES	National Environment Statute
PMA	Plan for Modernisation of Agriculture
POME	Palm Oil Mill Effluent
SET	South East Trade Winds
SS	Suspended solids
TSC	Timed Species Counts
TSS	Total Suspended Solids
UIA	Uganda Investment Authority
UTB	Uganda Tourism Board
UTM	Universal Transverse Mercator
UWA	Uganda Wildlife Authority
VODP	Vegetable Oil Development Project
WARM	Wild Animal Resources Management, Faculty of Veterinary Medicine
WHO	World Health Organisation

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1.0 INTRODUCTION

1.1 PURPOSE OF THE ENVIRONMENTAL IMPACT STATEMENT

This report, called an Environmental Impact Statement (EIS), presents the results of an assessment of the environmental implications of a proposed Oil Palm Development Project (OPDP), on Bugala Island, Kalangala District. The Oil Palm Development Project (referred to, for reasons of convenience, in this document as the Oil Palm Project) is a component of the Vegetable Oil Development Project (VODP) implemented by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF).

This EIS has been prepared as part and parcel of the project planning and design process for the development, to be jointly submitted by the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) and Bidco Oil Refineries Limited to National Environment Management Authority (NEMA) for review of its environmental implications and subsequent approval. The Oil Palm Development Project will comprise an oil palm plantation, oil mill, seedling nursery and related infrastructure including internal roads for collection of fresh fruit bunches (ffb), housing for workers, schools, health facilities, and electricity. Large-scale agriculture such as the oil palm project is provided for in Statute Supplement No. 3, (1995) and listed within Schedule 3 of the National Environment Statute (NES) (1995); as requiring environmental impact assessment (EIA). EIA for roads and food processing plants is also provided for in Schedule 3 Sections 3 and 9 of the NES respectively. This EIS has been therefore prepared in accordance with the requirements of the NES. It is the opinion of the developer that sufficient and relevant information on the development has been provided to allow NEMA and the Lead Agencies to 'establish whether or not the activity is likely to have significant impact on the environment' (NEMA 1997).

The purpose of the environmental impact statement is to

- Explain the need for the project;
- Describe the physical characteristics, scale and design of the project;
- Examine the existing environmental character of the application (proposed) site and the area likely to be affected by the oil palm project;
- Predict the possible environmental impacts of the oil palm project;

- Describe measures that will be taken to avoid, offset or reduce adverse environmental impacts;
- Describe measures that will be taken to enhance environmental management at the oil palm project site; and
- Provide the public, NEMA, Lead Agencies and other stakeholders with information on the proposals that will assist NEMA in making a decision on the oil palm project planning application.

1.2 PROJECT BACKGROUND

The Oil Palm Project is Government of Uganda's effort to reduce dependence on vegetable oil imports by encouraging domestic production of oil-bearing crops. Despite Uganda's suitable climate, soil and abundant natural resource base, it imports more than 70% of its vegetable oils requirement worth about USD60 million annually.

The project will address rural poverty and increase rural incomes through involvement of small holders in production of oil-bearing crops, cottage processing and fair marketing. In addition, the project will address the health problems of the population through increased vegetable oil intake. Uganda has among the lowest vegetable edible oil intake levels, reported to be 2.3kg/per capita, which is lower than the minimum recommended by World Health Organisation (WHO) of 3.3 kg per capita; and of the world average of 7 kg per capita.

1.2.1 The Oil Palm Project

GoU opted to develop palm oil in some suitable parts of the country because it is estimated that over 75% the country's vegetable oil imports is palm oil and its derivatives.

1.2.1.1 Efficient land utilisation

Oil palm is reported to produce over four times more oil per unit area per year than other oil seed crops being cultivated today (Table 1).

Table 1: Average productivity of various major oil crops

Crop	Oil per ha/year (kg)
Soya bean	351
Cottonseed	188
Groundnut	384
Sunflower seed	504
Rapeseed	556

Sesame seed	178
Palm oil	3,200
Palm kernel oil	454
Copra	356

1.2.1.2 Project objectives

The oil palm project seeks to increase domestic vegetable oil production with particular emphasis on the participation of smallholders and private sector processors.

Specifically, the project seeks to:

- Reduce poverty and increase farmer income by involving smallholder growers in oil palm industry,
- Facilitate the enabling environment to attract private sector investment in oil palm development with a view to reducing imports of vegetable oil and effecting substantial savings in foreign exchange,
- Promote private sector agro-industrial investment through the introduction of industrial oil processing mills with high environmental standards,
- Improve efficiency and impact of supporting services through support for research and extension,
- Promote and facilitate the interaction between the interested parties through the creation of a national industry based and eventually, industry financed consultative body that would advise government on the sub-sectors development priorities.

These objectives are to contribute to the broader sectoral objective of increased agricultural growth, and diversification of the economy as enshrined in the government's Plan for Modernisation of Agriculture (PMA).

1.2.1.3 Project funding and management

The oil palm project is to be co-implemented with major private investment from Bidco Oil Refineries Limited and its partners from Malaysia and Indonesia. Government of Uganda will finance the oil palm development for smallholders and facilitate the enabling environment whilst its partners will finance the nucleus estate and oil mill, and provide technical assistance. World Bank is supervising the project on behalf of IFAD as a cooperating institution.

The total project funding is about USD 155 million, with the following components:

GoU - USD 12 million

IFAD - Ushs. 19.9 million

Private Sector - USD 120 million

Farmers - USD 3.16 million

1.3 REASONS FOR LOCATING THE PROJECT IN KALANGALA

1.3.1 Climatic considerations

Viable commercial production of oil palm requires the following climatic conditions:

- annual rainfall of at least 2,000mm, evenly distributed throughout the year;
- a mean maximum temperature in the range of 29°C – 32°C and a mean minimum temperature in the range of 22°C – 24°C;
- constant sunshine amounting to at least five hours per in all months of the year and rising to seven hours per day in some months.
- Solar radiation of more than 350 calories/cm^2/day.

In Uganda, these conditions are most closely met on the Ssese islands. Climatic conditions on Bugala Island, the largest of the Ssese Islands, has conditions that support viable commercial production of oil palm.

The average annual rainfall of about 2,181mm at Kalangala Town on Bugala is amongst the highest in Uganda. Rainfall is relatively evenly distributed throughout the year, the heaviest rainfall occurs in the periods March-May and November-December. In no month is rainfall less than 100 mm.

The mean annual minimum temperature at Kalangala is reportedly above 18°C and mean annual maximum temperature ranges from 27°C to 30°C.

The effect of low temperature on yields can be severe. The development of cold tolerant hybrids in Costa Rica and elsewhere has enabled oil palm to continue to be viable at 1,000m above mean sea level and above. Being close to the equator, there is relatively little seasonal variation in mean monthly temperature on Bugala, and night temperatures are buffered by the presence of

surrounding lake water. Sunshine amounts to about 6 hours per day with a maximum of 7.3 and a minimum 5.8 with a total of 2,200 hours per year; solar radiation is about 450 cal per cm^2 per day.

1.3.2 Soils and geomorphology

While oil palm can be grown successfully under a wide range of soil conditions, well drained soils with adequate water holding capacity and texture are preferred. A flat, or gently undulating topography is desirable.

From soils surveys carried out on Bugala Island, the soils are suitable for oil palm along the hilltops.

The topography Bugala Island is gently undulating with few slopes. Near to the coast the land is flat and often seasonally flooded. Based on island geomorphology, three groups of soils can be distinguished. These include:

- A low terrace of lake deposits consisting of coarse sands lying below 1,160m and close to the lake level.
- Fine textured soils of the Ssese Red Series (about 1,000 ha) consisting of sandy loams with murram and boulders and a clay content of 40-50%, pH 4-4.5, with extreme deficiencies of magnesium and potassium, and high content of phosphorus; and Ssese Brown Series (about 4,000 ha) consisting of sandy loams with murram and boulders, a clay content of 18.32%, pH<5 and with severe deficiencies of magnesium and potassium. These soils occupy land mostly above 1,220 m.
- A terrace of older lake deposits is located between 1,160m and 1,220m; the western part of the island and Kikwayu Series (Ku) soils (9,000ha) in the eastern and southern regions. Bugoma Series consists of yellow-brown loamy sands with pH 5-6, deficient in magnesium and potassium and moderately fertile. They are currently the most intensively used and suitable soil for oil palm production. The Kikwayu Series consists of yellow-brown loamy sands overlying quartz gravel and laterite with pH<5. It has severe deficiencies of magnesium and potassium and low phosphorus content.

Current farm trials of about 60 hectares scattered on the island have shown good yields, with about 11 tonnes of fresh fruit bunches per hectare at the age of 6–8 years (DAO, Kalangala).

1.3.3 Current land use and availability

Kalangala is one of the least populated districts in the country. On Bugala Island, there are large areas of unoccupied land. From observations most people live in fishing villages along the lake shores. All the land acquired has no settlements.

Previous oil palm tirals

In 1972, Uganda introduced oil palm production in the form of research trials at four locations:

- Kituza in Mukono District;
- Bubukwanga in Bundibugyo District;
- Kalangala in Kalangala District;
- Nakabango in Jinja District.

Kalangala gave the best results during these trials (VODP Appraisal Report, Vol. II, Working Paper I).

1.3.4 Stimulation of development

The proposed project is a deliberate development programme by GoU, intended to stimulate the development process in Kalangala District. Since Tsetse fly infestation in the early 1900s, there has not been any serious development entered by government or private sector on the island. The project is to develop oil palm by the nucleus estate, smallholders and out growers so that, the combined size of the plantation would enable an industrial and economic size palm oil mill to process the produce efficiently, economically and ensure high returns on investment to both small holders/out growers and the private investor, with high environmental standards.

This therefore, means, attempts to locate this project in any other part of the country would mean denial of development to Kalangala people.

1.4 PREVIOUS ENVIRONMENTAL IMPACT ASSESSMENTS

Prior to this EIA, the project has earlier gone through two successful EIA studies since its inception. GoU/IFAD/WB undertook the initial EIA in 1995 and GoU carried out the second in 2000.

1.4.1 EIA of 1995

The 1995 EIA study was conducted in accordance with IFAD's Administrative Procedures for Environmental Assessment with the then Government of Uganda EIA processes and procedures and was carried out to ensure that the proposed project met the requirements of the National Environment Statute 1995 (IFAD Appraisal Report, Volume II, Working Paper No.3). The study assessment process included field visits and extensive consultations with persons in government, NGOs, development partners and the academia.

The key focus study areas included:

- Smallholder farmers;
- Nucleus estate;
- Oil mill; and
- Infrastructure and associated developments.

The impact analysis considered the following areas:

- Identifying possible negative impacts and suggesting mitigation measures;
- Site selection of nucleus estate and processing facility;
- Land clearing;
- Proposed cultivation practices;
- Use of agro-chemicals;
- Effluent treatment of processing plant/ Water Pollution control;
- Solid waste management;
- Air pollution;
- Oil mill energy production; and road rehabilitation plans

In addition, a detailed Environmental Management Plan with costs for the project was prepared in the study report (IFAD 1997 Appraisal Report, Volume II, Working Paper No.3).

1.4.2 EIA of 2000

The EIA was carried out under the premise that the project was to be implemented partly in degraded forest reserves and mostly on former public lands. The plan to use degraded forest

reserves was due to insufficient land being available for the project and this therefore, necessitated an EIA to be carried out, focusing on anticipated change in land use from forest reserves to oil palm plantation. The EIA was, therefore, undertaken to predict the likely negative impacts and propose a comprehensive mitigation plan to address the impacts relating to the proposed conversion of degraded forest reserves to oil palm plantation.

1.4.2.1 Application for planning permission

After the review of the EIS and receipt of comments from stakeholders, two public hearings were conducted, to further gather views and concerns on the project in two venues in Kampala and Kalangala districts.

Despite NEMA's conditional approval of 2001, based on advice from the World Bank, GoU decided not to implement the project in the degraded forest reserves. Instead alternative land was identified for the project.

1.5 GOVERNMENT STRATEGY TO ACQUIRE LAND OUTSIDE GAZETTED AREAS

Government decided to acquire private and former public lands outside gazetted areas and vest the ownership of such land with Uganda Land Commission, for the purpose of oil palm development. A land acquisition task force that involved various key stakeholders was set up in order to ensure that environmental, social and ownership concerns were integrated into the planning process from the onset. Task force members included:

- MAAIF
- NEMA
- MWLE-Chief Government Value and Land Registration Departments
- Solicitor General's Office
- Forestry Department, represented by Kalangala District Forest Officer
- MFPED
- UIA
- VODP
- Kalangala LC 5 Chairperson.

- Kalangala District CAO,
- Kalangala DAO

The land from private mailo landlords is purchased at market value on willing buyer, willing seller basis.

A total of 6,500 ha (see Appendix 1) of land has been acquired in this way for the nucleus estate. The 3,500 hectares to be raised by outgrowers/smallholders has been identified. This brings the total to the 10,000 hectares, which the project requires.

The oil palm project in Bugala will no longer require any reserve forest to be degazetted, nor will any such land be used for the project. All the land acquired is currently not utilised for any agricultural purposes. The proposed oil palm development on Bugala will be in accordance with the Statutory Regulations of Uganda.

2.0 LEGAL FRAME WORK

The proposed oil palm development has been designed to fully comply with national environmental codes and legislations in Uganda and with the World Bank's environmental and social safeguard policies. This chapter sets out the legal framework that provide the have guided the EIA for the oil palm development, including World Bank policies and Uganda's legal requirements on environmental impact assessment.

2.1 WORLD BANK SAFEGUARD POLICIES

The oil palm project will be undertaken by a private developer (BIDCO) and supported by the GoU and IFAD, which aim to address rural poverty and increase rural incomes through involvement of small holders in production of oil palm. The oil palm project is anticipated to have mostly beneficial impacts, as its main objective is to increase domestic vegetable oil production with particular emphasis on the participation of smallholders and private sector. This objective is to contribute to the broader sectoral objective of increased agricultural growth, import substitution and diversification of the economy as enshrined in the government's Plan for Modernisation of Agriculture (PMA).

Due to the nature of the project, which involves natural habitats, transboundary/international water body concerns, the proposed project has been rated Category B under the World Bank's policy on environmental assessment (OP 4.01), requiring a full EIA. The EIA is required to assess the potential impacts associated with the project. In addition to the OP 4.01, the oil palm project has also triggered a number of other safeguard policies as indicated in Table 2.

Table 2: World Bank Safeguard Policies

Policy	Applicability
Environmental Assessment (OP 4.01, BP 4.01)	Yes
Natural Habitats (OP 4.04, BP 4.04)	Yes
Forestry (OP4.36, GP 4.36)	No
Pest Management (OP 4.09)	Yes
Cultural Property (OPN 11.03)	No
Indigenous Peoples (00 4.20)	No
Involuntary Resettlement (OP4.12, BP 4.12)	No
Safety of Dams (OP 4.37, BP 4.37)	No
Projects in International Waters (OP 7.50, BP 7.50,)	Yes
Projects in Disputed Areas (OP 7.60, BP 7.60, GP 7.60)	No

2.1.1 OP 4.01 (Environmental assessment)

The OP 4.01 has been triggered because there is the potential that implementation of the oil palm project may lead to negative environmental impacts. The EA study, however, has determined that there are no potential large-scale, significant or irreversible environmental impacts associated with the project. The potential impacts identified are mainly localized impacts associated with activities to be undertaken (i.e. clearing of degraded natural habitats, oil mill effluent, agro-chemical use), which can be effectively mitigated and are addressed in the EIS. The EIS identifies the major potential environmental issues that could arise as a result of project interventions and proposes measures to be taken to mitigate these effects.

2.1.2 OP 4.04 (Natural habitats)

The OP 4.04 has been triggered due to the potential nature of oil palm activities to border or operate in degraded natural habitats on private land. The project areas under the project encompass a number of natural habitats and may border forests reserves and swamps. Thus, the EIS has identified potential impacts that activities to be undertaken by the project may have on natural habitats, including strategic habitat retention within the nucleus estate. This is in line with OP 4.04 Para. 5. The presence of District environment, Forestry and Agricultural offices in Kalangala underline the institutional capacity available to ensure implementation of mitigation measures in accordance with OP 4.04 Para. 6. Swamps will not be converted to project activities.

2.1.3 OP 4.12 (Involuntary resettlement)

The project may at first glance appear to trigger OP 4.12. Closer scrutiny of the development reveals that there will not be any involuntary resettlement resulting from project activities. The 6,500 ha of land acquired for the nucleus estate is not inhabited. Further outgrowers participating in the project and using a total of 3,500 ha will not be displaced from their homesteads. However for purposes of mechanization and provision of extension services by the nucleus estate, outgrowers may have their individual plots loosely consolidated to provide continuity and contagious blocks. The land earmarked for oil palm production by smallholders is currently not cropped. Through this system, social, economic and environmental risks (including dismantling of production systems, impoverishment due to loss of income sources, weakening of community institutions and social networks) associated with involuntary resettlement will not be experienced. A resettlement policy framework has been prepared by the project in case it becomes necessary to

resettle people, perhaps during road construction or at any stage in case land acquisition, compensation and resettlement of people arises.

2.1.4 OP 7.50 (Projects on international waterways)

The project is location is on Bugala Island in Lake Victoria, which is shared by Tanzania, Kenya and Uganda. The project, therefore, triggers OP 7.50. However, pollution of the lake by the proposed oil mill and oil palm cultivation activities is not envisaged because of various planned mitigation measures (3.9.2.3; Table 38). In addition there are arrangements for the management of Lake Victoria by the three countries through the Lake Victoria Fisheries Organisation (LVFO) and Lake Victoria Environment Management Programme (LVEMP) funded by the World Bank. In the unlikely event that any issues of pollution emerge, the project will notify the member states in accordance with OP/BP 7.50 Para. 2 & 3.

2.1.5 OP 4.09 (Pest management)

The project proposes the use of pesticides in its operations. This activity triggers OP 4.09 Para. 3 and 4. To the extent possible, pest control methods proposed will be biological methods and involve planting of shrubs within the plantation that harbour and encourage the natural parasites of insect pests, use of organic materials for fungal and bacterial disease and manual means of weed eradication. Pesticides will be used at a minimum for the purpose of obtaining economic yields. The pesticides to be used are permissible within the country regulations and are controlled by the Plant Protection Department under MAAIF.

2.2 UGANDA'S LEGISLATION FOR ENVIRONMENTAL ASSESSMENT

The preparation of this EIS has taken into account all the requirements for environmental assessment under Uganda's law, mainly under the National Environment Statute (1995).

2.2.1 The National Environment Statute (1995)

The NES 1995 stipulates that an environmental impact assessment be undertaken by the developer where the Lead Agencies, in consultation with NEMA, are of the view that the project

- may have an impact on the environment,
- is likely to have a significant impact on the environment; or
- will have a significant impact on the environment".

Furthermore, according to the Third Schedule of the National Environment Statute 1995, large-scale agricultural projects and any development that involves food processing must be subjected to an EIA.

Part V (I) of the same Statute further provides for environmental standards. They include standards for air quality, water quality, discharge of effluent into water, control of noise and soil quality. The standards for discharge of effluents into water or on land and minimum standards for management of soil quality have already been developed. The National Environment (Standards for Discharge of Effluent into Water or on Land) Regulations, 1999) and Minimum Standards for Management of Soil Quality Regulations (2001) are in place.

Other regulations that have been developed under Section 108 of the NES include the Environmental Impact Regulations (1998); National Environment (Wetlands, River banks and Lake Shores Management) Regulations (2000), National Environment (Waste Management) Regulations (1999) and Management of Ozone Depleting Substances and Products Regulations (2001).

Regulations 3 to 17 of the National Environment (Wetlands, River Banks and Lake Shores Management) Regulations (2000) give details on the management of wetlands. In Regulation 17 (1), every landowner, occupier or user who is adjacent or contiguous with a wetland shall have a duty to prevent the degradation or destruction of the wetland and shall maintain the ecological and other functions of the wetland.

Regulation 4 of the National Environment (Waste Management) Regulations (1999) describes the sorting and disposal of domestic waste and provides that the generator of domestic waste may, without a licence issued under these regulations, dispose of non-hazardous waste in an environmentally sound manner in accordance with by-laws made by a competent local authority.

The National Environment (Waste Management) Regulations (1999) also directly mentions the application of cleaner production as a means to minimise production of wastes. Regulation 5 (1) states that: A person who owns or controls a facility or premises, which generate waste, shall minimise the waste generated by adopting the following cleaner production methods:

a) Improvement of production processes through:

   i. Conserving raw materials and energy;

   ii. Eliminating the use of toxic raw materials;

iii. Reducing toxic emissions and wastes

b) Monitoring the product cycle from beginning to end by:

i. Identifying and eliminating potential negative impacts of the product;

ii. Enabling the recovery and re-use of the product where possible;

iii. Reclamation and recycling;

c) Incorporating environmental concerns in the design and disposal of a product.

The Executive Director of NEMA may, from time to time, give directions in writing to any person or class of persons, requiring application of specifically stated methods of cleaner production to achieve the goals of cleaner production stated in the directive.

2.2.2 The Water Statute, 1995

The statute provides for the management of water in Uganda and is under the mandate of the Directorate of Water Development (DWD) in the Ministry of Water, Lands and Environment. Section 31, subsection (1) of the Water Statute deals with prohibition of pollution to water and stipulates that a person commits an offence who, unless authorised under this Statute, causes or allows:

- Waste to come into contact with any water;
- Waste to be discharged directly or indirectly into water;
- Water to be polluted

Under section 107, the Water (Waste Discharge) Regulations (1998); the Water Supply Regulations (1999) and the Sewerage Regulations (1999) have been put in place to implement the Statute and are aimed at minimising pollution of public waters by developers and other users.

According to Regulation 4 (1) of the Water (Waste Discharge) Regulations (1998): No person shall discharge effluent or waste on land or into aquatic environment contrary to the standards established under section 27 of the National Environment Statute (1995), that is, The National Environment (Standards for Discharge of Effluent into Water or on Land) Regulations (1999); unless he or she has a permit in the format specified in the First Schedule issued by DWD.

In Part II of the Water Resources Regulations (1998), procedures for applying for a water abstraction permit are detailed.

2.2.3 The Public Health Act (1964)

Section 7 of the Act provides local authorities with administrative powers to take all lawful, necessary and reasonable practicable measures for preventing the occurrence of, or for dealing with any outbreak or prevalence of, any infectious communicable or preventable disease to safeguard and promote public health and to exercise the powers and perform the duties in respect of public health conferred or imposed by this act or any other law.

Section 105 of the Public Health Act imposes a duty on the local authorities to take measures to prevent any pollution dangerous to the health of any water supply that the public has a right to use for drinking or domestic purposes.

The Act further details the location of waste disposal facilities such as solid waste skips and septic tanks in relation to settlements and food points.

2.2.4 The Factories Act (1964)

This Act makes provisions for the health, safety and welfare of persons employed in factories and other places.

In addition, Section 13 of the Act requires that every factory be kept in a clean state, including floors, walls, workrooms and ceilings or top of rooms.

Further, Section 14 (1) states that a factory shall not, while work is carried out, be so overcrowded so as to cause risk of injury to the health of the persons employed therein.

Section 15 provides for ventilation in which effective and suitable provision shall be made for securing and maintaining by the circulation of fresh air in each workroom the adequate ventilation of the room.

Section 16 states that effective provision shall be made for securing and maintaining sufficient and suitable lighting, whether natural or artificial, in every part of a factory in which persons are working or passing.

Sections 19 to 46 in Part V of the Act deals with general provisions of safety in a factory including work in confined spaces and fire safety. For example, in Section 29, no person shall be employed at any machine or in any process, being a machine or process liable to cause bodily injury, unless he has been fully instructed as to dangers likely to arise in connection therewith and the precautions to be observed, and:

a) Has received a sufficient training in work at machine or in the process; or

b) Is under adequate supervision by a person who has thorough knowledge and experience of the machine or process.

Sections 51 to 55 provide for the welfare of persons employed in factories. It requires the provision of protective clothing and appliances for the protection of eyes, ears, nose, and limbs in certain processes and other special applications. It is the duty of the owner of the premises to provide safety of the workers from any dangerous aspect of his establishment at the owner's cost.

2.2.5 The Wetlands Policy (1995)

The Wetland Policy was formulated and adopted by government in 1995. A Wetlands Inspection Division has been created within the Ministry of Water, Lands and Environment in order to enforce the provisions of the policy. The legal framework for implementing this policy is elaborated in the National Environment Statute of 1995 and the National Environment (Wetlands, River Banks and Lake Shores Management) Regulations of 2000. It is pointed out in section 20(1) of the regulations that the following principles shall be observed in the management and conservation of riverbanks and lakeshores:

- Resources on the river banks and lake shores shall be utilised in a sustainable manner;
- Environmental impact assessment is mandatory for all major activities on river banks and lake shores and
- Special measures are essential for the protection of riverbanks and lakeshores such as preventing soil erosion, siltation and water pollution.

Section 30 of these regulations mention that all shores of lakes specified in the Seventh Schedule to these Regulations shall have a protected zone of two hundred meters from the low water mark. Lake Victoria is one of the lakes listed in the seventh schedule to these Regulations.

2.2.6 The Land Act (1998)

Sections 43, 44 and 45 (1) and (2) of the Land Act (1998), state that Government or local government may acquire land in accordance with the provisions of Article 26 and clause (2) of Article 237 of the Constitution of the Republic of Uganda.

A person who owns or occupies land shall manage and utilise the land in accordance with the National Environment Statute 1995 and any other laws binding.

The Government or the local government shall hold land in trust for the people and protect natural lakes, ground water, natural streams, wetlands and any other land reserved for ecological purposes for the common good of the citizens of Uganda.

A local government may, upon request to the government, be allowed to hold land in trust for the people and the common good of the citizens of Uganda.

The Land Regulations (2001) have been put in place to operationalise the Land Act. The Regulations give details on how matters such as application for Certification of Occupancy, converting leasehold into freehold system, formation of Community Land Associations, procedures for paying annual ground rent by bona fide occupants to landlords.

2.2.7 The Uganda Forestry Policy 2001

The Forestry Policy outlines six areas including the context of government policies and priorities; the importance of forestry in Uganda; opportunities and problems in the sector; forest sector guiding principles; the goal of the forestry policy, and a set of policy statements and strategies; and the framework of support for implementing the policy. Policy statement 1 points out that 'the permanent forest estate under government trusteeship will be protected and managed sustainably'. This is one of the factors for proposing the oil palm project to be located outside gazetted forests. Statement 2 points out that 'the development and sustainable management of natural forests on private land will be promoted'. This is in line with the proposal of the oil palm project to maintain sections of forests on areas of the island where the gradient is not suitable for mechanised agriculture. Moreover, it is intended that the project will support the planting of native tree and shrub species in suitable locations on land peripheral to the palm plantations.

In addition, the cultivation of oil palm under the intensive Indonesian system, mulching using palm fronds and suitable ground cover plants produces a forest-like environment where soil erosion, excessive run-off and fertility decline are prevented. When fully mature, the oil palm plantation forms a continuous forest canopy (cover photograph).

2.2.8 The National Forestry and Tree Planting Act, 2003

Legislation regulating the use of forest products is contained in the National Forestry and Tree Planting Act of 2003.

Section 38 requires 'A person intending to undertake a project or activity which may, or is likely to have a significant impact on a forest shall undertake an environmental impact assessment'. This EIA determines likely impacts of the development and proposes mitigation measures.

Section 21(1) states that:

'A person may register with the District Land Board, a natural forest situated on land owned in accordance with the Land Act 1998, or a forest or land in respect of which a licence is granted in accordance with the Act'.

Section 21(2) stipulates 'All forest produce in a natural forest registered under subsection (1) belongs to the owner of the forest and may be used in any manner that the owner may determine, except that forest produce shall be harvested in accordance with the management plan and regulations made under this Act.'

Section 21(3) points out that 'A District Forest Officer may issue directions to the owner of a plantation forest whether registered under subsection (1) or not, requiring the owner to manage the forest in a professional and sustainable manner.

3.0 PROJECT DESCRIPTION

3.1 INTRODUCTION

This section describes the oil palm project components, including access around the site, nursery development, nucleus estate, oil mill processes, smallholder/outgrowers plantation development materials to be used and the entire operation phase.

3.2 Project implementation strategy

The mode of implementation of this project will be based on the already well established, tested and environmentally friendly model used in the Indonesian oil palm industry. A group well versed with this model will be involved in the project set-up.

3.3 THE PROJECT

The Oil Palm Project is to be undertaken on Bugala, the largest of the Ssese Islands, a group of 84 islands located in the Northwestern part of Lake Victoria, just south of the Equator. Bugala is about 7 km from the western shore and about 45 km southwest of Entebbe. The island represents 56% of the total land area of the Ssese Islands, which administratively constitute Kalangala District. The district is named after the town of Kalangala, the main settlement and the site of district government, on Bugala Island. Bugala and the other Ssese Islands have not received any substantial investment in development.

The Oil Palm Project is an undertaking of the GoU and private sector, specifically Bidco Oil Refineries limited. The project will facilitate development of 6,500ha oil palm nucleus estate financed by Bidco. Further development of 3,500 ha of oil palm will be carried out by out-growers/small-holders, with support from IFAD and GoU.

3.4 THE NUCLEUS ESTATE

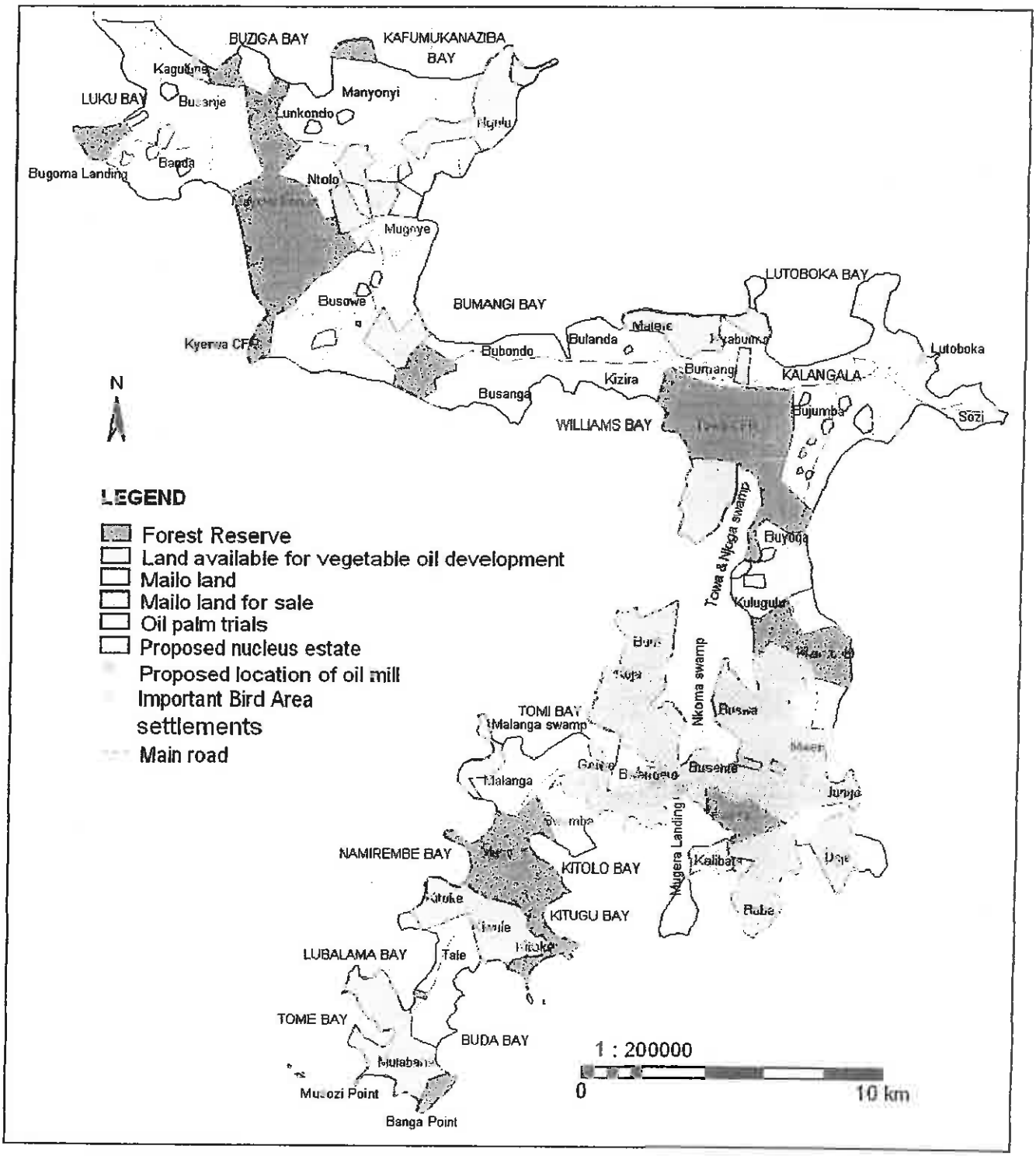
The nucleus estate will comprise of a nursery, an oil mill, oil palm plantation, plantation roads and social infrastructure including schools, a health centre and community hall. Further the nucleus estate will provide the following functions:

- Provision of technical assistance;
- Provision of selected high yielding planting material and other agricultural inputs;

- Purchase of oil palm fresh fruit bunches
- Processing of fresh fruit bunches;
- Marketing of oil; and
- Training of farmers and staff.

Approximately 1,500 ha of land will be put under oil palm in the second year. It is projected that over a period of 10 years 2000 people will be employed in Bugala.

Figure 1: Map showing land tenure types in relation to oil palm development



3.5 THE SMALLHOLDER FARMERS

The smallholders will each cultivate individually up to 3ha of oil palm. A total of 3,500 hectares of oil palm is to be raised by small holders. The holdings will be grouped in blocks as much as possible in order to facilitate supervision of work and fruit collection. The smallholders/outgrowers will be fully involved in the grouping of holdings to ensure their ideas are incorporated into the design at an early stage.

The participating farmers are expected to meet the following conditions:

- Possession of title to the land or a certificate of occupancy;
- Preparedness to pledge the title/certificate of occupancy against development/loan cost for the oil palm development;
- Preparedness to deposit the title with the Oil Palm Growers Trust, the organisation responsible for loan recovery;
- Preparedness to carry out the technical advice given by the nucleus estate;
- Preparedness to supply all fruit to the nucleus unit at a price fixed by the pricing committee;
- Land offered for development must be of acceptable agronomic standards and accessible; and
- Authorise deductions at source by the nucleus estate for purposes of loan recovery.

3.5.1 Support for smallholder production

Smallholder farmers will be supported by GoU and IFAD. The farmers will access a long-term production credit from IFAD loan funds. Farmers will repay the loan through the sale of their fresh fruit bunches. Repayment will commence in project year six, after planting and end in about 7 years. The economic life of oil palm is 25 years, although some palms can live for many more years.

3.5.2 Smallholder role in the oil palm company

Bidco and her partners, together with smallholder farmers participating in the project will form the oil palm company. The smallholder farmers will have a 10% share in the company.

Smallholder equity share will be on the basis of land availed to the project and equipment to be used by the farmer. The smallholders will be represented on the Board of Directors of the company to ensure their investments are protected.

3.5.3 Oil palm Growers' Trust

The smallholders will organise themselves to form the Oil Palm Growers' Trust (OPGT) to ensure a strong voice. The OPTG will be represented on the Board of Directors of the company and on the pricing committee that will be set up. Production credit will be availed and recovered through the OPGT.

3.6 THE NURSERY

Oil palm is propagated through seeds. Seeds will be procured as germinated oil palm seeds, to be imported from Malaysia and Indonesia. A pre-nursery of 50 ha will be established at Bwendero, under overhead shade because of the intense solar radiation in Bugala.

Water for nursery irrigation will be obtained from the Nalusegenya stream flowing adjacent to the nursery area. The stream has a discharge of 6 litres per second.

It is anticipated that seedlings will be raised for field planting within 9-12 months from seed planting.

Field planting will commence at the onset of the rainy season in March and will be completed prior to the commencement of the dry season, thereby allowing newly planted palms adequate time to consolidate prior to any distinct drought period. It is planned that germinated seed is delivered to the project site approximately one year prior to field planting.

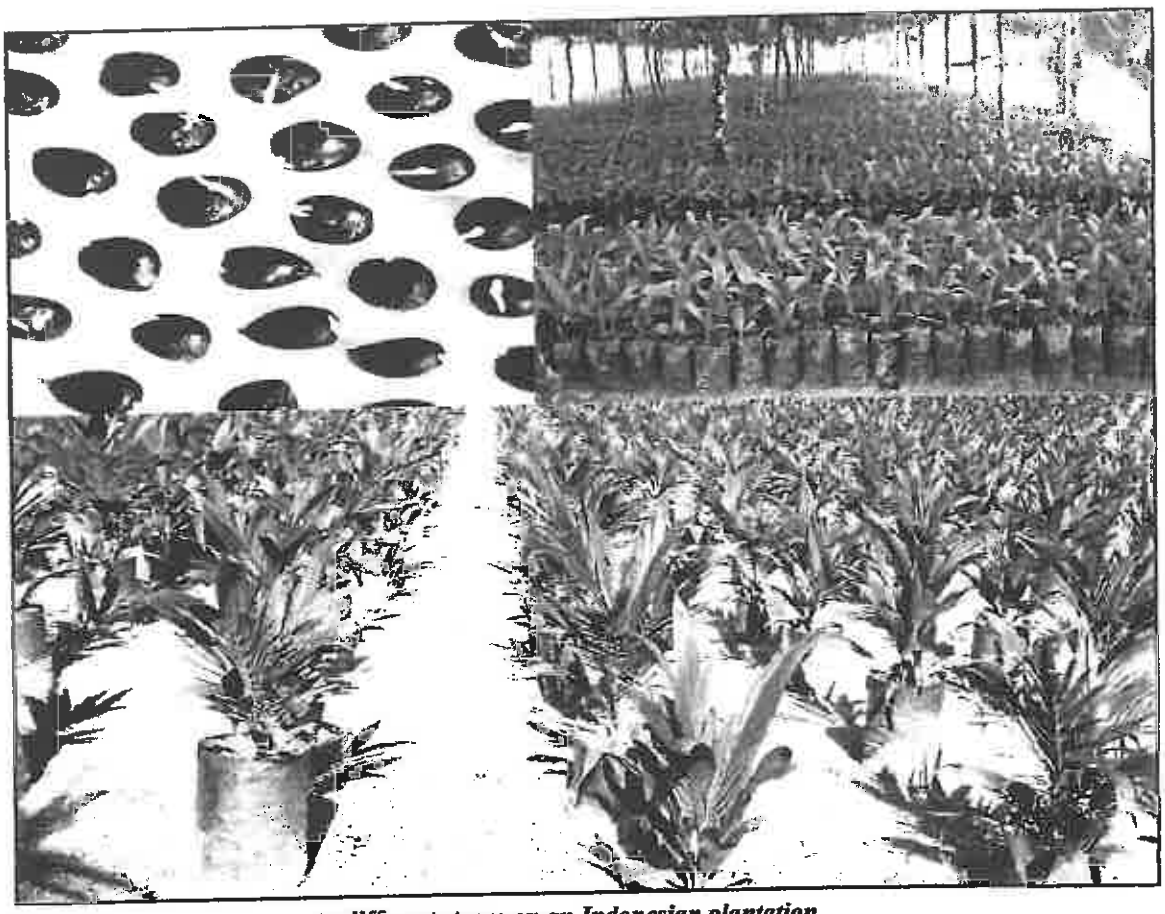


Figure 2: Oil palm nursery at different stages on an Indonesian plantation

3.5.4 Polybag requirements

The double stage nursery (pre-nursery and main nursery) will be used, with black perforated polybags of 15cm x 23cm x 250 gauge (small) and 38cm x 46cm x 500 gauge (large) used for planting. The polybags will be made available early as these will have to be filled with top soil which should be of good texture to permit proper drainage, unimpeded root growth and adequate root aeration.

Nursery beds in the pre-nursery will be 1.22m wide and 45.73m in length, allowing 13 filled small polybags to be placed across the bed and allowing easy access. The small bags will be filled with topsoil. Ten kg of rock phosphate will be incorporated with every 4.5 cubic meters of topsoil (enough soil to fill approximately 1,000 bags). Each large polybag in the main nursery will hold about 15 kg of soil.

These polybags will also have to be arranged and spaced adequately in the main nursery to ensure that the seedlings will not become etiolated due to overcrowding and the resultant competition for

light. The seedlings will remain in the pre-nursery for 2 to 3 months before transfer to the main nursery; where they will remain for a further 6 to 9 months. Spacing of the large polybags in the main nursery will be done at 3 feet triangular. Filling the large and small polybags with topsoil and stacking well in advance of seed arrival in conjunction with light watering will be done to allow enough time for the soil to settle in the bags. Topping up with more topsoil will be done as necessary.

The polybags will be ordered for early delivery and filling and arranging of both large and small polybags will be scheduled for completion prior to seed delivery for the small bags and within a further 2 to 3 months for the large bags.

3.6.1 Seed planting

Pre-heated seeds will be germinated under moist conditions in polythene bags. On reception, the germinated seeds will be planted out in small polybags in the pre-nursery within 4 days. However, should it be necessary to delay planting, the seeds will be stored for a further one week but the seed development will not exceed 21 days after germination. Preferably, planting will take place at the 10 - 14 day stage from germination. The seeds will be stored in a cool place with rat-proof arrangements, on receipt.

The labourers doing the planting will be familiar with the technique involved. They will be instructed and later tested individually on their ability to differentiate between the radicle and plumule. This is important because upside-down planting results in seedlings with twisted leaves and these will ultimately have to be discarded. Planting too deep will result in delayed development whilst shallow planting results in seed movement, exposed roots and uneven growth.

The simple operation of planting the germinated seed will involve making a hole with the finger about 4cm deep at the centre of the small polybag and inserting the seed into the hole with its plumule pointing upwards. The germinated seed will be just below the soil surface and covered with a light layer of soil. When transferring seedlings from pre-nursery to main nursery, care will be exercised to ensure that transplanting shock is minimised.

3.6.2 Nursery watering

Watering will be done once in the morning and once in the evening. This will be reduced according to amount of rainfall.

3.6.3 Nursery manuring

The growing radicle and plumule derive most of their nourishment from the nutrients stored in the seed during its initial stage of development. These nutrients are rapidly exhausted and will have to be supplemented. The use of slow release organic fertilisers in pellet form is recommended as it cuts down on labour and also reduces leaf scorch. The first application will be done at the 2-leaf stage of development and the second application done at 6 months from seed planting. The composition of the fertiliser is N: P_2O_5: K_2O: MgO in the ratio 10: 10: 5: 2.

3.6.4 Pest and disease control

A regime for spraying against insect pests and diseases may be necessary in the event of symptoms of attack being visible. Common nursery pests and diseases are shown in Table 3.

Table 3: Common oil palm nursery pests and diseases

Pests	Diseases
Apogonia	Corticium leaf rot
Valanga	Curvularia seedling blight
Red spider mites	Cercospora leaf spot
Rats	Pestalotiopsis leaf spot
Nettle caterpillars	Blast disease
Snails	Pythium seedling rot

A Pest Management Plan is given in Appendix 2. The following insecticides and fungicides may be used against the commonly occurring pests and diseases: trichlorofon, dimethoate, brodifacoum, monocrotophos, metaldehyde, propineb, maneb and thibenzole. More information about these chemicals is given in Appendix 3.

Some of these pesticides and fungicides are compatible with each other and also with the foliar fertiliser. It is therefore possible to mix the pesticide, fungicide and foliar fertiliser together and apply as a single spray solution. This will reduce labour requirements for pest and disease treatment.

It is proposed that in order to minimise the use of pesticides and fungicides, Integrated Pest Management (IPM) control measures will be undertaken.

3.6.5 Nursery weeding

Regular monthly weeding will be carried out and it will commence one month after seed planting and be continued until about 10 months from seed planting. The weeding operation will involve

weeding the polybags and also weeding between the bags. However, considering the size of the nursery, it may even be necessary to keep the empty polybags weeded while awaiting the arrival of germinated seeds.

3.6.6 Transplanting doubletons

Doubletons will be carefully separated into individual seedlings when they are at the 4 to 5 leaf stage. After separation, the seedlings will be kept under dense shade and be provided with adequate water for them to recover from shock. After about 2 weeks the shade will be gradually thinned out.

3.6.7 Nursery culling/selection

Seedlings with inferior and recessive growth characteristics will be discarded, as these will not develop into strong healthy palms. The first culling will be carried out when the seedlings are 6 - 7 months old. Just prior to field planting a final culling will be done. It is anticipated that about 7% to 10% of the seedlings will be discarded as runts.

3.7 OIL PALM FIELD PLANTING

3.6.1 Land clearing

Land clearing including felling, ploughing, and harrowing will be done during the dry season. Compacting of the ground will be necessary in areas of grassland where several anthill outcrops have made soil structure inconsistent.

Figure 3: Anthills within one of the grassland areas proposed for oil palm development on Bugala Island

Bulldozers and tractors will be used in land preparation. Bush burning will not be undertaken. The vegetation felled will be allowed to rot and also serve as mulch. The timing of land clearing is important to make land ready to receive the seedlings when the weather is suitable for field planting operations. Land preparation will be completed by the time the seedlings are at the most suitable stage for planting, otherwise early yields will be adversely affected. The anticipated time to be taken from starting clearing until field planting is about 7 - 8 months.

Weeds will be promptly controlled after land clearing using a cover crop *Centrosema* sp. This will be necessary given the fact that much of the project area is under secondary growth and such areas are usually rapidly infested with weed growth.

It is recommended that weed control measures should be started as soon as the area has been cleared, ploughed and harrowed.

3.6.2 Lining

Lining will begin as soon as clearing has been completed. It will be carried out before the planting of leguminous cover crop to allow the planting of cover seeds in drills equidistant from the palm

rows. The alignment will depend on the design of the road systems on flat land. Where possible, palm rows will run parallel to field drains.

The pattern to be used for oil palm planting is equilateral triangular, i.e., the palms in one row will be positioned opposite the midpoints of the inter-palm space in adjoining rows. This pattern gives optimal utilisation of the ground in terms of space and light for plant growth and development. The planting distance will be 9m triangular which will give a density of about 143 per ha.

3.6.3 Holing

This operation will only commence after lining has been carried out. The size of the hole will be large enough to accommodate the polybag seedling to be planted. After removal of the polybag, the hole will be partially filled with topsoil, the palm planted at bole level and the surrounding soil firmly consolidated. Further rounds of consolidation will be carried out after planting is complete.

3.6.4 Cover Crops

Leguminous cover crops will be planted in the area between the palm planting rows. This will help improve the soil fertility, control weeds and also reduce the ground temperature. Smallholders may plant suitable food crops in the oil palm inter row areas. The proportion of the field area utilised for such intercropping will decrease with palm age and will be restricted to the first two years following oil palm establishment. Farmers will be advised not to intercrop cassava in oil palm plantings.

The scarified cover crop seeds and rhizobium compost/inoculum will be purchased in advance to ensure their delivery at the proper time. The seeds will be made available when the lining is about one-third completed.

Figure 4: Cover crop in a Malaysian oil palm plantation

Table 4: Varieties to be planted as cover crop

Type	Rate per ha
Pueraria javanica	5.0 kg
Calopogonium caeruleum	1.0 kg

3.6.5 Field planting

Field planting will be scheduled to coincide with the rainy season and will be completed one month before the onset of the dry season.

Field planting will comprise of the following operations:

- transport of rock phosphate from store to field - (the amount of rock phosphate required per planting hole is 500g)
- loading of nursery seedlings onto transport vehicles
- transport of seedlings from the nursery to field
- off-loading seedlings in field at suitable locations
- carrying seedlings to planting holes

- checking holes for depth, fertiliser application, slitting and removing polybags, planting, filling back and consolidating

3.6.6 Upkeep of immature and mature oil palm

Circle weeding will commence one month after field planting and be repeated at monthly intervals for six months to keep down weed competition for moisture and nutrients. In order to avoid damage to the field planted palms, herbicides will not be used at this young stage.

On the nucleus estate, circle spraying will be carried out using paraquat dichloride when the palms are about 6 months old. Circle spraying will be repeated at 40-day intervals, if necessary, until the palms are 1 year old. Thereafter, glyphosate mixtures will be used in place of paraquat dichloride for longer lasting control of weeds. Circle spraying with glyphosate mixtures will be repeated at 3 - 4 month intervals.

For Smallholders and out growers, 4 rounds of circle weeding per annum will be carried out as necessary. Circle weeding will be carried out immediately prior to fertiliser applications.

Selective weeding will be carried out at least three times a year, depending on the rate of regeneration to suppress the growth of noxious weeds. This will not be necessary where smallholders are intercropping with food crops.

Manuring will be done by spreading the fertiliser thinly over the weeded palm circle. Care will be taken to avoid frond scorch when applying the fertilisers. Palm circles will be clean at time of application.

3.6.7 Ablation/Castration

Ablation or castration is the process where the young male and female inflorescences are removed. This will be done at monthly intervals commencing at 14 months after field planting and continued to about the 20th month after field planting. The inflorescences can easily be detached from the palms by hand at the initial stage. As the palms grow older, the inflorescences become bigger and will be removed by the use of a narrow chisel. Ablation will be stopped when 60% of the palms bear inflorescences or about 6 months prior to commencement of harvesting. Some extension of the period of ablation will be required for the initial nucleus estate and smallholder plantings to fit in with mill construction schedules. Such extension of ablation will not reduce overall bunch yields.

3.6.8 Mulching

Mulching will be done as a means of moisture conservation, weed control and to prevent soil splashes, which can lead to pathogenic infection. Rice husks will be used in the early stages of the development. Later oil palm kernel shells will be used as mulch.

3.6.9 Harvesting /Pruning

With proper management, it is anticipated that the palms can be brought into harvesting 32 months after field planting. Harvesting will be done by the use of chisels/sickles attached to long handles. It will be carried out in rotation at a frequency of three times a month. The harvesters will be instructed on how to identify ripe fruit bunches. All bunches will be cut at an appropriate standard to ensure high extraction percentages at acceptable levels of free fatty acid (FFA).

Pruning of excess palm fronds will be undertaken every 9 months as a means of improving harvesting output and fruit-set. No difficulties regarding insect pollination are anticipated as the weevil *Elaeidobills kamenmiclls*, the pollinating agent is already present.

After cutting the ripe fruit bunch, the following activities will be undertaken:

- Collection of loose fruits from the palm bases
- Trimming of long bunch stalks
- Removal of fronds that obstruct access to ripe bunches
- Stacking the cut fronds in designated avenues
- Transporting bunches and loose fruits to collection points for eventual transport to the processing mill

The harvesting operation will be made more efficient by organising labour into cutter/carrier teams whereby the cutting of the ripe bunches is done by the husband while the collection of bunches and loose fruits is done by other family members possibly a wife and children.

Collection and transportation of fresh fruit bunches (ffb)

It is proposed that these operations will be carried out as follows:

- ffb will be stacked at the roadside on nets
- Bunches from individual smallholders will be counted
- Lorries will be used to transport ffb to oil mill

- The lorry will be weighed on the mill weigh bridge, and this weight will be recorded for payment,
- As the number of bunches harvested by each individual smallholder is known, bunch weight will be easily ascertained and payment made accordingly

Estimates for yield profiles have been projected in the Vegetable Oil Development Project Appraisal Report; Volume II, by IFAD. Peak yields are estimated at 18 tonnes and 14.5 tonnes for the nucleus estate and out growers respectively.

3.8 PESTS AND DISEASES

With the exception *of Ganoderma lucidum*, no debilitating oil palm pests and diseases have so far been identified in Uganda. However, this may change with the introduction of large-scale plantings.

Rats, wild pig and monkeys can cause severe damage to young palms. Wire guards will be used as a preventive measure.

With regard to insect pests, biological control methods, i.e., natural predators, may be introduced before major infestations occur. Environmental assessment will be required in case of introduction of non-indigenous species.

Ganoderma lucidum is a fatal disease of more mature palms. There is currently no known successful treatment or cure for this fungus. However, at replanting the palm will be shredded or burnt and completely removed from the field. The inoculum is capable of surviving in small particles of the wood and also in other tree stumps.

3.9 THE OIL MILL

3.8.1 Introduction

An oil mill will be installed on the nucleus estate at Bwendero, approximately 1km from the Lake Victoria shore and about 200meters from the main road.The mill is proposed to handle ffb from both the nucleus estate and out growers. Inputs into the mill, including fuel and water requirements, will be about 5% to 10% of ffb processed.

Water will be obtained from the Nalusegenya stream flowing through the nucleus estate. Agricultural waste from the processing of ffb in the mill, especially from sedimentation tanks, will be used as fuel and fertilisers.

3.8.2 Facilities

The mill capacity will initially be 30 tonnes per hour. This will be expanded to 60 tonnes per hour with increased production of ffb over the years. Facilities at the mill will comprise a weigh bridge, CPO loading unit, CPO storage, ffb offloading platform, ffb cage system, steriliser, fibre collection unit, boiler and co-generation, oil mill, water treatment tanks, incinerators and effluent treatment plant as well as an administration and security units (Appendix 4).

3.8.3 Construction

Construction of the mill will last approximately one year. Conventional civil construction material, including structural steel, plant and machinery will be used. It is estimated that 200 – 300 tonnes of materials will be used in construction. Lorries will be used to deliver materials to the proposed construction site from the ferry landing at Bugoma. Approximately 100 people will be employed in the oil mill.

3.8.4 Activities

3.8.4.1 Processing of fresh fruit bunches

Machinery used in the processing of palm oil varies widely, but they work under the same principle. The main steps in palm oil processing include:

- Reception from the field
- Weighing and grading
- Loading ffb into cages
- Sterilisation
- Stripping or threshing of bunches
- Digesting
- Pressing - from which cake and crude palm oil (CPO) is obtained

Ripe and unbruised fruit at the time of harvesting have a low free fatty acid (FFA) content of 0.3% - 0.8% which mainly develops when fruits are on their way to the oil mill. The FFA content rises to between 20% - 25% on improper handling. This is caused by lipolytic enzymes developing in the bruised exterior part of the fruits, which eventually reduces both the yield and quality of the oil.

Sterilisation by heating is the most effective means of stopping the action of lipolytic enzymes. This process is carried out is autoclaves using steam as a heat carrier. When bunches are received from the field, they are unloaded from lorries through hopper in properly designed cages which easily fit into the autoclaves. When the autoclaves are filled, doors are closed and saturated steam is injected into the autoclave until a pressure ranging from 2.5 - 3 kg/cm^3 and temperatures 130 - 133°C are reached (provided the autoclave is fitted with a proper air -release system). Steam is then introduced into another autoclave in which pressure is down to normal atmospheric conditions - 1 atmosphere where the doors are opened to remove the cages. However, a safety system to ensure that the door does not open while steam is still in the steriliser must be effectively installed. It is equally important to exclude all air while sterilisation is being carried out. The air affects sterilisation and cooking efficiency by preventing heat penetration and may also cause oxidation of the oil.

The retention time of the fruits varies from 45 minutes to 60 minutes (1 hour) and therefore one autoclave can optimally perform 12-14 operations per day. The variables that affect sterilisation process are:

- Size of bunches
- Degree of ripeness of bunches

The sterilised bunches are then fed continuously into a rotary drum thresher or beater arm thresher for large outputs up to 30 tons per hour and small capacities (4 -5 tons per hour) respectively. This accomplishes stripping and separation of fruits from bunch stalks.

Rotary strippers comprise drum made up of equally spaced longitudinal U-bars, which revolve slowly. Longitudinal flat bars are located radially inside the drum. The clusters are introduced at one end of the stripper and raised by centrifugal force, and by the flat bars eventually falling on the U-bars, and are finally removed by a screw conveyor. The empty bunches are discharged at the other end of the drum for incineration.

From the thresher the fruits are conveyed onto a vibrating strainer. The coarser impurities are sent to the digester. The digester is a vertical cylindrical vessel provided with a double steam jacket where steam at pressure of 3 atmospheres is circulated with a central paddle stirrer. High mixing efficiency is achieved when the vessel is full. The purpose of digestion is to separate the fruit pulp from the nuts and the oil bearing cells to burst, thus releasing oil. Proper digestion ensures

rupturing of most oil cells, which facilitates pressing. The best digestion conditions are attained by mixing while stirring the fruits at a temperature of 90-100°C for approximately 20 minutes.

Expellers or continuous screw presses are used to separate the solid portion including the fibres and nuts from the liquid phase (i.e., water and oil). The mash from the digester is transferred to the expeller. Expellers or continuous screw presses are made of perforated cage or barrel of horizontal cylindrical design where the mass is subjected to increasing pressure by a variable pitch worm/scroll, which causes the oil to come out. The press function is to expel as much oil as possible but at the same time ensure minimum nut breakage. This ensures maximum kernel recovery. A well-designed process should guarantee less then 7% residual oil in the cake and 5% broken nuts. Two products are obtained at outlet of the press:

- A mixture of water, oil and solid impurities
- Press cake, which contains fibres and nuts

3.8.4.2 Clarification and drying of expelled oil

There are two methods available namely using static settling tank and separation, which requires big space requirement and new settling, and centrifugal separation system. In the first the diluted press liquid is first conveyed to a vibrating screen, which retains the fibrous material. It is then pumped through a control intake into a continuous vertical clarification tank where it separates into oil and sludge. Thereafter the wet surface oil is fed to a purifier, which may be of continuous batch type depending on the amount to be processed, where dirt and part of the moisture are removed. The residual sludge remaining in the tank has oil content of about 10%, which is recovered by a nozzle type separator. The oil leaving the separator is also passed through the clarifier for final polishing.

In the second process the diluted press liquid is fed into a vibrating screen, then into a clarification tank, and from there it is first passed through sand and cyclones and brush strainer and thereafter through a nozzle type separator which separates its three components (oil, water and solids) which account for one-third of each by weight.

Finally, the oil is dried to moisture content below 0.1%. Vacuum dryers are preferred since they allow oil to be dried at lower temperatures in the absence of air, thus reducing the risk of oil oxidation. Care to avoid oil oxidation is exercised throughout the process to produce high quality palm oil.

3.8.4.3 Processing of the press cake

The cake coming out of press consists of:

- wet oily fibre
- nuts

A depericarper, which is a vertical column inside which a hot air current created by a powerful fan is circulated, is used to recover and separate the nuts from the fibres. The cake is conveyed from the press station to the nut and fibres separated via a steam jacketed screw conveyor fitted with paddles, which serves to partly dry the cake and loosen the nuts from the mass. The light fibrous material is sucked into a duct, and then separated from the air in a cyclone. This is conveyed for use as fuel in the boiler house. The heavier nuts fall to the bottom of the cylinder, dried and stored.

3.8.4.4 Kernel recovery

One of the purposes of sterilisation is to loosen the kernels from inside the nuts. If this is not properly carried out a large number of kernels stick to the nut walls and break during subsequent cracking. It is necessary to keep the nuts for 10 - 15 hours in a drying silo where hot air is circulated in order to loosen the kernel. This drying process reduces the moisture content from about 20% at the outlet of depericarper to 11% i.e., nearly half.

At this moisture content level the kernels can be recovered in a nutcracker, which separates the nuts, by centrifugal force against the metal walls of the cracker. The separated kernels are first sent to a draining screen to remove any moisture before feeding to a dryer where moisture content is reduced to 6-7%, which ensures safe and long-term store condition.

3.8.4.5 Palm kernel processing

The bulk density of clean kernel is 0.6lg/dm^3 Recovery of oil from dry kernels is carried out as for all other oil-bearing materials, i.e., first conveyed to a cleaner to remove foreign matters, weighed, passed through a mill where they are broken to pieces, then into flakes suitable for extraction.

No heating of palm kernel is required. The extraction may be fully mechanical or of the solvent type extraction depending of quality to be processed.

3.8.5 Use of palm fruit products

The following are obtained from the processing of oil palm fruits

- Oil
- Palm kernel
- Fibres
- Palm kernel shell

3.8.5.1 Palm Oil

Palm oil has a pleasant characteristic odour and is very stable towards oxidation; has high tocopherol content. It is used in formulations for making of household margarines, shortenings, bakers fat and industrial margarines. There is no need for hydrogenation in making of margarines if correct proportions of palm oil are used. It is also a good frying fat because of its low foaming properties and low quantities of poly - unsaturated fatty acids.

3.8.5.2 Palm kernel oil

Palm kernels are contained in the endocarp of the palm fruit. On drying it contains up to 92% dry matter but some oil is still extracted.

3.8.5.3 Palm kernel meal

In addition to the oil, from the processing of palm kernel, a meal is obtained. The average composition is given in Table 5.

Table 5: Average composition of palm kernel meal by weight

Moisture	10%
Protein	20%
Fat	0.9
Fibrous matter	15%
Ash	4%
Non - nitrogenous extract	50%

This meal is usually used as animal feed either in marsh or pellet form.

3.8.5.4 Fibres and shell

After drying of the fibres, the shells, which are by-products of the oil palm, will be utilised as fuel in the oil mill where the fruit is processed. It will be used to generate steam as well as power. It

is most advisable from an economic standpoint because the palm oil mill is to be set up in plantation premises.

The resulting ash from empty bunches after burning in incinerators will be used as fertiliser because of its potash content.

3.10 ROADS/COMMUNICATION

3.9.1 Overview

The Ministry of Works, Housing and Communication (MoWHC) is responsible for providing road access to the district headquarters and those sections of the roads that attract traffic of over 10 vehicles per hour per day while the district is responsible for other feeder roads in the district. Maintenance of the Bukakata – Masaka road (38km), the 120tonne ferry and its landings at Bukakata and Luku and the Bugoma – Mulabana road is the responsibility of the MoWHC.

MoWHC has given assurance that it will upgrade the road from Bugoma Ferry Landing on the island to Kalangala District Headquarters, about 32 km, to a 6-meter wide class 2 road (connecting district to district). In addition, approximately 22 km of the road south of Kalangala to the proposed site of the project will also be upgraded to similar classification in consideration of the expected increase in traffic volume.

Other road construction/rehabilitation activity of the project is to be based on the planting programme and the fruiting of plants. As such, the roads development programme has been phased over a period of 8 years **(IFAD 1997)**, which has resulted in relatively slow road development over the years. The project will therefore, require rehabilitation of feeder roads linking smallholders, out growers, nucleus estate and the mill with the main spinal road on Bugala Island.

Construction of all roads in one year is not feasible since the cost of maintenance during subsequent years until the roads are fully needed.

In view of this, contracting out the construction work would not be a feasible option as the mobilisation and demobilisation costs would be very high per unit of construction. Also, it would not be possible to attract reliable contractors for such quantities of work. In view of these factors, it would be most economical for the project to undertake the construction/rehabilitation of all project roads. The assumptions for these statements are derived from machine hours and the phased requirements of road construction equipment obtained from the IFAD 1997, report.

Proposed project roads on Bugala Island fall under three categories, which include:

- Link roads - these will link the small growers, outgrowers nucleus estate and the mill to the main arterial roads in order to facilitate plantation activities and the collection of palm fruits for transportation to the mill.
- ffb roads – these roads will be constructed within the oil palm plantations only and based upon an economic carrying distance of 200m for ffb. The density of plantation roads will be 25m per ha.
- Access road to the mill.

3.9.2 Description and design standards of project roads

The description and design of the standards have been obtained from the IFAD (1997).

3.9.2.1 Link roads

It is assumed that all fruit collection shall be carried out by means of agricultural tractors and trailers or lorries. Existing tracks would be rehabilitated or upgraded. The following design standards are proposed to cope with such traffic and also occasional light vehicles for the transportation of other produce and goods. They include:

- Clear width and right of way - 12 m;
- Remove topsoil over 8m width to an average depth of 75mm where necessary;
- Formation width - 6m - with 4m wide carriageways, 1m wide shoulders and V-shaped side drains 1m wide and 0.5m deep;
- Lay-bys for two-way traffic, 8m wide and 50m long shall be constructed at 1km intervals;
- With materials from the drains, replace topsoil over carriageway and shape to a camber of2.5% to 3% and compact;
- Surface the carriageway - 4m width - with select material 100mm compacted maintaining camber of 2.5% to 3%;
- Realignment, horizontal or vertical, of the proposed roads would not be necessary;
- Drainage shall be given particular attention with run-offs or mitre drains as frequent as possible to allow for even dispersal of ground water;
- Allow the drains to grow grass to avoid erosion;

- Construct scour-checks in the side drains along slopes to reduce the flow of water to non-erosive velocity. The frequency of these would depend upon the gradients;
- Pipe culverts of suitable diameters shall be constructed for cross drainage and for natural watercourses. No bridges are foreseen in the proposed roads programme;
- Gravel pits shall be suitably designed to limit subsequent erosion and would be restored after use. Topsoil removed from the road surface shall be utilised for this purpose;
- Excavated soil and waste shall be spread to avoid disruption of natural drainage.

3.9.2.2 FFB collection roads

The ffb collection roads will originate from a link or arterial road into the plantation and up to its boundary and shall be spaced at 400m.

The construction work for such roads shall be phased in two stages. Since access will be required for planting activities, the roads will be opened up with a crawler tractor and topsoil removed to facilitate the passage of wheel tractors during the year of planting. Thereafter, these roads would only be used extensively as from the third year when the palms start bearing fruits. However occasional maintenance work would be necessary. As such, actual construction work shall commence about 3 years after the roads have been opened up. The design of the roads shall be dictated by the spacing of the oil palm trees. In the proposed configuration, the total width of the freeway shall not exceed 6m. Hence the carriageway shall be limited to a width of 3.5m allowing for side drains, 0.5m wide, with no shoulders. The remaining design standards shall be similar to that of Link Roads.

3.9.2.3 Access road to mill

The oil mill shall be located within 200m from the main road. The access road will be subject to a traffic volume of over 30 vehicles per day (VPD), increasing to over 50 VPD at the peak of operations with a maximum axle loading of 10 tonnes when the mill becomes operational. However, since the offices and part of the housing development shall be implemented during year 2 of the project, the access road would need to be constructed during the same year and maintained during this period. The proposed design standards for this road are derived from IFAD, 1997 and are given below:

- Clear width and right of way -14m;
- Remove topsoil over a width of 10m to a depth of 75mm to 100mm as necessary;

- Formation width - 9m, with 6m carriageway, 1.5m shoulders and side drains 1m wide and 0.5m deep;
- With material from the drains and additional material from borrow pits, replace topsoil and increase level by a well compacted 150mm;
- Surface the 6m width carriageway with select material to a compacted depth of 150mm maintaining a camber of 2.5% to 3%;
- Drainage will be given particular attention with run-offs or mitre drains as frequent as possible for even dispersal of ground water;
- Allow the drains to grow with grass to minimise subsequent erosion;
- Pipe culverts of minimum 600mm diameter would be constructed for cross drainage with head walls and apron. No bridges are foreseen on this section of road;
- Gravel pits shall be suitably designed and restored after use;
- Excavated soil shall be disposed or spread to avoid disruption of natural drainage.

4.0 ENVIRONMENTAL ASSESSMENT

4.1 IMPACT ANALYSIS

Environmental impact analysis was carried out with regard to:

- Use of agrochemicals
- Processing plant/oil mill effluent and water pollution
- Solid waste management and air pollution from processing plant

Ecological and socio-economic issues were analysed in detail, including:

- Vegetation removal
- Hydrology
- Fauna (mammals, avifauna, reptiles, amphibians, butterflies)
- Limnology and fisheries
- Agro-economy
- Socio-economic aspects

4.2 USE OF AGROCHEMICALS

The nutritional status of the palm trees will have to be balanced with potassium and magnesium given soil conditions prevalent in Bugala. A fertiliser program will be established based on soil analysis with the assistance of Kawanda Agricultural Research Institute for the immature period. For the mature period, an annual fertiliser program will be established based on results obtained from foliar analysis. Fertiliser use shall be carefully regulated to minimise costs and negative impacts on the environment. Part of the strategy to achieve this is fertiliser applications design which targets spraying fertiliser where the plant uptake is very efficient to avoid fertiliser getting into runoff.

Use of herbicides will be prohibited at the pre-nursery and nursery stages. During the immature period, use of herbicides (preferably glyphosate) may be necessary in the interlines to spot-spray grasses. During the mature period strip weeding may be considered only when manual labour is not available. In general, use of herbicides will be uneconomical as labour is expected to be available.

The use of fungicides might be necessary at pre-nursery and nursery stage to control leaf diseases. In that case dithane M45 is recommended at a monthly frequency depending on the incidence of Cercospora. The use of insecticides may be required to combat crickets (*Zonocerus variegatus* sp.) although the incidence is not expected to be significant. Given the climatic pattern of the area, no blast at nursery stage is expected. In the event blast does occur, systemic insecticide will be used. However, the entire surrounding of the pre-nursery and nursery) should be kept clean weeded in order to prevent the development of *Recilia mica* (Homoptera).

The limited use of fertilisers will improve soil conditions and plant growth. The carefully designed integrated pest management program (Appendix 3) and the limited use of pesticides envisaged by the project effectively eliminate any potential negative impacts of chemicals. In addition a monitoring programme (Table 39) has been designed to ensure that any negative consequences will be detected and dealt with.

4.3 IMPACT OF OIL MILL

4.3.1 The zero waste philosophy

The processing of oil palm ffb to produce palm oil results in production of waste in the form of palm oil mill effluent (POME), empty fruit bunches, mesocarp fibre and shell. All these are potentially important polluters if badly managed. The Bugala oil palm project will adopt the 'zero waste' management philosophy used in Indonesian oil palm plantations, in which all components of the fresh fruit bunch is utilised. A description of the 'complete value chain' is given in Appendix 6.

4.3.2 Palm oil mill effluent

Most palm oil mills installed in the world produce approximately 2.5m^3 of effluent per tonne of oil produced. POME is biodegradable and does not contain any poisonous substance. POME contains a high level of plant nutrients and, after digestion, is allowed for land application (Figure 5). Studies have shown that such applications is beneficial to oil palm as well saving on both the environmental and financial cost of fertiliser use. Long-term studies have shown that water quality was not affected in areas where such use of POME occurred.

In order to produce effluent that meets the most stringent international requirements and to eliminate any form of pollution, the proposed oil mill design will incorporate:

- a stalk processing press and muncher;
- a tri-phase decanting system;
- an effluent treatment system;
- an effluent/land application system.

The clarification section of the mill will be designed with a 3 phase continuous decanter whereby crude oil juice does not have to be diluted and which recovers all solid from the crude juice. This reduces the production of effluent to 1.5 m^3 of effluent per tonne of oil produced. The solids will be gathered and used as boiler fuel.

POME will be collected in a succession of four aerobic and anaerobic ponds where it will be retained for 14 days. The sludge will be applied in the plantation. Steriliser condensates, clarification effluent, and empty bunch juice will be pounded and retained until the residual liquid conforms to Uganda standards (Table 6) before disposal takes place. Subsequently the effluent will be pumped to the nucleus plantation and distributed by gravity irrigation system.

In order to avoid any accidental release of effluent a stand by empty pond will be constructed to receive any effluent that leaves the mill premises accidentally. In this way, no effluent will be released into any stream, river or lake.

Figure 5: Part of a system for application of treated POME to the land in an Indonesian oil palm plantation

Table 6: Characteristics of untreated POME and Uganda environmental standards

Parameters	Untreated POME	Uganda Standards
PH	4.0	6.0-8.0
Temperature (centigrade)	80–90	20-35
Biochemical Oxygen Demand (BOD) mg/l	25,000	50
Suspended Solids (SS) mg/l	19,000	100
Total Nitrogen (TN in mg/l)	770	10
Oil and grease (mg/l)	8,000	10

4.3.3 Solid waste management

The plant will be designed to produce and use steam and electricity from solid waste such as empty fruit bunches. The total caloric value of these products represents approximately 3 million

KCal/tonne of ffb processed. This amount of energy is sufficient to run the plant independently and meet electricity requirements elsewhere. The ashes produced after incineration of the fibres, shells and stalks are recovered and used as fertilisers. They cover approximately 50% of the fertiliser requirements of the plantations. Ashes are rich in K_2O (25%), MgO (5%), CaO (10%) and some oligo-elements.

The emission of smoke could be a minor source of pollution. In order to obtain a perfect combustion the boiler furnace will be equipped with an air injection device to achieve complete combustion; thus reducing smoke emission to a minimum. Scrubbers will be incorporated into the chimney to eliminate the occurrence of unburned substances.

Empty fruit bunches can also be returned to the field to act as mulch if needed.

4.3.4 Oil mill energy production

All process waste will be burned in the boiler for the production of steam used for the generation of electricity and processing of fruit. Apart from fibres, empty bunches are to be pressed and munched to augment fuel supply. Palm kernel will be cracked and shells used to further increase fuel supply. The boiler will therefore be designed to consume fibres and shells and eventually palm kernel cake. The furnace will have tilting grids to enable continuous functioning and an ash extraction device. Ashes will be recovered for recycling into the plantation as fertiliser.

The minimum calorific value of all by-products including palm kernel cake amounts to minimum 1,000,000KCal per tonne of ffb processed. This amount of energy is sufficient to produce approximately 1 tonne of steam or 50KW of electricity. If properly designed and managed, the mill will produce about 340KW of electricity per hour throughout the year when the plantations reach full maturity.

4.4 VEGETATION

The land cover/use on Bugala Island consists of secondary forest alternating with subsistence farmland, grasslands, woodlands, bushland and wetlands. In the more densely populated and most fertile soils of the north and west, the proportion of land cultivated is relatively higher. Small areas, especially close to the Lutoboka point remain with primary forest.

The vegetation of Bugala was described by Thomas (1942), distinguishing four zones:

- Upper forest;
- Grasslands;
- Lake-side forest; and
- Aquatic vegetation

The dominant species according to Thomas (1942) were *Uapaca guineensis* and *Piptadenia buchananii*. The upper forest is further distinguished by sub-dominant species such as *Pseudosponsias microcarpa, Canarium schweinfurthii, Erythrina abbyssinica, Pycnathus kombo* and *Musanga smithii.*

The dominant species in the grasslands according to Thomas (1942) were *Loudetia kagerensis, Eragrostis chalcantha, Ctenium concinnum, Andropogon dummeri* with taller grasses such as *Hypparhenia diplandra* and *Loudetia phragmatoides* in the wetter areas.

Neither the forest nor the grassland is confined to any specific soil type and both may alternate with each other within a distance of less than 2 km. There is typically a very sharp boundary between the forest and the savanna with little or no transitional vegetation. It seems therefore, that the distribution of the forest and grassland is largely, if not entirely, controlled by the past and present farming practices (Radwanski, 1960). Thomas (1941) observed colonisation of grassland by forest in certain areas. Further expansion of these forest clumps is checked by seasonal grass fires as well as by the very low content of nutrients in the grassland soils.

4.4.1 Previous vegetation assessments on the Ssese Islands

Vegetation surveys have been carried out on Ssese Islands previously (Forest Department, 1996, 1998, 1999; Thomas, 1941; EIA reports 1995, 2001). These served different purposes and hence the objectives and methods varied.

The specific objectives of this vegetation survey were to:

- assess the species diversity in the project areas and its environs and the likely impacts as a result of a changed land use
- examine the conservation and sustainable utilisation vis-à-vis the proposed land use changes
- identify conservation options available for forest reserves to ensure the continued existence of species of special conservation and economic importance.
- identify issues that should be considered in the environmental and forest management to ensure minimum adverse impacts of oil palm production in project sites.

4.4.2 Study methods

Forest sites were subjectively selected after reconnaissance. They were distant from each other and always representative of the vegetation. The selection criteria for transects include:

a) Absence of obvious signs of recent disturbance and/or limited human impact in the immediate past;

b) Degree of representation of the arboreal vegetation of the area, including the local variations in topography and elevation;

c) Physiognomic homogeneity.

Plot size adopted for this study was chosen to suit the aggregated growth habits of the trees, shrubs and herbs. Square or rectangular plots have been shown to yield more accurate results than circular p-lots (Greig-Smith, 1983). Data were collected using quadrats of 10m x 50m for trees in the forest ecosystem. These were located at intervals of 100 m alternately along the transect. The UTM coordinates for the sites sampled are a) 408300; 9946600 b) 408600; 9947400 c) 412600; 9951400 and d) 419200; 9952700. Transects were placed to capture as many microhabitats types as possible. Trees of dbh $\leq$ 5cm were recorded with their respective diameter and height. The plots were temporarily marked with wooded pegs and biodegradable flagging tape. In each plot demarcated on the ground, enumeration and identification of all trees dbh $\leq$ 5cm was done. For the shrubs 10m x 10m nested plots were used and 5m x 5m nested plots for the herbaceous species. Voucher specimens were collected for specimens that could not be identified in the field. These were brought to the Makerere University Herbarium for identification. Every specimen collected was tagged and given a field identification number, which indicated the plot where it

was collected. Identifications of all species were based on floras and keys (e.g. FTEA, Polhill 1952 onwards; Beentje, 1994; Hamilton, 1991; Eggeling & Dale, 1952)

In the grasslands, a species checklist was drawn up through an inventory by walking through the grassland and a subjective measure of abundance attached to each species using the DAFOR scale. The scattered trees and shrubs in the grasslands were also recorded.

4.4.3 Data analysis

A species-sample plot matrix (Okland, 1990) was used as the primary matrix. This is based on presence/absence of species in the sample plots of the three study sites in the forests. The matrix used was 179 x 30 where the rows represented the species vectors and the columns represented sample plot vectors.

Diversity indices were used to measure the different aspects of variability in the forests studied. Species richness was the main category of diversity index used. Calculations of diversity indices and evenness were performed using the computer program EstimateS (Colwell, 1997). Diversity indices and species estimators were used to determine tree species diversity. The Shannon-Weiner Index and Simpson's Index were used. Shannon's Diversity Index, H' (Magurran, 1988) assumes that individuals are randomly sampled from an indefinitely large population (Pielou, 1975). Simpson's Index, D is a commonly used dominance measure because it's weighted towards the abundances of the commonest species rather than providing a measure of species richness (Magurran, 1988). The value of D varies as the total number of species increases, depending on the type of species-abundance relationship used in the index (May, 1981).

Jack 1 and Jack 2 jackknife estimators of species diversity (Heltsche & Forrester, 1983, Palmer, 1991) were used. Palmer (1991) discusses the merits and demerits estimating the species richness of an area when it's sub sampled with smaller units using two jackknife estimators that are nonparametric resampling procedures. The number of observed species will typically be smaller than the true number of species. These jackknife estimators produce more accurate and less biased estimates, at least when sampling a restricted area.

Similarity and grouping of the forests were investigated using cluster analysis (Okland, 1990). The Sorensens Index algorithm using centroid method of clustering was found to be the most appropriate as per the structure of data set and conditions in the field. Cluster Analysis (CA) is a technique that sorts objects (such as sampling units) into groups or clusters based upon their overall resemblance to one another (Ludwig & Reynolds, 1988). There several CA algorithms

including single-linkage, average-linkage and complete linkage, all having different ways in which clusters are formed (Johnson & Wichern, 1992); and although most CA strategies give similar results, several algorithms were explored and the results compared. Clusters were then determined from one of the CA methods based on the underlying ecological knowledge of the area (Ludwig & Reynolds, 1988).

Species accumulation curve was drawn to ascertain whether the sampling effort was sufficient for the three forest sites covered. They are used to evaluate the adequacy of sample size in a community data set. The version in PC-ORD is not intended for the island-biogeographic use of species accumulation curves, where the sample units vary in size.

4.4.4 Results

4.4.4.1 Floristics

A total number of 178 observed species were recorded on transects; an additional 8 species in grasslands through opportunistic recordings. These belonged to 62 families and 146 genera. Of these, 9 families had 5 species or more as shown in Table 7. Rubiaceae was the most speciose with 14 species followed by Euphorbiaceae (13); Apocynaceae (10); Poaceae. Moraceae and Aspleniaceae with 9 species each.

Table 7: Distribution of species among families

Family	Species number
Amaryllidaceae	1
Anacardiaceae	1
Araceae	1
Araliaceae	1
Balsaminaceae	1
Begoniaceae	1
Burseraceae	1
Costaceae	1
Cuctaceae	1
Cucurbitaceae	1
Cyatheceae	1
Dracaenaceae	1
Flacourtiaceae	1
Labiatae	1
Lauraceae	1
Liliaceae	1
Linaceae	1

Marratiaceae	1
Menispermaceae	1
Myrsinaceae	1
Oxalidaceae	1
Palmae	1
Phytollacaceae	1
Rutaceae	1
Scrophulariaceae	1
Smilacaeae	1
Thymeliaceae	1
Ulmaceae	1
Acanthaceae	2
Amaranthaceae	2
Celastraceae	2
Connaraceae	2
Guttiferae	2
Melastomataceae	2
Myrtaceae	2
Piperaceae	2
Rhamnaceae	2
Urticaceae	2
Verbenacaeae	2
Vitaceae	2
Adiantaceae	3
Dennstaedtaceae	3
Dioscoreaceae	3
Icacinaceae	3
Ochnaceae	3
Compositae	4
Marantaceae	4
Meliaceae	4
Orchidaceae	4
Passifloraceae	4
Sapotaceae	4
Zingiberaceae	4
Cyperaceae	5
Leguminosae	5
Sapindaceae	5
Annonaceae	6
Commelinaceae	6
Aspleniaceae	9

Moraceae	9
Poaceae	9
Apocynaceae	10
Euphorbiaceae	13
Rubiaceae	14
Grand Total	186

Sixty-five (65) herbaceous species were recorded, 39 lianas, 10 shrubs and 72 species of trees were also recorded. The commonest species recorded in the forest included: *Uapaca guineensis* (tree), *Tabernamontana holstii* (tree), *Aframomum luteoalba* (herb), *Myrianthus holstii* (tree), *Craterospermum laurinum* (tree), *Urera trinervis* (liana) *and Raphia farinifera* (tree). *Others are Marantachloa leucantha* (herb), *Pteris burtonii* (herb), *Palisota manii* (herb), *Geophylla repens* (herb), *Funtumia elastica* (tree), *Macaranga kilimandjarica* (tree), Paptadeniatsrum Africana (tree). These were also the predominant species at the proposed construction site of the factory. These were recorded in at least 18 of the 30 plots sampled (Appendix 7)

The dominant species recorded in the grasslands were *Loudetia kagerensis, Panicum maximum, Hyparrhenia filipendula, Themeda triandra*, with *Bulbostylis ugandensis* and *Scleria catophylla* being more common in the disturbed areas and roadsides. Others included *Harungana madagascariensis, Earlangea sp., Brachiaria sp., Measopsis eminii, Tridax sp., Biophytom petisiamum, Macaranga kilimandjarica, Peddea fischeri, Tetrachidium didymonstemon, Dissotis sp.* Other tree species recorded included *Uapaca guineensis*, and *Xylopia parviflora.*

4.4.4.2 Species accumulation curve

The curve for the observed species (Sobs) shows that species saturation was approached although the species richness estimators Jack 1 & Jack 2 (Figure 6) show otherwise.

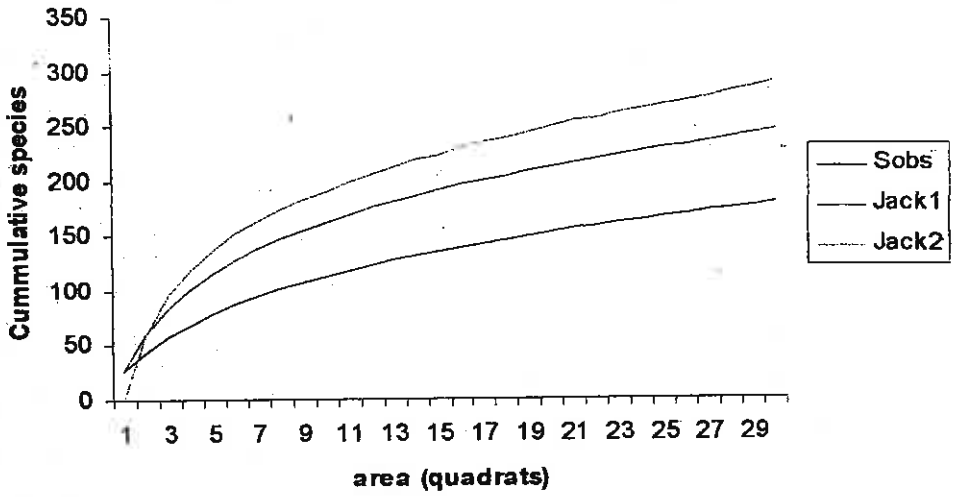


Figure 6: Species accumulation curve for the species found in the sampled forested area

4.4.4.3 Similarity and grouping of sites of forests

Spatial changes were detected between the plots. The similarity indices varied between 0.483 and 0.603 as shown in Table 8 demonstrating a fairly high species turnover between the plots. From both the similarity matrix and tree (Figure 7), it can be seen that sites 2 and 3 were more similar in terms of species composition with a similarity index of 0.603.

Table 8: Similarity matrix (Sorensens index) from plots species data of plots sampled

	Site 1	Site 2	Site 3
Site 1	1.000		
Site 2	0.554	1.000	
Site 3	0.483	0.603	1.000

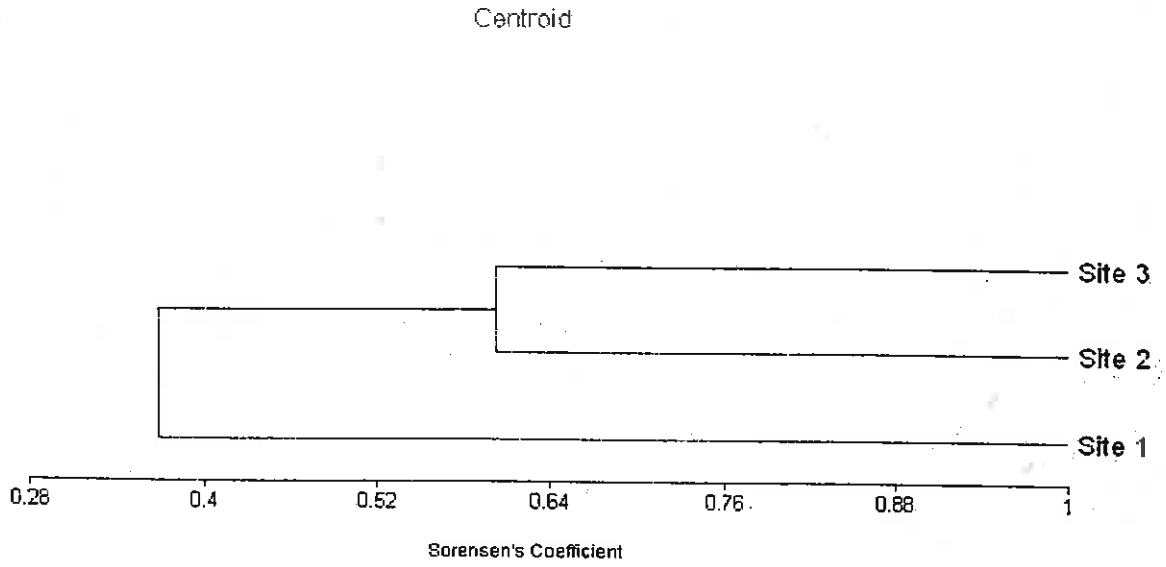


Figure 7: Cluster diagram for the species from the 30 plots in forests (Similarity based on Sorensens index)

4.4.4.4 Species richness estimations

The species richness estimations as per the Jack 1 and Jack 2 species richness estimations are 244.7 and 288.4 respectively (Table 9). It's argued by Palmer (1991) that observed species richness does not give a true estimate of species richness. It always underestimates it because you cannot count all species in a given area. Hence the adoption of estimators like the ones mentioned above. This is relatively high species richness for the forest sites sampled. This depicts the high species richness characteristic of high rainfall tropical forests.

Table 9: Species richness estimations and diversity indices.

Samples	30
Sobs	178
Individuals	825
Singletons	69
Doubletons	23
Uniques	69
Duplicates	23
Jack1	244.7
Jack1_SD	9.65
Jack2	288.37
Jack2_SD	0
Shannon	4.67
Shannon_SD	0
Simpson	82.04

4.4.4.5 Population structure

Results are presented in Figure 8 of the diameter class distributions of the tree species found in the study sites. Most individuals were recorded in the 0 – 10 cm class. The distribution of diameter size classes shows inverted J-shaped curve with a slight deviation.

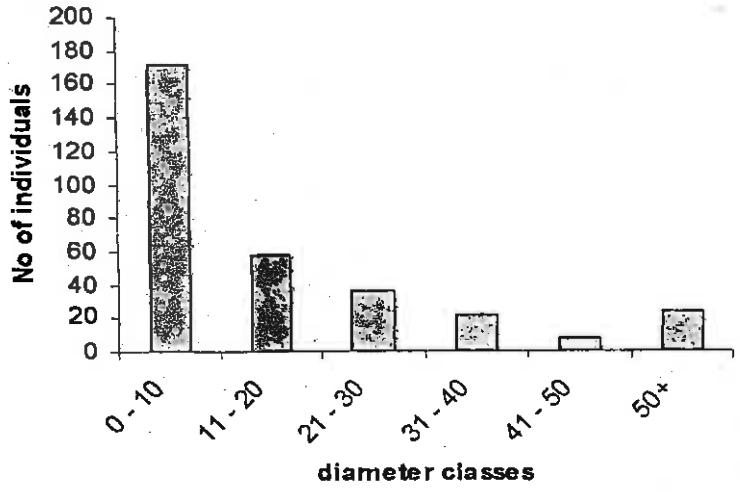


Figure 8: Size class distributions of the tree species in all sites studied

This inverted J-shaped curve (negative exponential distribution) is typical for trees in many forests, including the tropics (Richards, 1952). It is an indication of mature forest stands with many young trees coming up and few old ones (Nadkarni et al., 1995).

There were many large stemmed individuals recorded in the forest sites. Presence of large stemmed individuals is an indication of the maturity of a forest, but evidence is still limited. Some deviation was noticed in the shape of the reversed J-shaped curve. Nadkarni et al., (1995) report that deviations from the J-shaped curves imply disturbances in the natural environments. Tropical forest, dominated by particular tree species (in this case *U. guinensis*), often occur on nutrient poor or moisture sites (Connell & Lowman, 1989). The persistence of *U. guineense* persistence can be ascribed to possession of ectotrophic mycorrhizae, or fairly large seeds and high degree of shade tolerance, high rainfall regime, including immunity to attack by natural enemies like insect predators etc.

4.4.4.6 Species richness

The species richness recorded in this study is indicative of the richness of the flora on the forests of Bugala Island. Hill et al., (1994) reports that both the effects of the ecological processes alone and sampling alone increase species number with area but they also point out that only ecological processes could be expected to increase the number of species per unit area. A record of approx. 190 plant species in about 2 ha. is a high species number in a tropical rain forest. Species richness was observed to increase with increasing area and this reflects the floral richness of the forests. Species richness was relatively high given the ecological status of the forests in light of succession and previous disturbances.

4.4.4.7 Diversity

The Simpson's Diversity Index, D being a dominance index is weighted towards the abundances of the commonest species rather than providing a measure for species richness (Magurran, 1988). As D increases diversity decreases though when the reciprocal form of Simpson's is adopted, the value of the index increases with increasing diversity. A value of 82.4 denotes high species diversity and a very low dominance of species. The Shannon Index gave a diversity value of 4.67. This denotes a high species evenness and richness in relative terms. This further implies that these forests have relatively high species richness in general terms. This could be attributed to the high rainfall regime and intermediate levels of disturbance on this island compared to the mainland forests.

4.4.4.8 Species of special conservation significance

Species recorded and found to be rare in the forested lands as per the quadrats surveyed include *Ficus denstipula, Englerophytum oblanceolatum, Dioscorea baya, Acacia pentagona* and *Afromamoum zambezica*. These are of special conservation value because of their rarity. This study did not record any of the species reported to be endemics of the Ssese Islands forests. Nevertheless, it has revealed some insights on the relative importance of these forests in terms of species diversity, which can be considered indicative of the overall floral diversity.

4.4.5 Implications of the 'no project scenario'

Forests make substantial contributions to the country's economic development and well-being (NEMA, 2001). Forests contributed 6% of the nations GDP in 1999. Products and services provided by forests include fuel wood, employment, subsistence needs, environmental services and biodiversity, and tourism. Deforestation is the main environmental issue confronting

Uganda's forests (NEMA, 2001). Impacts of deforestation include destruction of habitats, reduction in water catchments potential of forests, soil erosion, landslides, siltation, loss of environmental functions etc.

In the event that the project is not implemented, it is expected that there will be continued exploitation of the forest for timber and other forest products in both the Forest Reserves and forests on the private lands. Encroachment will continue as the population grows and this will lead to forest degradation. The long-term projection is that forest estate will continue dwindling. This is expected to be at a high rate because of the high growth rate on the islands projected at about 6% per annum (Population Office, Kalangala district). Though the extent of the impact on biodiversity is difficult to determine, there is no doubt that this will be negative.

4.4.6 Community use of plant resources

During this study, it was observed that there is continued harvesting of timber and other forest products from forests though it was not easy to ascertain whether it was licensed or not. It was also observed that charcoal burning especially in the acquired lands is prevalent. Trees cut for charcoal burning include *Uapaca guinensis* and *Maesopsis eminii*. The former is also used for timber and making of canoes for the fishermen. Fuel wood harvesting is mainly at subsistence level and there are no preferred species as such, although charcoal is sold in trading centres. The grasslands provide thatching material from the *Hyparrhenia* and *Loudetia* spp.

4.4.7 Impacts

The project will lead to loss of vegetation (Figure 9 and Table 10) due to the establishment of both the nucleus estate, outgrowers/smallholders and establishment of processing facilities. In addition there is likely to be increased deforestation due to increased demand for fuel wood and farmland.

The loss of forest cover is only a short-term impact, however. It is expected that, after the oil palm trees are fully established, the forest coverage on the island will be the same or greater than the existing coverage due to planting in some grasslands.

Table 10:Summary of land use/cover types potentially affected by the oil palm project

Cover type	Area in project land	Area on Bugala island	As % of total project area	As % of total cover type area on island
Crops	141.50	1,330.90	2.15	0.53
Crops/Forest	253.75	2,714.93	3.86	0.95

Grassland	1,976.00	3,730.41	30.06	7.43
High forest	3336.075	14,781.32	50.75	12.54
Open high forest/crops	300.50	366.88	4.57	1.13
Wet Forest	262.75	789.55	4.00	0.99
Wetland	303.50	2,893.42	4.62	1.14
TOTAL	6,574.08	26,607.42	100	24.71

Source: Calculated from data provided by the National Biomass Study Programme See appendix 8

4.4.7.1 Negative impacts

- **Plant species diversity decline**

The impact of clearance on biodiversity depends on its biogeographic significance and conservation status. It will tend to be significant in areas where ecosystems contain a relatively high diversity of habitats and high numbers of endemic species with restricted ranges, especially those that are also considered to be threatened. It is noted under 4.4.4.4 that the proposed sites have high species diversity (species richness estimates of 244.7 and 288.4).

It is expected that clearing of the vegetation will decrease the biodiversity value of these forests, particularly the floral diversity. The oil palm will be the dominant woody perennial. It is, however, important to note that as the oil palm trees age, there will be a number of ephemerals established on the trunks.

- **Habitat loss**

The impacts of vegetation clearance on the extent of floral ecosystems and ecological communities are well known. The immediate effect of clearance on plant and animal species can be significant. Longer-term effects of vegetation clearance on species can result from habitat loss and fragmentation in combination with other threats. It is anticipated that there may be decrease in species richness and abundance due to the gradual clearing of forest cover within the project area.

- **Decreased availability of forest products**

When the oil palm project reaches its peak (i.e., highest production levels), there will be less forested land and, therefore, availability of forest products such as fuel wood, charcoal

and other forest products will decrease. This is bound to increase the cost of living as prices of various products rise.

- **Soil erosion**

Soil erosion might occur during the first phase if vegetation clearance and nursery establishment is poorly planned.

4.4.7.2 Positive impacts

- **Increase in forest cover**

In the long term there will be an increase in forest cover due to implementation of the project. Some of the lands acquired are depleted forests or grasslands that will be planted with oil palm trees.

- **Increase in biomass**

Mature stands of oil palm trees tend to have a higher biomass than the forest type now on the island.

4.4.8 Mitigation

Table 11 gives a summary of potential negative impacts on vegetation (both direct and indirect) that would arise as a result of implementation of the project and the proposed mitigation measures.

Table 11: Proposed mitigation measures and responsible institutions/agencies

Potential Impacts	Mitigating measures	Implementing Institution
Loss of existing natural vegetation	▪ Setting up woodlots for energy needs ▪ Phased clearance of natural vegetation ▪ Establishment of oil palm plantation (tree cover will add to forest cover) ▪ Gazetted forests will not be converted ▪ Planting cover crops	▪ District Environment Office ▪ District Agriculture Office ▪ District Forest Office ▪ Developer
Destruction of environmentally sensitive areas such as swamp forests	▪ River banks, lakeshores left intact ▪ Location of the factory to avoid water pollution ▪ Treatment of oil mill effluent	▪ District Environment Office ▪ District Forest Office ▪ Developer
Disposal of woody debris	▪ Wood from species such as *Uapaca guineense* and *Maesopsis eminii* will be converted into timber for construction ▪ Other debris will be used as compost	▪ District Environment Office ▪ District Agriculture Office ▪ District Forest Office ▪ District Engineering Department
Decline in timber	▪ Sustainable harvesting regimes in	▪ District Environment Office

Potential Impacts	Mitigating measures	Implementing Institution
production	production zones in forest reserves to ensure continued timber supply ▪ Some private forest will not be converted hence will continue to supply timber	▪ District Forest Office ▪ NEMA
General decline in private forest cover leading to reduced local availability of forest products	▪ Forest reserves to supply some needs under the collaborative forest management approach ▪ Utilisation of other private forest ▪ Encouraged reservation of trees in farmland ▪ Agroforestry programmes ▪ Afforestation programmes	▪ District Environment Office ▪ District Forest Office ▪ District Agriculture Office
Degradation of soil from erosion, and removal of vegetation cover	▪ Temporary erosion control measures: contours, mulching of exposed areas. ▪ Permanent erosion control measures: reserve forest patches in erosion prone areas; plant with *Paspalum notatum* on sides of tracks and roadsides; plant cover crop e.g. *Calliandra* or *Pueraria* that are useful as mulch and fodder ▪ Closed canopy oil palm crop should reduce erosion to minimal levels in the long run	▪ District Environment Office ▪ District Forest Office ▪ District Agriculture Office

However, afforestation with indigenous species in areas that will be deemed unfit for oil palm growing will be carried out. This is expected to counter the effect of clearing for oil palm growing, though not as effectively as would be expected under natural conditions.

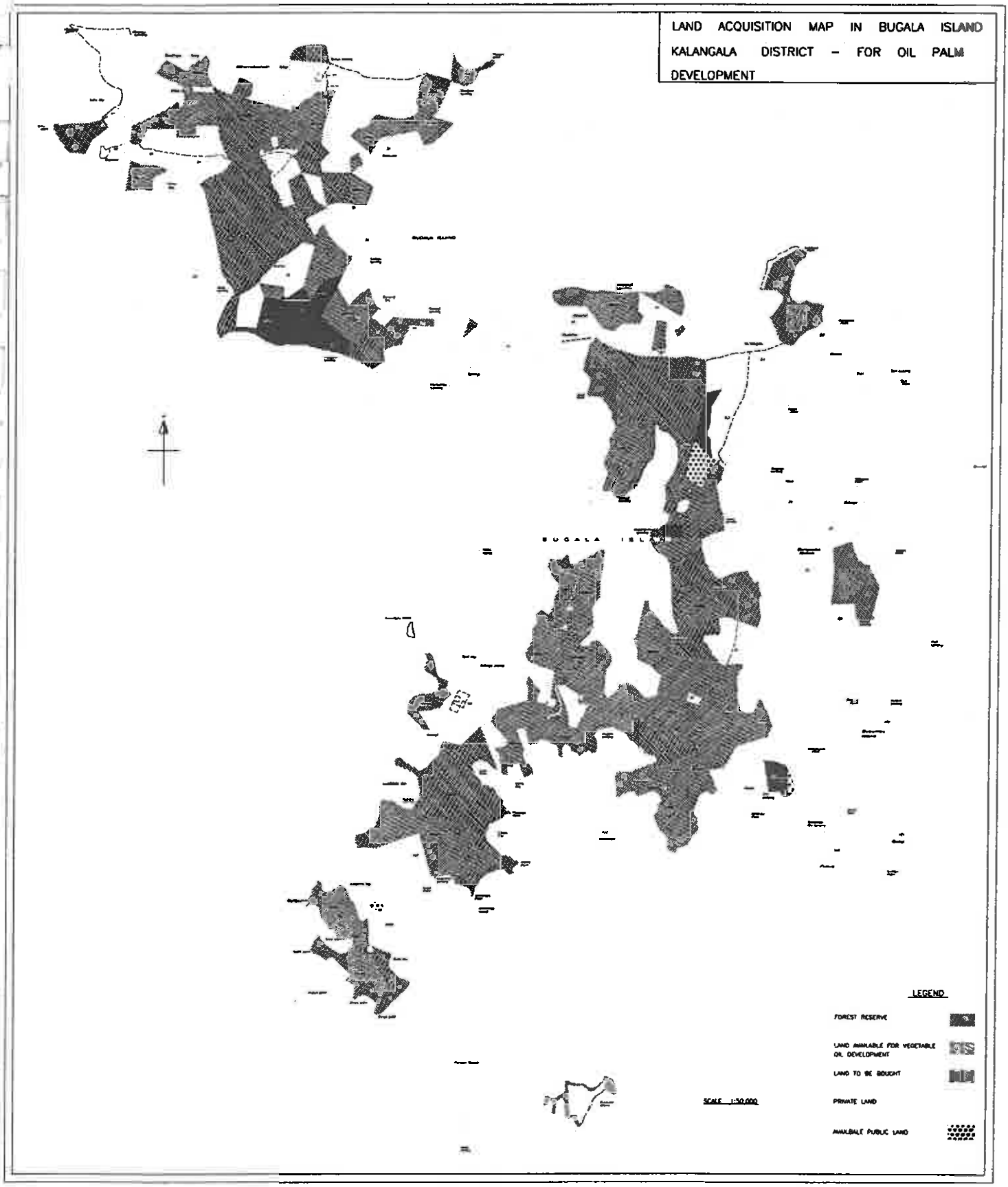
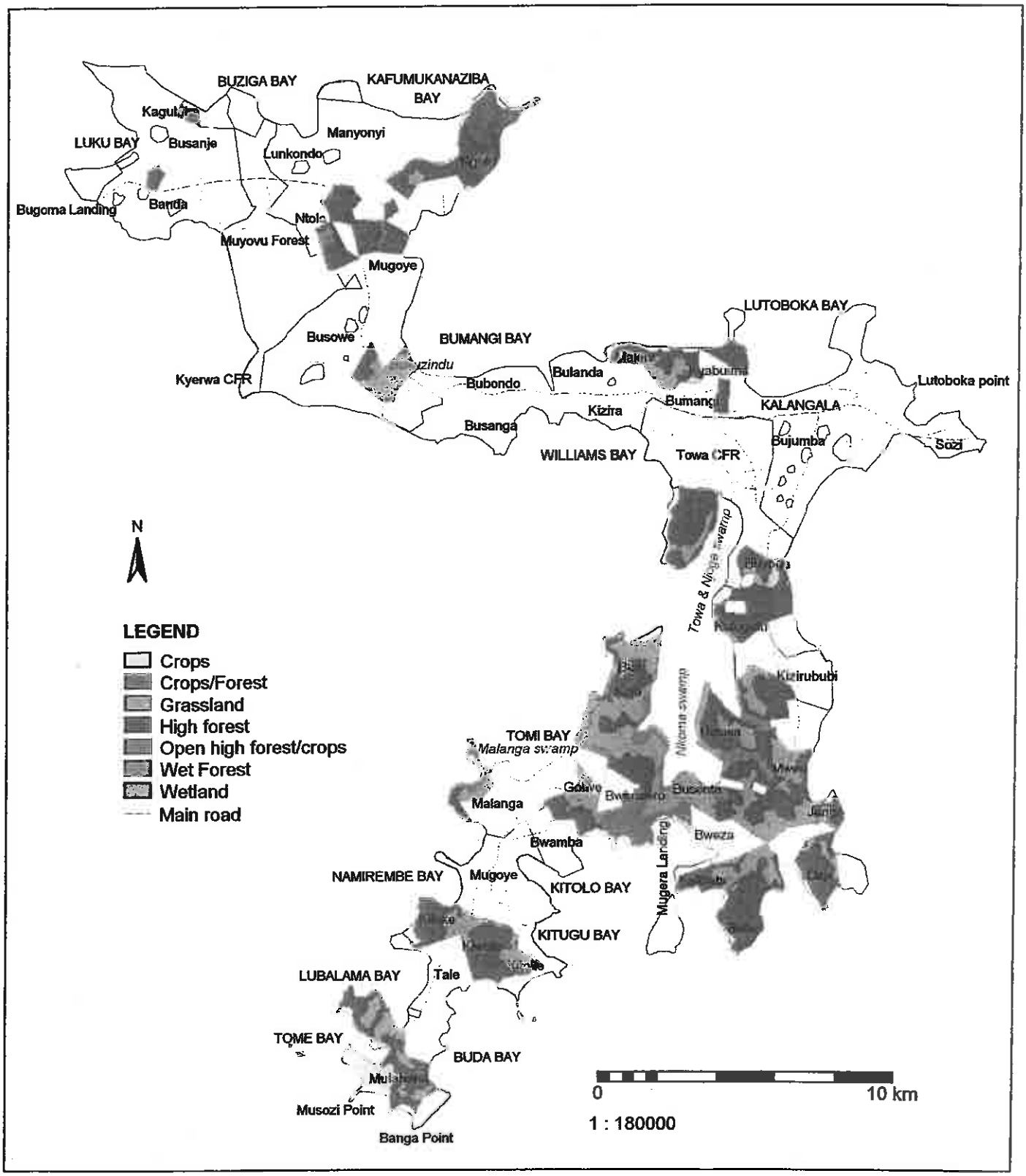

LAND ACQUISITION MAP IN BUGALA ISLAND KALANGALA DISTRICT – FOR OIL PALM DEVELOPMENT
LEGEND
FOREST RESERVE
LAND AVAILABLE FOR VEGETABLE OIL DEVELOPMENT
LAND TO BE BOUGHT
PRIVATE LAND
AVAILBALE PUBLIC LAND
SCALE 1:50,000

Figure 9: Map showing land use/cover of areas for oil palm development



4.5 FAUNA

A number of biodiversity surveys have been carried out on the Ssese islands over the past century, but there has not been any consistent monitoring programme. This section features some of the major surveys focusing on avians, mammals, butterflies and, to a lesser extent, amphibians and reptiles.

4.5.1 Mammals

Small mammals, including rodents and insectivores, are an important part of terrestrial ecosystems. Impacts on the dynamics of their populations, species composition and preferred habitats may have gross and irreversible impacts on the ecosystem for other species. They are also important as pest species. Larger mammals are important for similar reasons in addition to their aesthetic values. Due to relative ease in sampling, the terrestrial small mammals are most commonly used as indicators and of and for monitoring environmental change.

The Ssese Islands are not particularly known for a rich mammalian diversity, though there have been records of important endemic species on the islands. Detailed mammalian surveys have been carried out on the islands before by Delany (1975), Kingdon (1971-74), Kityo (1991) and the Forest Department (1996).

In a comprehensive survey of small mammals on the Ssese Islands, Kityo (1991) recorded 11 species of terrestrial small mammals on Bugala Island (listed in Table 12). A total of 13 species have been recorded before on this island but two* were not recorded in Kityo's survey.

Table 12:Small terrestrial mammals of Bugala Island

Species
*Dendromus mysticalis**
Otomys irroratus
Thamnomys dolichurus
Oenomys hypoxanthus
Dasymys incomtus
Pelomys isseli
Rattus rattus
Praomys jacksoni
*Mastomys natalensis**
Mus minutoides
Luphuromys flavopunctatus

Luphuromys sikapusi
Thryonomys sp.

Source: Kityo (1991)

Of special interest is the species *Pelomys isseli*, a Ugandan endemic only known to occur on the Ssese islands. The low species diversity on the island is perhaps a result of its isolation from the mainland. Another important species recorded on the islands (including Bugala) is the sitatunga, *Tragelaphus spekei spekei*. This is an antelope adapted to living in wetlands, but the population on the islands is considered unique due to adaptation to living within an upland forest habitat (Kingdon, 1982). These two species would need special protection, as they are likely to be seriously affected by habitat alteration. Vervet monkeys (*Cercopithecus aethiops*) are abundant throughout Bugala Island and may present the most serious pest problem. Hippos (*Hippopotamus amphibious*) are occasionally sighted at the lakeshores. These species are important and should be included in a monitoring programme.

4.5.1.1 Impacts

- **Loss of habitats**

For mammals the most serious impact could come from the alteration and loss of habitat. This means the animals have to find new breeding and feeding grounds and, for species that are unsuccessful, the result would be a decline or loss of the species. While the small terrestrial mammals are highly adaptable and some species such as *Praomys jacksonii* could easily adapt to live in a palm plantation, the effects for larger mammals, particularly the unique sitatunga population on the island could be more negative. The sitatunga population on the islands, though adapted to living on upland forested habitat, still needs the aquatic environment and they would not live too far away from the lakeshore. Similarly the endemic rat *Pelomys isseli* has previously been captured in a swampy or semi-aquatic habitat.

- **Behavioural change**

The effects on all mammals could be significantly negative if they adapt to become pests on the palm oil fruits or by-products. This would probably elicit a pest-control strategy response that may involve methods or operations that are destructive to the animals.

4.5.1.2 Mitigation

- Maintain a fairly heterogeneous habitat in the palm plantations during the early stages of the project, to allow for adaptation of certain species. This can be done by phasing vegetation clearing and planting. A ratio of at least 1:5 of natural to converted habitat could be maintained in the initial three years of the project.
- The lakeshores and vegetation near the shore should be left intact to preserve important habitat and population for the aquatic mammals.
- A comprehensive pest control strategy worked out by the developers in conjunction with UWA and other stakeholders.
- Constant monitoring, with comparisons on distribution and abundance between the natural and converted habitats, to give an idea on how all the species are adapting to habitat change.

4.5.2 Butterflies

Butterflies are conspicuous, taxonomically tractable and diurnal in habit, which greatly facilitates their study. A number of surveys have been conducted before on the butterfly fauna of the Ssese Islands, by among others, Carpenter, 1920, Carcasson, 1961 and D'Abrera, 1980. Butterflies are usually sampled using baited traps and sweep nets. A total of 122 species of butterflies comprising 5 families were recorded in the Ssese Islands in the most recent comprehensive survey (Forest Department, 1996). Although butterflies are widely adaptable to different habitats, there are species with specific habitat requirements that could be affected by habitat alteration.

Butterfly species of special interest on the Ssese islands include the nymph *Acraea simulata*, an extremely uncommon and little known butterfly, endemic to Uganda and specifically to the Ssese Islands (D'Abrera, 1980). Two other subspecies endemic to the Ssese Islands include *Thermoniphas togara bugalla* and *Acraea epaea angustifaciata*. Species recorded that are closed forest specialists include *Caenides dacela*, usually restricted to dense forest from 800 to 1300 metres. Its distribution is limited by its larval food plant, the palm *Phoenix dactylifera*. Others are *Neptis puella*, a predominantly West African species, and *Teratonuera isabellae*. Butterfly species of internationally restricted range include *Telipna nyanza* known from Eastern Congo (DR) and Uganda, and *Pseudacraea boisduvali*. Other rare specie includes *Euptera elebontas* and the sub-species *Triclema lamias katerae*, which is known in Uganda and rarely in Western Kenya (Forest Departemnt, 1996). Any monitoring programme will need to take into account the habitat

requirements for butterflies, specifically those of the endemic or restricted range species. A full list of butterfly species composition can be found in the Biodiversity Report (Forest Department, 1996).

4.5.2.1 Impacts

Butterflies associate with particular plant species for breeding, feeding and habitation. They could thus be affected in a similar way as the mammals due to habitat alteration. For some species the effect could be more severe, especially the endemic and close forest specialists mentioned above. Many of the butterfly species on the island are adaptable and the ones of special conservation concern are protected in the Forest Reserves.

4.5.2.2 Mitigation

- Special attention needs to be paid to the presence of habitat specialists in the project area. Areas of closed forest need to be monitored for any of the species of concern, and habitat conversion needs to be properly phased after comparing the species distribution in the project area and the natural habitat.
- If a site proves to be vital for the conservation of a certain specie or group of species the developer could consider leaving small patches of the natural vegetation or of the specific plant species used for breeding, such areas could also be used for an integrated tourism project by the developer.
- The tree/plant species or the areas determined as important for butterfly conservation should also be protected from pesticides/herbicides. Such chemicals could have a negative effect on butterflies and other insects.

4.5.3 Amphibians

Amphibians are known to be good bio-indicators because they often respond to environmental changes probably more rapidly than any other taxon. They can therefore serve as early warning indicators of environmental degradation. Amphibians are also important as indicators because they are known to be an easily recognisable taxon in a given habitat, and populations are often specialised within a narrow habitat. This makes it easy and practical to monitor changes in composition over time, given different conditions. Geographical ranges of amphibians are also smaller than those for other vertebrates, which makes them more likely to be affected by vegetation changes faster than other vertebrates.

In an Environmental Impact Assessment study carried out in 2000, 17 amphibian species were recorded. These were mostly found at the lakeshores, an area that was not to be directly impacted by the project activities, except in the case of extensive use of pesticides that could find their way into the water. Indeed amphibians thrive best in or near an aquatic habitat. The only species that was regularly encountered in the forest away from the water edge was the common toad, *Bufo regularis*. Most of the species encountered are also found in water-bodies on the mainland. Table 13 lists the amphibian species recorded.

Table 13:Amphibians of Bugala Island

Bufo regularis
Bufo vittatus
Bufo sp.
Xenopus laevis laevis
Afrixalus quadrivittatus
Hyperolius viridiflavus bayoni
Hyperolius viridiflavus variabilis
Hyperolius k. bituberculatus
Hyperolius nasutus
Hyalarana galamensis
Hyalarana albolabris
Ptychadena anchiate
Ptychadena porississima
Rana occipitalis
Kassina senegalensis
Leptopelis bocagei
Phrynobatrachus graueri

Source: (EIS 2000)

4.5.4 Reptiles

Most reptiles, unlike amphibians, are highly mobile and are diversified in habitats. They can be encountered in aquatic habitats, shorelines, rock outcrops, trees and bushes and on any slopes of the terrain. The more specialised in habitat use such as crocodiles, monitor lizards and water snakes, are good for monitoring changes in habitat due to human activity.

During an EIA study (2000) 13 species were recorded (see Table 14).

Table 14: Reptiles of Bugala Island

Scientific name	Common name
Typhlops lanceolatus	Blind Snake
Python sebae	African Rock Python
Philothamnus sp.	Green Water Snake
Dendroaspis jamesonii	Green Mamba
Naja melanoleuca	Water Cobra
Bitis arietans	Puff Adder
Causus rhombeatus	Night adder
Dispholidus typus	Boomslang
Hemidactylus brookii	Common house Gecko
Mabuya quinquetaeniata	Rainbow Skink
Agama atricolis	Blue-headed agama
Agama agama	Orange-headed Agama
Varanus niloticus	Nile Monitor

Source: EIS (2000)

Except for species such as the green water snake and the water cobra, most of the species recorded were terrestrial, and are adaptable to a wide variety of habitat types. Though it would be useful to monitor the response of all species to change in land use, the species that would probably be mostly affected by agricultural activity, especially if pesticides are used on a large scale would be the aquatic species. All the reptile species recorded above widely spread throughout the mainland.

4.5.4.1 Impact on amphibians and reptiles

Amphibians, and to some extent reptiles, require predominantly aquatic/semi-aquatic habitats. Reptiles are particularly more adaptable to a wide range of habitats than amphibians. While most of the reptile species listed above are adaptable and would not be significantly affected by habitat alteration, the amphibians would be more significantly affected in case of alteration of their habitat quality. The upland areas are not rich in amphibian species compared to the shorelines. The discharge of effluent or other wastes and disturbance of the vegetation at the shorelines would have a high negative impact on amphibians and a few aquatic reptiles. This would be as a result of poisoning of the animals, and especially of their eggs and the destruction of breeding and nesting ground.

4.5.4.2 Mitigation

The shoreline habitats should be protected according to Uganda's environmental regulations and this would significantly reduce the possible negative impacts of the project on amphibians. Discharge of effluents or waste into the lake (not anticipated) should not be done without treatment.

4.5.5 Avifauna

4.5.5.1 Study area

The study area is within the Lake Victoria biome, which is one of the regional centres of endemism (White, 1983). This biome has various habitats ranging from lowland forests, grassland and papyrus swamps to open mudflats. Some of these areas form important bird habitats that include large waterbird congregation. The Lake Victoria biome contains 12 characteristic bird species three of which occur at Bugala Island, namely: Black-lored Babbler (*Turdoides sharpie*); Red-chested Sunbird (*Nectarinia erythrocerca*) and Northern Brown-throated Weaver (*Ploceus castanops*). The study area has a diverse species of birds. The area is dominated by birdcalls of species such as Tambourine Dove (*Turtur tympanistria*), Little Greenbul (*Andropadus virens*), Common bulbul (*Pycnonotus barbatus*), White-spotted Crake (*Sarothrura pulchra*), Paradise Flycatcher (*Terpsiphone viridis*), Yellow-breasted Apalis (*Apalis flavida*) and Western Black-headed Oriole (*Oriolus brachyrhynchus*).

4.5.5.2 Materials and methods

Birds in the Direct Impact Zone (DIZ) were studied using Timed Species Counts (TSC), mist-netting and opportunistic observations. These methods are essential to the compilation of species list and determination of relative abundance of birds for an area. Reference was also made to previous studies in order to compile the species list for the study area. In the field, 8 x 42-field binoculars and field guides were used.

- **Timed Species Counts**

Timed Species Counts is a simple quantitative technique of studying the avifauna of large areas by sampling representative habitats. TSCs yielded two kinds of information: species richness which was extrapolated to give the approximate total number of species in the given habitat; and relative abundance at a variety of sites and in providing information on bird's habitat preferences.

During each TSC, the observer moved slowly in a defined area for one hour listing all species positively identified either by call or seen (Pomeroy, 1992). The listing included all species flying over regardless of their distance and the time noted at 10-minute intervals against the growing list. Species recorded in the first ten minutes were then scored 6, for the next ten minutes 5, and so on to 1 for the last ten minutes. Mean scores over a series of counts were then obtained to reflect the species relative abundance.

All together, seven counts were made in the project area at different times of the day (starting at 9:30 hours in the morning and ending at about 17:00 hours in the evening) for three days. All the seven counts were done along the accessible areas of the forests and the grassland habitats, where the project activity will take place. Efforts were made to sample as many microhabitats in the project area as possible. Pomeroy (1992) recommended that for good quality data from TSCs at least ten counts should be made. Since only seven counts were made, the assessment of the data quality is medium, that is, (B-medium).

- **Opportunistic Observations**

All those species of birds that were not counted in the TSCs but were observed were recorded to maximise the number of species encountered in the study area. This method involved moving around the study area at different times and listing different bird species as they were encountered. There was no time limit and the observations were extended beyond the project area. Notes on the species, its habits and habitats, breeding, and abundance were taken when the method was being used.

- **Previous Work**

A review of several ornithological studies (Carpenter, 1920; Pitman, 1929 and Southampton University, 1970) on the Ssese islands provided some additional record of the species not recorded in this study. When combined with the Forest Department Biodiversity Study (1996) of three forest reserves in Bugala Island, a useful insight into bird communities of the island was provided.

- **Mist-netting**

Mist netting was carried out in selected forested, forest edge and grassland areas of the study area (Direct Impact Zone) on the assumption that the habitats were representative. A total of 4 mist-net hours were made with two ten meters net set under the forested and forest edge habitats. The nets were opened from 10:20 in the morning to about 14:30 hours in afternoon. Otim (1995)

recommended that the nets should be opened for approximately 36 hours of daylight in order to be effective.

4.5.5.3 Data analysis

- **Species identification**

Birds in the project area were effectively identified using standard field guide reference texts: Birds of East Africa by Van Perlo (1995), Birds of Kenya and Northern Tanzania by Zimmerman et al (1996) and The Birds of Africa Volume I-III by Fry et al (1988).

Birds recorded were given ecological categories where possible to determine their preferred habitat types (Wilson, 1995; Bennun et al, in press). The categories are as follows:

FF: forest specialists – these are true forest species most characteristic of the interior of undisturbed forest. Breeding also happens in the forest.

F: forest generalists – typical birds of forest edges and gaps. Breeding is typical within forest of some type.

f: species – forest visitors and breeding is outside the forest.

NF: non-forest species. These species are either grassland or wetland species

W: water-birds – specialists – normally restricted to wetlands or open water.

w: water birds – non-specialists but often found near water.

Descriptions of conservation status of regional importance were also assigned to birds recorded following Bennun and Njoroge (1996):

- Critical in the region R-CR
- Endangered in the region R-EN
- Vulnerable in the region R-VU
- Near-threatened in the region R-NT very close to vulnerable (Collar et al., 1994)
- Regional Responsibility R-RR Species with at least 90% of range or population within political boundaries and or confined to coastal or Albertine Rift forest or papyrus and or with population which depend on a very few significant sites for breeding or during migration.

A TSC assumed that the more common and abundant species are most likely to be seen or heard within the first minutes and in higher proportion of the count and hence have higher scores. The converse is true for the less common and abundant species. Averaging of the TSC scores therefore gives some indication of the relative abundance or rarity of a species in the area. In this study the average TSC scores of 4.0 to 6.0 is taken to indicate common species and 2.0 to 4.0 to indicate frequent species and less than 2.0 to indicate uncommon or rare species.

4.5.5.4 Results

- **General**

The full list of 75 bird species was recorded in the study area and the surrounding areas of the project as presented in Appendix 9. Previous EIA and work done on the avifauna of three forests of Bugala Island yielded eighty-nine species bird species (Biodiversity Report, 1996). Therefore, the seventy-five bird species recorded is almost typical of this area and the data set can be considered to be sufficient and representative of the area. Ssese Island archipelago has been observed to contain less diverse bird species than equivalent mainland habitats. The number of species recorded in this study supports this observation. However, some species are more abundant than they are normally represented in other habitats. Paradise Flycatcher (*Tersiphone viridis*) and Winding Cistiocla (*Cisticola galactotes*) have been encountered in much large numbers in the forest and forest edges and the grassland respectively. The lower bird species diversity could be attributed to the size and the level of disturbance the island went through in the early 1900 when the forests were cleared because of sleeping sickness epidemic.

The species composition appears to be similar throughout the study area when defined by analysis of the ecological characteristics of the bird species recorded. About 32% of the species are dependent on the forest habitat and 54% of the total depends on the forest edges, open habitat in the forest and the grassland. A significant number of water birds were also observed. This is because habitat characteristics do not indicate significant difference in composition. The bird species composition of the study area is comparable to the lakeshore areas of Sango Bay, Busoga and Mpigi (Biodiversity Report, 1996), although they appear to be less diverse. The area studied indicated signs of degradation. Pit sawing is rampant in the forested project area, occasional burning of the grasslands and grazing also takes place.

Of the 60 bird species recorded during TSCs (Appendix 9), the majority (61%) were uncommon, 18% were frequent whereas 21% were common. The latter included species such as White-

spotted Crake (*Sarothrura pulchra*), Tambourine Dove (*Turtur tympanistria*), Yellow Bill (*Ceuthmochares aureus*), Black and White Casqued Hornbill (*Ceratogymna subcylindricus*), Western Black-headed Oriole (*Oriolus brachyrhynchus*), Little Greenbul (*Andropadus virens*), Common Bulbul (*Pycnonotus barbatus*), Grey-backed Camaroptera (*Camaroptera brachyura*), Olive Sunbird (*Nectarinaia olivacea*), Snowy-headed Robin-Chat (*Cossypha niveicapilla*), African Paradise Flycatcher (*Terpsiphone viridis*), and Yellow White (*Zosterops senegalensi*)s. This is the general trend in ecological communities to have a few very common species and many less common.

A total of six metre-net-hours (mnh) were undertaken in at the forest edges and the forests in the study area catching 11 individual birds of four species, producing a capture rate of 1.8 birds caught per mnh. Since only six mist-net hours were made in the study area (Direct Impact Zone) the assessment of the data quality is poor (D-Poor) as was the case in the previous study.

- **Species of conservation concern**

Out of the 75 bird species recorded during this study, none is endemic or of global concern. However, seven species are listed in the East Africa Regional Red List of Birds (Bennun and Njoroge, 1996) as shown in Table 15. This include the Great White Egret (*Egreta alba*) and Weyn's Weaver (*Ploceus weynsi*) which are mainly threatened by loss of suitable habitats including breeding sites, Grey Parrot (*Psittacus erithacus*) that are under pressure from hunters who capture young ones for illegal trade as pets. The 200m strip around the Lakeshore will provide additional habitats for water birds and forest birds.

Table 15:Bird species that are threatened or of regional responsibility in the project area

Common Name	Habitat category	Threat/RR category
Great White Egret	W	R-VU
Grey Parrot	FF	R-NT
Black-lored Babbler	f	R-NT
African Marsh Harrier	W	R-NT
Red-chested Sunbird	f	R-RR
Northern Brown-throated Weaver	F	R-NT
Weyn's Weaver	F	R-VU

Key: R-NT = Regional Near threatened
R-RR = Regional Responsibility
R-VU = Regional Vulnerable
W = Water bird specialist
F = Forest generalist
f = Forest Visitors

Notable migrant present was the Black Kite although resident populations (races) are present. There are also a number of intra-African migrants, which may not occur in the area in certain months of the year. These include Woodland Kingfisher and White-throated Bee-eater.

Bugala Island has been and is still known to support breeding colonies of Great Cormorant (*Phalacrocorax carbo*) on rocky and fringing habitats. According to Byaruhanga et al, 2001, the island may support as many as 50,000 breeding colony of Great cormorant but Important Bird Area Inventory Team recorded 5,000 nests at Lutoboka and 500 nests at Banga. A large breeding colony is found at Lutoboka point near Kalangala Township and at Banga point. Conservation of these sites is paramount. However, the project is not targeting these sites.

The study recorded 75 species of birds, none of which is of global conservation concern. However, seven are listed as species of regional conservation concern (Bennun and Njoroge, 1996).

A range of both potentially positive and negative impacts that may be caused by the development of the project were identified. During the clearing phase, the main negative impact will be on forest and wetland birds in the project area as result of lost of habitats.

4.5.5.5 Impacts

4.5.5.5.1 Clearance phase

Negative impacts

- **Ecosystem disturbance**

Disturbance during clearance of vegetation may cause avoidance of some sections of these habitats by birds such as White-spotted Crake, Little Greenbul, Yellow Bill, Black-lored Babbler, Weyn's Weaver, Northern Browned Weaver and Tambourine Dove. This however is likely to be a short-term impact, which can be categorised as insignificant.

- **Loss of habitat**

Clearance of the vegetation is likely to cause significant impacts on the avifauna, as some habitats will be lost. This will affect forest specialists and generalists as well as wetland specialists and generalists more than other ecological groups, because of the loss of food, breeding areas and the suitable microclimate. However, the sites (Lutoboka and Banga Points), which are Important Bird Areas (IBA) and where waterbirds are prevalent, are all outside the proposed sites, hence no significant negative impact on the group is anticipated.

- **Erosion and siltation of lake and wetlands**

Clearance of vegetation and other site preparation activities is likely to expose large areas of loose soil, some of which may be washed into the lake and the surrounding swamps. If a high level of siltation occurs aquatic life will be affected, leading to an impact on piscivorous birds such as fish eagles and wetland birds that forage in that part of the lake. This can be categorised as a significant or insignificant negative impact depending on the size and the location of the area cleared. However, with the creation of a buffer of 200m at the shoreline siltation of lake fringe wetlands and of the lake itself is not likely to occur.

4.5.5.5.2 Operational phase

During the operational phase, there will be both positive and negative impacts on the avifauna depending on the species. This is because of the differences in ecological requirements of the various species.

Negative impacts

- **Change in population dynamics**

The replacement of various habitats by palm oil will cause a shift in biological diversity. This is may affect the long-term population dynamics of avifauna as well as the behaviour and habits of some species.

Positive impacts

- **Increase in frugivorous birds**

During the operational phase of the project, especially when the palm are fruiting, a medium positive impact on certain species particularly frugivorous birds such as Black and White Casqued Hornbill, Ross's Turaco, Grey Parrot and Eastern Grey Plantain Eater, will be favoured because of the improved food availability.

- **Increase in habitats for some birds**

The plantation will create additional breeding habitats for some of the species like Red Eyed Dove, Vieillot's Black Weaver and Tambourine Dove that are forest visitors that breed on forest edges. Hence, this will either stabilise or contribute to an increased population of some forest generalist in the long term. This is a significant positive impact.

4.5.5.6 Mitigation

It is proposed that since avifauna of the study area is likely to be affected, mitigation measures that would minimise negative impacts and enhance positive ones should be implemented.

- A strip of vegetation of approximately 200 meters should be left where the plantation is close to the lake. This will help to reduce siltation of the lake and the surrounding swamps and marshes that are potential breeding and foraging grounds of wetland bird (CATEGORY B).
- Forests in the valleys should not be cleared as they will act as water catchment areas, refugia for forest birds and for stabilising climate (CATEGORY B).
- The use of agrochemicals, especially insecticides should be minimised and carefully regulated. Biological control or use of agrochemicals that can decompose very fast is highly recommended for pest control. (CATEGORY C).

4.6 HYDROLOGY

4.6.1 Water resources

Water sources on Bugala Island comprise the following:

- Protected and unprotected springs;
- Protected shallow wells;
- Gravity water systems (for Lutoboka, Mweena, and Senero villages);
- Roof rainwater harvesting;
- Lake Victoria;
- Boreholes (at Kalangala Town Council and Kibale);
- Streams.

A summary of the location of these water sources is indicated in Table 16.

Table 16:Some water sources and their location in Bugala Island

Location	Water source, Quantity		
	Spring	Shallow Well	Gravity system/ bore hole
Bujamba S/C, Kyagalunyi		2	
Kasumba		1	
Kozi		1	
Kagoonya		1	
Mugoye S/C, Nyoga		1	
Buziga		1	
Kibaga		1	
Kasekulo		3	
Sereno			1, gravity
Bugoma		2	
Lutoboka			1, gravity
Mweena			1, gravity
Kalangala T/C			1, bore hole
Kibale			1, bore hole

Source: Kalangala District Water Office

The average safe water coverage in the district is 47 %. Most of these water sources (springs, shallow wells, gravity water system and streams) are connected to the unconfined aquifers, which depend heavily on ground water recharge. The shallow wells are 3-5 m deep and the boreholes are about 30 m deep. This suggests the unconfined aquifers can be between less than 1 m to several m deep depending on the location; near the shores or near the ridge.

4.6.2 Assessment methods

The average rainfall of 2026 mm/year of 37 years (MAAIF 2001) report was used to determine the runoffs.

The Soil Conservation Service (SCS) or Curve Number (CN) method was used to determine the runoff generated from the design rainfall. Equation 1 and 2 and Table 17 were used to determine the runoff.

A review of Environmental Impact Statements of 1995 and 2000 was carried out to identify issues and fill in any gaps identified.

$$Q = \frac{(p - 0.2S)^2}{P + 0.8S} \quad \text{.....(1)}$$

$$S = \frac{25400}{CN} - 254 \quad \text{.....(2)}$$

Equation 1:

Q =runoff depth, mm

P = rainfall depth, mm

S =potential maximum retention, mm

CN = Curve Number

Table 17:Runoff Curve Numbers: agricultural land uses (antecedent moisture condition II)

Land use description	Hydrologic Soil Group			
	A	B	C	D
Cultivated land without conservation treatment	72	81	88	91
Cultivated land with conservation	62	71	78	81
Pasture or range land, poor condition	68	79	86	89
Pasture or range land, good condition	39	61	74	80
Meadow, good condition	30	58	71	78
Wood/forest land, thin stand, poor cover	45	66	77	83
Wood/forest good cover	25	55	70	77
Open spaces, lawns, parks, golf courses	49	69	79	84

The deep sandy loam, the common type of soil found in Bugala Island, belong to hydrologic soil group A.

4.6.2.1 Review of Environmental Impact Assessment Reports of 1995 and 2000

The two documents have adequate climatological and hydrological data such as rainfall, temperature, sunshine hours, topography, soils and land cover. The 2000 report recommendation, on page 96, that 'the project will have no significant climatological impacts' is acceptable because

winds and air movement, which originate from thousands of kilometres away, mostly control climate. However, there is likely to be some impacts on hydrology due to change in land use/cover. It is expected, that due to the change from forest and thick vegetation cover to that of the oil palm spaced at least 9 m apart, there is likely to be increase in runoff and less infiltration (see section 4.6.3) and therefore less ground water recharge especially during the construction and the first one year before establishment..

The effect of wind is explained in the 2000 report and is acceptable if mitigation measures are taken as per recommendation of forest belts/ strips provision.

4.6.3 Assessment of impact of proposed land use on water resources

The expected runoff from the present land use/cover and that from the new land use/cover can be seen from Table 18 and Table 19.

Table 18:Determination of Runoff for present land use/cover from 1 ha

	Area, ha	Soil group	Land use	CN
	1	A	Wood/forest good cover	25
From equation (2), S = (25400/25)-254 = 762 mm				
From 1, Q =(2026-0.2*762)2/(2026+0.8*762) = 1332 mm = 1332*1*10 = 13,320 m^3/yr				
From 1 ha Q=1.5 m^3/hr Rainfall received on 1 ha =0.4 l/s 2026*10= 20,260 m^3/yr=0.64 l/s				

The runoff represents 62%; i.e., 38% is infiltrated to recharge ground water

Table 19:Determination of Runoff from oil palm field of 1 ha

	Area, 1 ha	Soil group		Land use	CN	
		A		Wood/forest poor cover	45	
From equation (2), S = (25400/45)-254 = 310 mm						
From 1, Q =(2026-0.2*310)2/(2026+0.8*310) = 1,696 mm = 1,696*1*10 = 16,960 m^3/yr						
From 1 ha Q=1.94 m3/hr = 0.54 l/s						

This represents 84% of the rainfall, i.e., 16% is infiltrated into the soil to recharge ground water. From Table 19 and Table 19 it can be seen that with the proposed land use change to oil palm from the forest vegetation, 58% (38-16)*100/38) of the water which originally infiltrated into the soil is lost due to runoff.

4.6.4 Impacts

- **Lowering of water table**

Lower levels of infiltration of water into the soil leads to less ground water recharge and possible lowering of the water table as well as changes in water levels of springs and wells. It also leads to soil erosion.

If the water table lowers, the population will have to resort to deep boreholes and lake water for source of water.

- **Climatological changes**

Considering field investigations and the 1995 and 2000 reports, one can say that the project will have no significant climatological impacts because winds and air movement, which originate from thousands of kilometres away, mostly control climate. The forest reserves and a considerable area of private forests on the island will not be cleared. This can act as a buffer for the effect of the lost forest cover. The anticipated microclimate variation will be mild if only the planned land is cleared. However, vegetation clearance will initially affect the microclimate and it is likely to cause a change arising from a change in the amount of ground water recharge, evapo-transpiration patterns, and wind. Also, there will be increase in soil erosion due to land clearance and consequent nutrient loading at the mouths of the streams especially during the construction period. This could lead to concentration of fish in these spots. As the oil palm reaches maturity and establishes full canopy, the microclimate will revert to near original.

There is no available wind data for the island of Bugala. The nearest available data is from Entebbe and Masaka, which is not so much different from that one for Bugala. From the field investigations and interviews with the local people and technical staff of the district, there is no evidence of strong winds that could cause destruction.

4.6.5 Mitigation

- **Soil erosion and runoff**

The potential lowering of water infiltration levels can be minimised by incorporating good mechanical and agronomic soil and water conservation systems in the oil palm field design.

- **Possible lowering of water table**

Provision of boreholes and utilisation of lake water.

- **Strong wind and erosion**

Stretches of forest should be left along the shores, streams and headwaters as windbreaks and as soil and water conservation measure. This measure is provided for under the National Environment Regulations, 2000.

4.7 AQUATIC ECOSYSTEM AND FISHERIES

4.7.1 Aquatic habitat types

Bugala Island has generally straight shore with wide, open bays. The north to south orientation of the eastern arm of the island exposes its eastern shores to the wind effects of the prevailing South East Trade winds (SET). The exposure is, however, considerably reduced towards the south by the other islands of the Ssese group. The northern shoreline of the entire island is exposed to the open lake with generally weaker local windstorms. Extensive forest cover especially along the lakeshore shelters the inshore zone of the island from offshore winds. The above features contributed to the evolution of the habitats of the inshore aquatic ecosystems and their characteristic biota including fish.

The baseline water quality parameters around the shores of the oil palm project area (Table 22 and Table 23) reflect a healthy ecosystem rich in oxygen and having a generally desirable mix of nutrients

4.7.2 Study area

The aquatic ecosystem study focused on Bugala Island where the planned Oil Palm Project would be located. Experiments were limited to the inshore waters (up to 200m from the shoreline) around the southern portion of Bugala Island, where the nucleus oil palm estate would be located. One sampling station was identified at the southern side of the island in a sub-bay at Migera fish landing. Two other sampling stations were selected at the northern shores in Namirembe Bay close to Makoko and to Kasenyi fish landings. The location and environmental features of the three sampling station are outlined in Table 21. Migera sampling station is located in a well-protected sub-bay, surrounded by forested land acquired for oil palm development. The sub-bay is part of a larger bay, which receives the waters of the stream draining the prospective location of the nursery for the nucleus Oil Palm estate, and the planned oil-processing factory. This sampling station is regarded as vital to the monitoring of the potential impacts of an extensive portion of the oil palm estate, the nursery and, possibly the oil mill, on the aquatic ecosystem and the fishery of the bay.

Makoko sampling station is located in a moderately protected bay shaped like an egg with the top quarter chopped off. The station lies at the border of a forest acquired for oil palm development and a Forest Reserve expected to remain intact. Makoko was selected to facilitate monitoring of the potential impacts at the transition of the natural forest and an oil palm plantation.

Kasenyi sampling station to east of Makoko was selected to represent an aquatic ecosystem whose forest fringe would remain largely intact. Milanga situated in the bay further to the east of Kasenyi and reported to be fringed by an extensive forest reserve was considered a more suitable sampling station for the above scenario because it was much further away from possible direct influence of the Oil Palm Project. Kasenyi was, however, sampled instead because the time allotted for the survey was insufficient to permit collection of samples at Milanga.

4.7.3 Study methods

Selected baseline data and information were collected on the aquatic ecosystem and fisheries using a variety of methods and equipment. The general distribution and abundance of aquatic habitat types around Bugala Island were assessed in an initial rapid land-based reconnaissance aided by a topographic map of the island (1;50,000). In lake surveys were conducted in each of the selected bays (Migera, Makoko and Kasenyi) to identify habitat types and inshore macrophytes.

Baseline data on the aquatic ecosystems and fisheries were collected along a single transects between the shoreline and 2000m from shore, as determined by GPS. Further data and other information on fisheries were obtained through discussions with local stakeholders especially the District Fisheries Officer Mr. Mbareba J.W.

4.7.3.1 Method for aquatic ecosystem study

Data was collected on selected physico-chemical parameters of the water; on species richness, relative abundance and biomass (as chlorophyll-a) of the major phytoplankton taxa (Cyanophyta, Chlorophyta and Bacillariophyta); as well as on species richness and relative abundance of zooplankton and macro-invertebrates.

I. Water quality

Instruments used to measure water quality parameters in situ are detailed in Table 20. Measurements of physical parameters were taken under surface and just off the lake bottom. Water samples for determination of total suspended solids (TSS) were collected under surface (0.1m) and just off bottom but only under surface samples were used for nutrient analyses and for measurement of biological oxygen demand (BOD). Samples for water quality studies were put in appropriate translucent polythene bottles and stored in the dark over ice at about 4°C in transit to the laboratory. Analyses were done within 24 hours of sample collection, using methods for Chemical Analysis of Fresh Water (Stainton et al 1977).

Table 20:Instruments used to measure water quality parameters during the EIA on the proposed oil palm development on Bugala Island (September 2003)

Parameter	Equipment used
Total Depth	Echo sounder
Secchi depth	Secchi disc
PH	pH meter, WTW pH197
Dissolved Oxygen	DO meter, HANNA instruments HI9143
Conductivity	Conductivity meter, HANNA instruments HI9033
(BOD5)	BOD bottles, 250ml capacity; DO meter; magnetic stirrer
Total suspended solids, (TSS)	Filter paper; Oven at 105°C

II. Phytoplankton study

Water samples for the analysis of phytoplankton species richness and algal units counts were collected at the sub-surface and fixed with 2-5ml of Lugol's solution in 20ml glass vials. Microscopic examination was at x150-400 and taxonomic identification was to genera, using several checklists (Nygaard, 1976; Olsen and Blomqvist, 1981; Mosille, 1984; Talling, 1987). Algal units counts were made in Sedgewick counting chambers (1ml capacity). Colonies of cells (e.g. Microcystis) or filaments (e.g. Anabaena) were regarded as single units irrespective of their size. Estimation of Chlorophyll-a content was based on 200ml of samples filtered through Whatman's GF/C filters paper and soaked in 10ml of 90% methanol at 5°C for 18-24 hours. Readings were recorded at wavelengths 665nm and 750nm using the spectrophotometer, Spectronic 501.

III. Zooplankton study

Zooplankton samples were collected using a cone-shaped net (Nansen type) 0.3m diameter and 1.0m long, with a mesh size of 60µm. Three vertical hauls were taken at every sampling site and combined to make a composite sample The samples were concentrated using a 60µm sieve and preserved in 10% formaldehyde solution mixed with sugar to prevent ballooning of the Cladocera. In the laboratory the samples were washed on a 60µm sieve to eliminate formalin, and diluted to manageable concentration. Sub-samples of 2ml, 5ml and 10ml were taken and identified to species where possible, under an inverted microscope with magnification of 40 and 100. Appropriated calculations were made to adjust the data obtained to individual organisms per m^2.

IV. Macro-invertebrates study

Triplicate random samples of bottom sediments were collected at each sapling site using a ponar grab with surface area of 238cm^2. The sediments were washed through a 400µm-bag to reduce

bulk, preserved in ethanol (70%) and kept in polythene bags for transportation to the laboratory. In the laboratory, the samples were rinsed in tap water, sorted and identified under a Zoom Microscope (x10.5 to 45), with the help of standard taxonomic guides (Mendall-barth 1954, Corbet 1960, Mellanby 1960, Kellog 1994, Merrit and Cummins 1996) to mostly genus level although some species were identified.

4.7.3.2 Method for the fisheries study

Fisheries data were collected through experimental fishing, examination of catch records and discussions with local administrators and other stakeholders especially at fish landing beaches. Fishing experiments were made with three sets of multifilament nylon gillnets, each comprised by 11 nets of mesh sizes 1" to 6", increasing by 0.5". The three sets of nets were set parallel to the selected shoreline between 10m and 200m from the emergent vegetation; at 5 pm and retrieved at 6.00 am local time the following day. The fish catch was sorted, classified to species level, counted and weight by taxon. Biometric data including weight, length, food and sex were recorded for the most dominant taxa (Nile perch). The food was assessed by taxa and ranked according to estimated percentage bulk (Balirwa, 1984, Winemiller, 1990, Nakamura et. al., 2003).

Table 21:Description of sampling stations in the aquatic ecosystem impact study on the proposed oil palm project on Bugala Island (September 2003)

Sampling site	Distance from shore (m)	Coordinates	Depth (m)	Bottom type	Background cover; shoreline fringe; submerged/floating macrophytes
Mugera: in a bay sheltered from land; virtually plugged by island	10m	S00°26.852' E032° 14.116'	1.8	Hard Sandy bottom with some mud	Shores of bay almost entirely forested to the water edge; shallow inshore mostly covered by patches of the rooted *Vallisneria sp* up to about six metres from shoreline
	200m	S00° 27.005' E032° 14.128'	8.7	Dark soft brown mud of planktonic origin	
Makoko: in a bay sheltered landward but largely exposed to the open lake	10m	S00° 28.390' E032° 10.084'	0.9	Hard bottom, rocky in parts, with sandy & muddy patches	Shores of bay mostly forested to the water edge except about a quarter of shoreline fringed by narrow patches of emergent *Vossia cuspidata* interspersed with shrubs and herbs; the shallow inshore covered by scattered strips of *Nymphaea cearulia* and *Vallisneria sp*
	200m	S00° 28.191' E032° 10.004'	8.0	Dark soft mud of planktonic origin	
Kasenyi: in a bay mostly well sheltered landward but largely exposed to the open lake	10m	NR	4.1	Soft mud /some sand	About one quarter of the hinterland under grass cover with no trees; shores of bay mostly forested to the water edge; less than a quarter of shoreline fringed by narrow patches of *V. cuspidata* interspersed with shrubs and herbs; one small mat of *Cyperus papyrus*, shallow inshore with few patches of *N. cearulia* and *Ceratophyllum demersum* scattered
	200m	NR	7.7	Dark soft mud of planktonic origin	

R = Recorded; NR = Not recorded

4.7.4 Results

4.7.4.1 Water quality

Baseline data for selected water quality parameters are presented in Table 22 and Table 23.

Table 22:Physical parameters measured at the lakeshore near, and the stream through, the proposed oil palm nucleus estate on Bugala Island, Kalangala District (September 2003)

Station	Distance offshore	TD (m)	SD (m)	Temp (°C)	DO (mgl^{-1})	Cond. (μScm^{-1})	pH	BOD (ppm)	TSS (μmgl^{-1})
Mugera	10m	1.8	*	27.0	9.8	101.0	9.2	4.7	8.8
Mugera	200m	8.7	0.1	26.2	11.1	103.0	9.5	*	8.5
Makoko	10m	0.9	0.9	25.2	9.1	105.0	9.4	4.6	8.8
Makoko	200m	8.0	1.1	25.5	9.0	101.0	9.5	*	8.5
Kasenyi	10m	4.1	*	*	*	*	*	4.9	8.6
Kasenyi	200m	7.7	*	*	*	*	*	*	8.9
Stream		*	*	21.8	6.9	19.0	6.9	5.4	8.6

* = Parameter not measured; TD = Total depth; SD = Secchi depth; DO = Dissolved Oxygen; Cond. = Conductivity; BOD = Biological Oxygen demand; TSS = Total dissolved solids, TP = Total Phosphorus; SRP = Soluble reactive Phosphorus; TN= Total Nitrogen; Chl-a=Chlorophyll-a.

Table 23:Selected nutrient parameters measured along the lakeshore near, and the stream through, the proposed oil palm nucleus estate on Bugala Island, Kalangala District (September 2003)

Station	Distance from shore (m)	TP (μmgl^{-1})	TDP (μmgl^{-1})	SRP (μmgl^{-1})	TN (μmgl^{-1})	TDN (μmgl^{-1})	Chl-a (μmgl^{-1})
Mugera	10	279±25	259±5.0	22.9± 0.0	1544.9±0.8	1094.5±84.4	*
Mugera	200	289±5.0	234±0.0	20.7±0.0	1074.5±14.6	1077.8±129.6	*
Mukoko	10	254±10	174±0.0	13.9±0.4	1486.2±58.8	1422.4±31.7	37.5
Mukoko	200	279±5.0	194±30.0	13.5±0.0	1084.5±157.1	299.9±160.0	36.8
Kasenyi	10	359±15.0	209±5.0	15.1±1.4	1329.9±5.0	1045.3±30.4	49.3
Kasenyi	200	269±5.0	164±0.0	11.1±0.4	1396.6±88.3	1009.5±417.9	38.9
Stream		184±10.0	164±0.0	12.9±0.0	1517.4±45.0	920.3±425.4	6.3

* = Parameter not measured; TP = Total Phosphorus; SRP = Soluble reactive Phosphorus; TN = Total Nitrogen; Chl-a = Chlorophyll-a

4.7.4.2 Phytoplankton

Baseline data on the species richness and relative abundance of the phytoplankton community along the shores of the proposed Oil Palm nucleus Estate on Bugala Island in Kalangala District (September 2003) is detailed in Table 24.

Table 24:Species richness and numerical relative abundance (number of units) of phytoplankton along the lakeshores of the proposed oil palm nucleus estate on Bugala Island (September 2003).

Stations (Distance offshore)	Mugera (10m)	Makoko (10m)	Kasenyi (10m)	Mugera (200m)	Makoko (200m)	Kasenyi (200m)	Total no.
Taxa	(Each the Sum of four counts)						
Cyanophyta (Blue green)	4*	4*	5*	3*	5*	3*	5*
Microcystis	12	27	16	17	13	22	**107**
Planktolyngbya	19	44	32	26	26	44	**191**
Anabaena	6	32	23	10	14	21	**106**
Anabeanopsis	-	-	1	-	3	-	**4**
Merismopedia	1	9	9	-	4	-	**23**
Total units	**38**	**112**	**81**	**53**	**60**	**87**	**431**
Chlorophyta (Green)	**1***	**0***	**2***	**4***	**2***	**1***	**5***
Cosmarium	-	-	-	1	-	-	**1**
Ankistrodesmus	-	-	3	4	2	3	**12**
Straurastrum	-	-	-	1	-	-	**1**
Scenedesmus	-	-	1	1	1	-	**3**
Dictyosphaerium	1	-	-	-	-	-	**1**
Total counts	**1**	**0**	**4**	**7**	**3**	**3**	***18***
Bacillariophyta (Diatoms)	**3***	**0***	**2***	**2***	**1***	**3***	**3***
Nitzchia	4	-	5	4	-	2	**15**
Synedra	1	-	-	-	3	5	**8**
Cyclotella	3	-	5	5	19	12	**41**
Total counts	**8**	**0**	**10**	**9**	**21**	**19**	***64***
Total species	***9***	***4***	***9***	***9***	***8***	***7***	***13***

* = Number of species recorded

4.7.4.3 Zooplankton

Baseline data on species richness and relative abundance of the zooplankton community along the shores of the proposed oil palm nucleus estate on Bugala Island in Kalangala District (September 2003) are detailed in Table 25.

Table 25:Species richness and numerical densities (indiv. m^{-3}) of zooplankton in selected sampling stations along the lakeshore near the proposed oil palm nucleus estate on Bugala Island (September 2003).

Stations (Distance offshore):	**Mugera (10m)**	**Makoko (10m)**	**Mugera (200m)**	**Makoko (200m)**
Taxa	**Depth 1m**	**Depth 1m**	**Depth 9m**	**Depth 7m**
Copepoda: 9 Species				
Mesocyclops sp.			337	1011
Thermocyclops emini		135		
Thermocyclops incisus		108	404	269
Thermocyclops neglectus		674	337	539
Tropocyclops confinnis	202	1240	472	808
Cyclopoid copepodite	539	3288	9836	34425
Calanoid copepodites				2223
Nauplius larvae	2088	17165	46921	115299
Harpacticoida		135		
Total densities (Indiv.m^{-2})	**2,829**	**22,743**	**58,306**	**154,574**
Number of species	**3**	**7**	**6**	**7**
Cladocera: 2 Species				
Bosmina longirostris		81		
Moina micrura				337
Total densities (Indiv.m^{-2})	**0**	**81**	**0**	**337**
Number of species	**0**	**1**	**0**	**1**
Rotifera; 12 Species				
Asplanchna sp.		81	202	1213
Brachionus angularis				606
Brachionus calyciflorus	4918			
Brachionus forficula			472	269
Euclanis sp.	67	81		1213
Filinia opoliensis				606
Keratella cochlearis	674	485	2897	3234
Keratella tropica	269	54	2290	808
Lecane bulla	269	54	472	
Polyarthra vulgaris.	404		18391	
Synchaeta spp.	73801	566	3166	606
Trichocerca cylindrica	404		1617	1078
Total densities (Indiv.m^{-2})	**80807**	**1320**	**29507**	**9634**
Number of species	**8**	**6**	**8**	**9**
Total number of Zooplankton species (23)	**11**	**14**	**14**	**17**

4.7.4.4 Macro-invertebrates

Baseline data on species richness and relative abundance of the macro-invertebrate community along the shores of the proposed oil palm nucleus estate on Bugala Island in Kalangala District (September 2003) are detailed in Table 26.

Table 26:Species richness and relative abundance (mean no./m^2±SE) of benthic macro-invertebrates along the lakeshore near the proposed oil palm nucleus estate on Bugala Island (September 2003)

Sampling station	**Mugera (South)**		**Makoko (North)**		**Kasenyi (North)**	
Sampling site (distance offshore)	10m	200m	10m	200m	10m	200m
Taxa						
Diptera						
Ablabesmyia Sp	462±234	280±61	42±52	154±69	70±17	28±0
Chironomus Sp	28±28	14±14	14±17	28±34	168±155	70±0
Bezzia Sp	0±0	14±14	0±0	0±0	0±0	0±0
Chaoborus Sp	0±0	56±28	0±0	420±361	14±0	140±103
Oligochaeta						
Unidentified Spp	84±49	0±0	14±17	28±34	0±0	0±0
Ephemeroptera						
Povilla adusta	112±56	0±0	0±0	0±0	28±34	0±0
Heptagenia Sp	0±0	0±0	0±0	0±0	0±0	0±0
Ephemerella Sp	0±0	14±14	28±17	0±0	0±0	0±0
Trichoptera						
Polycentropus Sp	0±0	84±24	14±17	28±34	0±0	28±34
Odonata						
Sympetrum Sp	42±24	0±0	0±0	0±0	0±0	0±0
Decapoda						
Caridina nilotica	14±14	0±0	0±0	0±0	0±0	0±0
Gastropoda						
Bellamya unicolor	28±28	56±28	14±17	56±34	42±17	28±0
Melanoides tuberculata	0±0	0±0	14±17	14±17	0±0	14±0
Bulinus Globosus	0±0	0±0	0±0	0±0	0±0	0±0
Gabbia humerosa	0±0	0±0	0±0	0±0	0±0	42±0
Bivalvia						
Corbicula africana	560±226	210±49	14±17	154±52	434±137	224±34
Byssanondota parasitica	126±42	28±14	0±0	28±17	0±0	14±0
Sphaerium stuhlmani	154±51	0±0	140±172	0±0	0±0	0±0
Caelatura hauttecoeri	14±14	0±0	0±0	0±0	0±0	0±0
Total no. Species	**12**	**9**	**9**	**9**	**6**	**9**

SE = Standard Error

4.7.4.5 Fish species composition

A total of seven fish species belonging to three families were recorded (Table 27). Makoko recorded all the seven species encountered as compared to only two recorded at Kasenyi. *Lates niloticus* was the most abundant species both by number and weight at both sampling sites (

Table 28). *Rastrineobola argentea* was not recorded from the experimental catches possibly because the gear used was not suitable for catching that species. The fish was, however, recorded in the stomachs of Nile perch. The relative importance of Nile perch and other fish species in the fisheries of Bugala Island and other zones of Kalangala District were highlighted in the catch statistics provided by the District Fisheries Officer, Mr. Mbareba J.W (Table 29). The major commercial fishes landed on Bugala and other zones of Kalangala were, in order of importance, *L. niloticus, R. argentia, O. niloticus, Protopterus aethiopicus, Clarias gariepinus, Bagrus docmac, Synodontis victoriae* and *Mormyrus kannume*. Most of these fish species, which were not recorded in Table 27 appeared as "other species". Many of them for example, *P. aethiopicus, C. gariepinus* and *S. victoriae*, occur in specialised habitats. Some fishermen were reported to periodically target them by going to those habitats.

Table 27: Fish taxa caught in experimental gillnets along the lakeshore near the proposed site of the oil palm nucleus estate on Bugala Island (September 2003)

Family	Species	Makoko	Kasenyi
Centropomidae	*Lates niloticus*	R	R
Mormyridae	*Mormyrus kannume*	R	NR
Cichlidae (Tilapines)	*Oreochromis niloticus*	R	NR
Cichlidae (Haplochromines)	*Paralabidochromis crassilabris*	R	NR
	Prognathochromis ripponiunas	R	NR
	Yssichromis sp	R	NR
	Astatotilapia sp	NR	R

R = Recorded; NR Not recorded

Table 28: Total fish catch (g) by species from experimental gillnets at the lakeshore near the proposed site of the oil palm nucleus estate on Bugala Island

Family	Species	Kasenyi	Makoko
Centropomidae	*Lates niloticus*	401.3	1017.3
Mormyridae	*Mormyrus kannume*	0.0	12
Cichlidae	*Oreochromis niloticus*	0.0	131.8
	Paralabidochromis crassilabris	0.0	3.1
	Prognathochromis ripponiunas	0.0	14.5
	Yssichromis sp	0.0	1.1
	Astatotilapia "red tail"	2.4	0.0

Table 29:Catch statistics of major fish species caught in Kalangala District 1998 to 2003

Species	1998/99	1999/00	2000/01	2001/02	2002/03	Total	% Catch
L. niloticus	3,726	3,053	7,292	5,524	10,200		
O. niloticus	1,753	698	2,040	2,110	1,930		
R. argentia	4,384	3,489	3,280	4,316	3,400		
Other fishes	1,096	4,892	1,096	1,092	800		
Total catch							

4.7.4.6 Length frequency distribution

The length frequency distribution of nile perch, the most dominant species in the inshore areas of the prospective nucleus estate is plotted in Figure 10 to illustrate their size range. Too few specimens of the other fishes such *O. niloticus, Momyrus kannume*, and haplochromine species were recovered. It was, therefore, not possible to give their length frequencies distribution. The largest nile perch was recorded at Makoko and measured 42.4cm total length and the overall mean length was 20.5 cm TL at Makoko, 19cm at Kasenyi and was 21cm for all the sites combined.

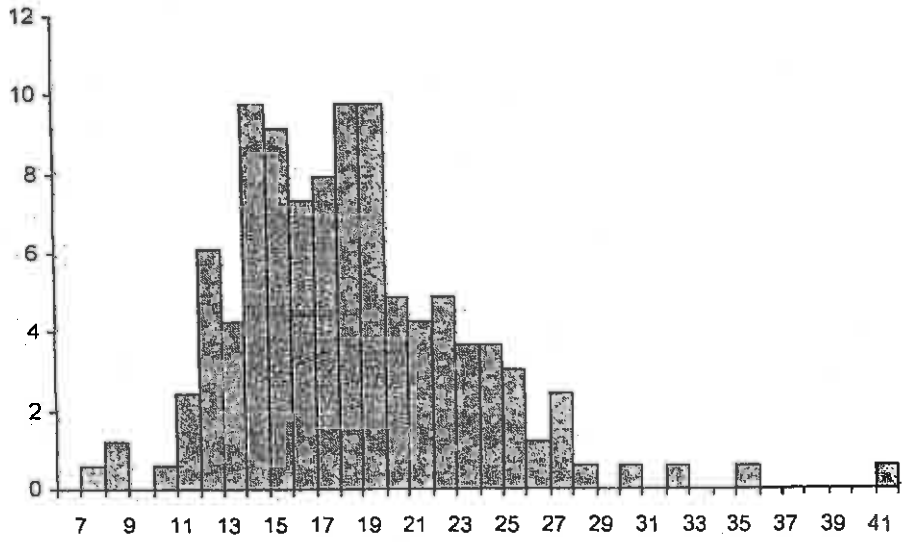


Figure 10: Length frequency distribution of nile perch

4.7.4.7 The food of Lates niloticus

A total of 31 stomachs of Nile perch were dissected for food analysis but only 12 contained food materials. The percentage contribution to the diet of nile perch, by volume of the different prey items, is plotted in Figure 11. Invertebrates, especially Odonata (dragonfly) nymphs, were the dominant items in the diet of nile perch but fish prey also formed a significant component.

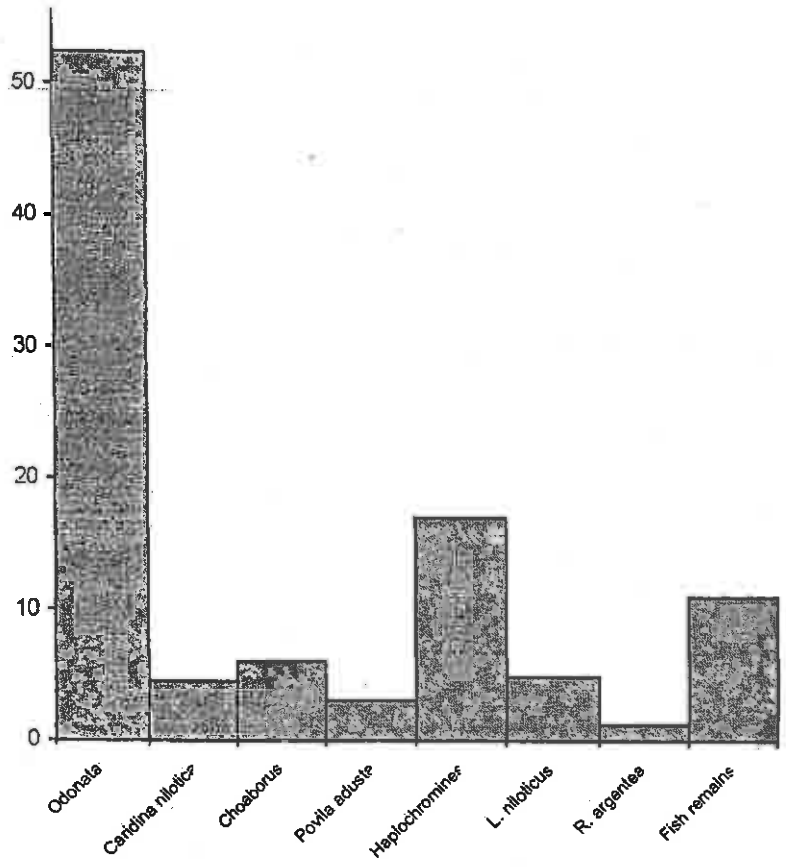


Figure 11: Percentage contribution to the diet of nile perch, by volume of the different prey items

4.7.5 Discussion

4.7.5.1 General

Soluble reactive Phosphorus at Migera was comparatively higher compared to that at Makoko and Kasenyi. This was possibly partly due to the fairly closed nature of the bay (Table 21) with onshore prevailing winds (the SET) and a large fishing camp at the entrance to the bays. The preponderance of cyanobacteria over green algae and the diatoms (Table 24) is a reflection of the tendency to eutrophication in some parts of Lake Victoria. The zooplankton and benthic macro-invertebrate communities (Table 25 and Table 26) were richly represented in species and individual numbers but the variety of the Cladocera (2 species) was very low probably due to the strong predation pressure exerted on this genus by young fishes. The invertebrate community especially the benthos play a vital role in converting plant carbon, including that of terrestrial origin e.g. forest litter, into animal protein. They are also vital food for the young of almost all fish species including *L. niloticus* (Figure 11).

Fish species richness and relative abundance recorded in

Table 28, Table 29 and Table 29 tentatively demonstrate the expected dominance of young *L. niloticus* in the experimental area (see also Figure 10). This conclusion requires consolidation through more representative sampling expected during the pre-commencement baseline data gathering exercise. The majority of the *L. niloticus* caught in this inshore sampling zone inshore had ingested invertebrates, thus demonstrating the vital role of this taxon as food juvenile fish.

4.7.5.2 Conservation status of aquatic biological resources

Bearing in mind the changes that have taken place in some zones of Lake Victoria in relation to declining environmental quality (e.g. eutrophication, decline in species richness and relative abundance especially of commercial fish species), the aquatic ecosystems in the areas sampled were considered relatively healthy. The preponderance of *L. niloticus* in the fishery explained the low number and variety of haplochromines, which are the preferred food of the adult predator. *L. niloticus* is also often blamed for the serious decline of indigenous fishes such as *B. docmac*, *C. gariepinus* and *P. aethiopicus* in the commercial catches. The District Fisheries Officer of Kalangala reported a dramatic revival of the fishery of mature *O. niloticus*. The revival was attributed to sustained sensitisation of all stakeholders about the rewards of responsible fishing methods.

No endangered or threatened taxa (on the IUCN Red List) were found.

4.8 SOCIO-ECONOMIC EVALUATION

4.8.1 Method of study

A number of individuals, groups and organisations in Kalangala and elsewhere were interviewed in order to incorporate information and views from as many interest groups as possible. The list is given in Appendix 10.

4.8.2 Background

4.8.2.1 Population

Although the majority of the people living in Bugala Island are Baganda, they come from almost all the districts in the central region including Mukono, Mpigi, Masaka and Sembabule. There are also a significant number of people from Bunyoro, Buruli, Bugungu and Busoga and other tribes in the country as was reported in the 2000 report. The population on the island is reportedly increasing because of the fishing activity. According to the 2000 EIA report, the 1991 population of Kalagala District was 16,371. Bujumba subcounty (proposed location of the nucleus estate) population was estimated at 3,808 but the most recent census (2002) puts it at 6,603 and of the entire district at 36,661. These figures reflect a more than double population growth over the last 12 years.

Table 30 shows the population of the three subcounties in which the oil palm project will be based as of 2002 Population census.

Table 30:Population of three sub-counties in Kalangala District

Subcounty	Male	Females	Total
Bujumba	4,081	2,522	6603
Kalangala TC	1669	1394	3063
Mugoye	4367	3279	7646
Total	10,117	7,195	17,312

Source: National Population Census, 2002

The total population of the three subcounties in Table 30 is 17,312. The highest population in Kalangala District is in Bufumira Subcounty with 5,025 males and 3,301 females. The nucleus estimate is planning to employ about 2000 people directly.

Population structure

A household socio-economic survey carried out by the Uganda Bureau of Statistics (UBOS) in 2002 revealed the age structure of the Kalangala population as shown in Table 31.

Table 31:Age structure of Kalangala District population

Age range	Percentage
0-4	18
5 – 9	11
10 –14	10
15 – 19	11
20 – 24	12
25 – 29	12
30 – 34	9
35 – 39	7
40 – 44	3
45 – 49	2
50 – 54	1
55 – 59	0
60 – 64	1
65+	2

Source: Household Socio-economic Survey of Kalangala District, 2002, UBOS

Table 31 indicates that about 50% of the population are children, defined as persons below the age of 18 by Ugandan legal definition, and are not expected to work fulltime. Of the adult population, about 45% are in the most productive age group 20 – 49. This means that about 17,000 people on Bugala Island are available for employment in the nucleus estate. Based on these figures, it is assumed that, the present population of Kalangala District can provide adequate unskilled labour for the nucleus estate. However, adequate skilled labour may not necessarily be available on Bugala, given the low educational levels on the island. Other districts might be relied upon for some skilled labour.

A total of about 2000 people (males and females) have registered to participate as smallholders. Some of the people registered do not own land in Bugala Island. In particular, cultural barriers regarding land ownership, has hindered their participation. Some people in this category are planning to acquire land in the area earmarked for the project.

The population of Bugala Island and Kalangala District in general is characterised by more males than females. This has implications for the spread of HIV/AIDS as is discussed later in the report. There are three main reasons advanced for this situation:

- The nature of the economic activities on the island (fishing and pitsawing) mainly attract men;
- The migrant nature of settlement is characterised by men leaving behind their families;
- Poor quality of social services (schools, health centres, roads) in terms of limited and poorly qualified staffing makes settlement on permanent basis on the island unattractive.

Figure 12: ***A meeting with locals to discuss the oil palm project***

4.8.2.2 Economic activities/employment

The three main economic activities in Bujumba Island are fishing, pitsawing and agriculture, mainly crop cultivation with a few herds of cattle. These also form the main employment for the people of Bugala Island. Tourism and trade are reportedly on increase. The main cash crop for

the moment is coffee. There are a few oil palm trial farmers who have begun earning from it. Food crops grown are mainly root crops such as cassava, sweet potatoes, yams, plantains as well as vegetables and fruits.

4.8.2.3 Land tenure system

The current land tenure system in the area includes leasehold, public and private mailo land. The majority of the residents in the area do not have land titles and most of them are squatters. According to Land Act 16 of 1998 Section 30, this means, they are lawful owners or "Bona fide occupants". Others are tenants by occupancy. "Bonafide occupants" is defined as follows:

a person who before the coming into force of the constitution

a) had occupied and utilised or developed any land unchallenged by the registered owner or agent of the registered owner for twelve years or more or

b) had been settled on land by government or agent of the government which may include a local authority." Most of the people are in the category (a) above and some are tenants by occupancy.

Both 'bonafide occupants' and tenants by occupancy can transact business by using land as security. For tenants by occupancy, a certificate of occupancy is preferable but the process of acquiring one is cumbersome and time consuming for a project that is to take off soon. It is also intimidating for the majority of the potential small holders who are largely illiterate.

4.8.3 Issues identified

4.8.3.1 Land consolidation

Consolidation of smallholder plots might be preferred in order to enhance yields through efficient management. This will ensure easy manoeuvring equipment, provision of extension services to small holders by management of the nucleus estate, and collection of fresh fruit bunches. Consolidation of smallholder plots will involve voluntary acceptance by individuals owning plots available for oil palm development. Homesteads will not be moved/relocated in the process of the loose consolidation of the plots.

The present settlement structure on Bugala Island, characterised by settlements along roads and on the lakeshore, easily suits land consolidation and contagious blocking with the nucleus estate.

4.8.4 Impacts

4.8.4.1 Negative impacts

- **Increased pressure on food and energy resources**

Although more people are expected to migrate to Bugala Island as a result of the project, migration is not a new phenomenon on Bugala Island, and has been going on due to the fishing activity. With the coming on of the project there is likely to be rapid population increase within a short period arising from availability of employment during road and housing construction. This will increase the demand for food supplies. Pressure on energy resources is likely to increase in the short term.

- **Strain on social services**

Increased migration to Bugala Island is likely to put a strain on the already limited social services such as medical facilities and safe water sources. Medical facilities on Bugala are already poorly equipped, with a lack of drugs and medical staff.

- **Housing and working arrangements**

The current housing in Bugala Island and Kalangala town is not adequate for the project workforce during the initial stages of the project, especially during construction of roads and other infrastructure. The existing small lodges at the beaches are far from the nucleus estate of the project area and would be expensive for the majority of workers, especially the unskilled. This will have implications on the working arrangements of the workers and their remuneration.

- **Social dynamics**

If the population on the island increases as anticipated, the project area is likely to evolve from a rural to an urban setting in the long run. This may result in all the social ills associated with such set ups, including alcoholism, prostitution, increase in crime rates and communicable diseases including HIV/AIDS.

A more positive prediction is that the presence of the project is likely to encourage more permanent settlement on the island in the long run, as the quality of social services (schools, health units, roads) may improve. This is likely to lead to more men living together with their families, promoting family unity and perhaps reduction of HIV infection rates.

- **HIV/AIDS prevalence**

The spread of HIV/AIDS is likely to increase as the population increases. The population of Bugala Island is unbalanced (more men than women), increasing the risk factors in the spread of HIV/AIDS. According to the district health authorities, HIV/AIDS is a significant problem. HIV infection is estimated at 11% of the population, almost twice the national average of 6.5%. The district is in the process of conducting a detailed study on the HIV/AIDS problem and its impact on the district. The results of this study are expected next year.

The district already has in place a strong HIV/AIDS control programme, under the Community HIV/AIDS Initiatives (CHAI), which reaches out to the communities. It is multi-sectoral and is coordinated by a focal point person/ coordinator in the district.

The shift in social dynamics likely to be caused by the project will have both positive and negative impacts on HIV prevalence. The increase in employment opportunities is likely to lead to a more settled and balanced (in terms of sex ratios) population in the long term, removing some of the factors that play a big role in the spread of HIV/AIDS. Since the project workforce is an organised entity, HIV/AIDS control programmes can use this as an opportunity to address the problem.

- **Gender issues**

Many women on Bugala Island have registered to participate in the project. However, some of them do not own land, a requirement to participate as a small holder in the project. This means that these women, many of whom may be categorised among the poor targeted by the project, cannot participate in the project as smallholders until a proposal for acquiring land for the landless is effected by the district. However many of them can participate through a family that owns land or as workers within the nucleus estate.

4.8.4.2 Positive impacts

Anticipated positive impacts of the project include:

- **Increased employment opportunities**

Subsistence farming, fishing and pitsawing are among the main occupations on Bugala Island. The project is expected to provide additional employment for the residents in the nucleus farms as well as in their own consolidated farms. It is also expected, in the

medium term, that retail trade, catering, transport services and road works will also provide additional employment for the residents. As population increases on the island, in the long run there will be need for establishment of more schools and health facilities. These will provide employment for teachers and medical workers.

Tourism is also expected to provide more employment opportunities in the long run, while fish processing will also employ some people as the project is expected to bring electricity in the area. It is expected that there will be increase in the demand for foodstuff from the neighbouring village to the project area leading to a rise in employment in food crop production.

- **Increased income levels**

The income levels of the residents of Bugala Island are expected to increase with the establishment of the project. At the moment the trial oil palm farmers are harvesting about eight (20 litre) jerrycans of oil per month and each jerrycan is worth 30,000 – 40,000 Ushs This means farmers are earning between 240,000 and 320,000 per month only from palm oil alone. These earnings are expected to increase when the project fully takes off, as there will be extension services and other support available, which will improve production. Additional income will be earned by people through employment in the different trades mentioned above.

- **Increase in investment**

The people of Bugala Island are reportedly already investing in capital assets in anticipation of the project. Some landowners who sold their land to the project, for example, have used the money to develop various commercial businesses. It is expected that the farmers will acquire more assets when the project takes off.

- **Improved living standards**

Some of the oil palm trial farmers are already using their earnings to meet their basic family requirements such as school fees and clothing. This indicates that when the project becomes fully operational living conditions as well as educational status will improve, with more children going further in school. The project will therefore go a long way in reducing poverty on Bugala Island.

- **Increased revenue for local government**

The local government tax base will be wider as a result of the factory and other facilities as well as increased incomes.

- **Development of infrastructure**
  - The project plans to develop a health facility and schools to cater for the large workforce and their families;
  - Extension of electricity to the island, improvement of roads and other facilities are already in advanced stages of preparation and, once effected, will have the effect of stimulating the economy of the island;
  - Improvement of roads and other infrastructure will boost tourism on the island;
  - More opportunities for income generating activities such as trade, service provision

While the people of Bugala Island expect lot of development to arise from implementation of this project it should be stressed that the project alone will not solve all the problems on the island. Other actors in development need to play their role as well.

4.8.5 Mitigation

- The project plans to construct a health unit within the nucleus estate to handle cases requiring first aid. The district might need to plan for a hospital to handle more serious cases in the long term;
- The district needs to ensure that the existing health centres are strengthened and where necessary more health centres established;
- Provision of alternative medical services such as mobile units need to be considered by the project;
- Additional safe water sources should be established to meet the likely increase in demand;
- The project needs to provide temporary housing for staff, especially in the initial stages of the project. The loan agreement may have a clause requiring farmers to sell their ffb to the developer as the equivalent of collateral;

- It is proposed that the district comes in to facilitate the process of acquiring certificates of occupancy for tenants by occupancy. During consultations with the district, concerned District officials had already made contacts with experts in land law to consider the legal issues related to land ownership in the project area;
- Smallholders should be provided with loans based on agreements signed between them and the project/district that they will repay the loan in addition to certification of land ownership by the district;
- Blocking/consolidation of smallholder plots was not seen as the best option for the moment by all parties consulted and should not be regarded as a condition for the project to take off. It could be considered in the future and in that case, a Resettlement Action Plan will need to be developed according to the World Bank Safeguards;
- There should be sensitisation by the developer to help people appreciate the benefits of blocking plots before they (communities) decide themselves to take up the idea;
- Only where it is possible, blocking of plots can be done without relocation of people's residences and should be voluntary. This can only be done in Bujumba subcounty where settlement is very sparse. Mugoye subcounty was ruled out of this exercise as it has dense population. Blocking of plots could be piloted in possibly one parish and if positive results are realised, the idea could be promoted gradually as the other communities see the benefits;
- HIV/AIDS programme be initiated from the onset of the project. The developer should liase with the Federation of Uganda employers to develop a comprehensive HIV/AIDS control mainstreaming strategy in its activities among other potential strategies. This may entail provision of budgets for production of information, educational and communication material (IEC) for HIV/AIDS, company promoted programmes incorporating HIV/AIDS messages, provision of condoms for workers and liasing with health units in the districts for HIV/AIDS counselling/treatment;
- In view of concerns over adequacy of food supplies, the district may need a deliberate effort to produce more food. This may include development of bye-laws on food production improvement of agricultural extension services to ensure higher yields;
- There is need to sensitise the local residents on use of energy saving cook stoves and also introducing local by laws to regulate deforestation. Moreover the palm branches

can serve very well as firewood and this will need to be promoted. The district and Bidco will need to work together to ensure sustainable use of energy sources on the island;

- The developer (Bidco) will need to plan for affordable recreational facilities such as indoor/outdoor games especially on the nucleus as well as encourage income generating activities such as poultry farming, vegetable gardening especially for women, apart from employment in the nucleus estate. These initiatives are likely to preoccupy the workers thus, turning them to productive labour;
- In order to cope with the increased population security needs, the police on the island may need support in terms of staff, infrastructure and equipment.

Table 40 emphasises some mitigation measures, indicating cost estimates. Budgets for the following items will require experts in different fields specified in Table 32.

Table 32:Selected budget items and the specialities required

Budget Item	Specialist
Construction of medical facilities	Civil engineers
Mobile medical services	Medical experts
Strengthened medical services	Medical experts
Construction of recreational facilities	Civil engineers
HIV/AIDS treatment and counselling	Medical experts
Establishment of police post/ law enforcement unit	Security experts

Budget estimates are not given for some activities expected to be routine district activities. It is assumed that these are catered for in the district budgets. These include agricultural extension services.

4.9 AGRO-ECONOMY

4.9.1 Introduction

In earlier appraisals (1995,1997) of the project, it was pointed out that Bugala Island that not only had ideal conditions for oil palm production; it has adequate land for the project. Furthermore, it was argued, in relation to the existing enterprises, oil palm production would provide significant improvements in net return to land and labour compared with the next best alternatives being coffee and cassava.

From the time when these recommendations were made Bugala Island in particular, and Kalangala in general, has not remained static. For instance, there have been a lot of improvements in the infrastructure starting with the provision of a modern ferry providing an easy link with the main land. Another is the rehabilitation of 68 km murram road that runs across the island. This has triggered off immigration, leading into unprecedented population growth rate of 5.8% between 1980 and 1991 and 6.9% for the period 1991 to 2002 (UBOS, 2002). This kind of population will need to be provided for in terms of food requirements, employment opportunities and other services.

The methods employed in the study include:

- Review of background literature on the project
- Field trips to project area to get a feel of the prospective outgrowers' attitudes on the project and
- Updating enterprise costs

4.9.2 Farming systems on Bugala Island

The farming system on Bugala Island is typically of a subsistence nature. There is no evidence of large-scale production. Intercropping is predominant where a number of crops are grown on the same piece of land. The typical average land per family is between 1-5 hectares. Majority of farmers grow cassava for home consumption, but when there is surplus it is sold in unprocessed form. Bananas are usually intercropped with coffee, or in some cases mixed with other annual crops such as beans and yams. Maize and beans are intercropped with sweet potatoes while a small portion of land is devoted to horticultural crops such as cabbages and tomatoes for sell. The coffee plantations seem to have been abandoned as evidenced by the uncared-for trees. Some farmers keep a few chickens or goats and those better off keep a cow.

With the implementation of the project, it is envisaged that the culture of intercropping will have to be modified, in view of the new knowledge acquired. Since the demand for food is expected to increase, the non-participating farmers will be forced to respond to the new opportunities availed by the project. They would need to increase production to satisfy the demand created. Thus, there is a strong likelihood that non-participating farmers will specialise in one or two of the crops such as cassava and maize. Alternatively, they would have to increase area under the more competitive crop such as cassava to feed the working class. What follows is the current estimate of the food requirement in Bugala Island.

To estimate food requirements for the people of Bugala Island, the consultant adopted a number of assumptions: an individual daily minimum requirements of 2056 Kcal estimates (Kikafunda et al., 1992) for Uganda; a population of 17,312 for Bugala Island (UBOS, 2003). Using these figures, the annual Kcal requirement is 12,991,617,280. Assuming that the population remains constant, the land required to supply the estimated Kcals is arrived at by assuming that the diet in Kalangala consists mainly of starch and that it is got from fresh cassava. They may supplement this diet with beans or fish, but for simplicity only cassava was used.

From the FAO (2003) nutrient composition tables for tropical Africa crops, 1kg of cassava has 3,400 kcal. The yield figures for the crop given by the agricultural officers at Kalangala district were 2,000kg/hectare. One hectare of cassava is equal to 6,800,000Kcal (2,000x3,400). Thus the number of hectares required to meet projected demand is equal to total demand divided by total Kcal produced from one hectare of cassava. This is equal to 1,910.5 hectares, which is required to meet the projected demand annually. Bugala Island occupies an area of 29,600. With 10,000 dedicated to oil palm, there is enough land for the island to be more than self sufficient, if some of the bottle necks to be pointed out later are contained.

4.9.3 Economic assessment of standing land values in the project area

The project has acquired a total of 6,629.75 hectares of which 3,439.44 hectares were former public land and 3,190.31 were mailo land. This is marginal land in terms of its use, consisting mainly of grassland. At the time of field visit there was very little activity apart from a few grazing animals. This is not surprising because in the past, the animals could not survive because of tsetse flies infestation. Other than grazing, the land acquired did not appear to have any other major economic activity.

In contrast to the situation prevailing during the previous EIA, where the forest reserve land was involved in the appraisal of palm oil project, the current land earmarked for palm oil production has no visible economic activities being undertaken. Therefore, there will be no opportunity costs in turning this land over to palm growing. Indeed, palm production is going to increase the value of the land from UShs. 246,000 paid per hectare by the government to purchase it. The same hectare of land will appreciate to UShs 1,151 288 per hectare in 8 years' time. Further more with oil palm project, one hectare will earn an outgrower UShs 3,420,000 in the same year. Thus the land will be utilised better under oil palm than leaving it idle.

4.9.4 Cost/benefit analysis of oil palm growing vis-à-vis other economic activities

4.9.4.1 Economic activities

The Island has limited economic activities as pointed out in the previous EIAs. The major economic activities are fishing, pit sawing of timber and subsistence farming as confirmed by latest field trip (September 2003). The district officials indicated that over 90 per cent of inhabitants rely on agriculture and this is in line with the national population census figures carried out in 2002.

Due to dwindling stock of fish in the lake, fishing has taken a second position, yet this was the main activity which attracted many people to this island between 1980 and 1991 (KLG/UBOS, 2000). The recent assessment study in 60 villages in 2002 showed that fish catch in Uganda is declining due to illegal methods. Some of the few fishermen interviewed revealed that they only earned Ushs 2,000/- a day (approx. 1USD). Fishing is therefore not a viable alternative since the same calibre of people may expect to earn Ushs 4,000/ per day in oil palm sector (DAO, Kalangala, pers comm).

Furthermore, the KLG/UBOS (2000) survey as well as the 1995 EIA pointed out that tourism has not taken off as had been expected, mainly due to the fact that the district lacks suitable facilities to attract tourists. There are no hotels of international standards and, although the beaches hold a lot of potential, they have not been developed. Accessibility to the island has been very poor until the introduction of the 250 tonne ferry. The road infrastructure is still poor, but with the project it is expected that the main road network through the island will be upgraded to first class murram. In addition, a few feeder roads will be resurfaced and maintained. With this kind of road infrastructure, tourism is likely to increase. The infrastructure development would help enhance the benefits of this project to Bugala economy. To consolidate these benefits it would be

necessary to invest in facilities, training personnel, developing beaches to acceptable standards and advertising in the local as well as international media. It is very unrealistic to expect the project alone to suffice in increasing tourism on the island.

The other issue that needs to be evaluated is that of the profitability of alternative crops currently grown by the farmers in Kalangala vis-à-vis oil palm production. In this analysis we have selected cassava, coffee and beans. Cassava was selected mainly as it is the major food crop and coffee as the traditional cash crop while beans can serve as both a relish and source of income.

4.9.4.2 Analysis of profitability

The analysis of the profitability of the aforementioned crops for the current situation is shown in Table 33. Oil palm has the highest output: input ratio. As expected, coffee has the lowest gross margin and moreover negative. This may explain why the crop is slowly being abandoned. Analysis of other crops by NAADS (2003) showed that sweet potatoes had an output/input ratio of 1.31, while maize and bananas had an output/input ratio of 0.97 and 1.41, respectively. However, when oil palm is adopted within the farming system, the situation will change accordingly. The Semple (2003) report shows that even with the low performance scenario (i.e., subsistence farmer following minimum agronomic practices) the project has positive cash flow in year 12 and an IRR of 21 (Appendix 11)

Both gross and net margins with the project, irrespective of the level of performance, are higher. The return to family labour is also higher with the project. Moreover, the crop by its nature will give a consistent income throughout the year to the farmer.

Table 33: Profitability of selected crops grown in the project area (per ha)

	CASSAVA	COFFEE	BEANS	OIL PALM
A. INPUTS				
1.Planting Materials				
(i) Physical	Cuttings 10 sacks	Given	50kg seeds	148 seedlings
(ii) Unit cost	4000		1200/=	4320=
(iii) Total Cost	40,000		60,000/=	640,000/=
(iv) Miscellaneous	15,000	-	-	-
(Subtotal) UShs.	**55,000**		**60,000/=**	**640,000/=**
2.Pesticides & Others				
(i) Physical		0.5 litres		
(ii) Unit Cost		14,500		
(iii) Total Cost		7,250		
3. Materials				
(i) Physical		3 tonnes of manure		
(ii) Unit Cost		40,000		
(iii) Total cost		120,000		
(iv) Sub-total		120,000		5,978,0002
4. Labour				
(i) Person hours	200	149	140	624
(ii) Unit cost	4000	4000	4000	4000
(iii) Sub-total	800,000	596,000	560,000	2,496,000
5.Total valuable Costs	**855,000**	**723,250**	**620,000**	**9,114,000**
B OUTPUTS				
[1]Yields				
(i) Physical	11,000kg/ha (intercrop)	1,201kg	1,663kg	173,333
(ii) Unit price	260/=	500/=	1200/=	180/=
(iii) Gross revenue	2,860,000/=	600,500	1,995,600/=	31,200,000/=[3]
[2]Gross Margin	2,005,000/=	-122,750	1,375,600/=	22,086,000/=
[3]Output/input ratio	**3.3**		**3.2**	**3.4**

[1]assumed yields of an intercrop; pure stand yields 20,000kgs/ha. Figures from DAO, Kalangala
[2F]igure includes cost of materials and fertilisers
[3]This figure is the estimated total revenue from 1 hectare of oil palm for a period of 25 years.

For details, refer to Appendix 11.

4.9.5 Opportunities in production of oil palm by out growers

a) Market for the crop

Oil palm is a new high value crop that will also have a ready market. The presence of a mill to be set up by the investors will provide a ready market for outgrowers' ffbs. This therefore offers unique opportunities to the farmers, who would not have to waste their efforts by growing a crop without a ready market.

b) Production credit for oil palm

Since the production arrangement between the private company and outgrowers is to advance credit to the latter, this will help to solve one of the worst nightmares faced by the subsistence farmers in Kalangala in particular and Uganda in general. Many studies conducted in the country and elsewhere show that credit is essential in agriculture and yet very few have access to formal credit. In Kalangala itself, KLG/UBOS, 2000 showed that 79% had no access to credit. Thus the project, which has an inbuilt credit component, will enhance the productivity of the crop.

c) Access to technical knowledge

The project presents a unique opportunity to farmers to gain access to technical knowledge in raising oil palm from the nucleus estate through training and provision of elite planting materials.

d) Share in the oil palm company by outgrowers and working at the estate.

This will assist farmers to have a say in a stake in the success of the project

e) Participation in the oil palm pricing

f) Cooperation through Oil Palm Growers Trust

g) Acquiring legal ownership of land by the outgrowers, which has not been possible in the past

h) Ecological/Environment benefits

- Reduction in pressure on the lake due to alternative source of income
- More forest coverage due to oil palm production. Most of land acquired is grassland

i) Economic benefits

- Saving of foreign exchange

It is estimated that Uganda imports vegetable oils worth about USD 60m of which 75% is palm oil.

At peak production, it is expected the Bugala project alone, will produce about 40,000 tonnes crude palm oil per year, which is equivalent to between USD 14,000,000 to USD 20,000,000 per year.

- Importation substitution

Expected production per year is ffb (tonnes): UShs 180,000/=, palm oil (tonnes): UShs 37,800/=, palm kernels: (tones) UShs 7,200.

During the project period of 25 years the project will produce 721,680 million tonnes of CPO and 135,996 million tonnes of palm kernels (85,914.28 tonnes of palm kernel oil). This is equivalent to USD 411,357,600 from CPO (at USD 570 per tonne) and; and USD 48,971,139.6 from palm kernel oil.

- Improved infrastructure
- Employment
- Settled population due to agriculture
- Alleviation of poverty in rural areas. A total of 3500 families (households) will directly benefit from the project. At peak production, about 190 tonnes of ffb per hectare will be produced, estimated at UShs 3,420,000/= gross revenue or USD 90 per tonne.

Not only Bugala, but also the rest of Uganda should experience improved quality oil on the Ugandan market.

4.9.6 Bottlenecks anticipated

a) Lack of technical knowledge due to the novelty of the project

The major bottlenecks to oil palm production stems from the fact that this project is new to the farmers and people of Bugala. Being a new crop, farmers are not equipped with the requisite agronomic practices. It will require intensive training in these practices if the project is to succeed. In addition, close supervision is important to maintain productivity since the crop demands a prescribed management practices regime.

b) Another bottleneck that the participating farmers may face is keeping up with the payment of the credit sourced from the company. Since the credit is in terms of inputs and services, however, the major problem would be to keep up with the recommended agronomic practices so as to get the expected yields and therefore assure surplus revenues after credit repayments are made.

4.9.7 Non-quantified effects of the project

The non-quantified effects are mainly due to externalities. For instance, those people who will participate directly in the project will benefit directly through increased income. The families of the participants will however benefit indirectly. The income received by the participants, particularly if they happen to be heads of households, will assist in the purchase of the household requirements such as food and clothing. Furthermore, the income could be used to improve housing and pay school and medical fees. In this way, the income realised will have a multiplier effect in the economy and in the long run improved welfare of the community. The project is, therefore, expected to have far reaching positive impacts on the communities.

4.9.8 Estimates of employment opportunities created by the project

The project is expected to generate employment opportunities at all levels ranging from unskilled to skilled labourer. It is estimated that, the project will require about 1,250 persons to carry out field operations, (Table 34). These field operators would require supervision at different levels with different qualifications. It is estimated that 270 persons would be required. The mill would also require some semiskilled labourers who are estimated at 240. In addition, since the project is envisaged to use labour intensive techniques in opening up feeder roads and rehabilitating the old ones, this will provide also opportunities for casual labourers, estimated at 240. Overall, it is expected that the project will generate employment for 2,000 persons earning at least UShs 2,112 billion (USD1,056 million) per year.

Table 34:Employment opportunities created by the oil palm project

Type of labour	No[a]	Rate per day[b] UShs	Rate per person per year UShs. 000	Total in a year UShs. 000
Unskilled	1250	4000	1056	1320000
Field supervisor	200	5500	1452	290400
Manager level 1	40	10000	2640	105600
Manager level 2	20	15000	3960	79200
Manager level 3	4	20000	5280	21120
Manager level 4	2	30000	7920	15840
General manager	1	50000	132000	132000
Factory workers (mill)	240	5500	1452	348,480
Road maintenance	247	4,000	1,056	260,832
Total[c]	2000			2,573,472

a Unskilled labour - 7 hectare/person Formula from which these figures were derived were provided by VODP Project Director

c in 25 years

4.9.9 Impact of oil palm on other farming activities

Since 90 per cent of the people of Kalangala are engaged in farming activities, growing of Oil Palm is likely to have a very wide impact. In one of the meetings held with a group of farmers in Kizira village, some of them indicated that if the project were to be implemented, they would shift from growing coffee to oil palm growing. Some, especially the youth, are willing to leave fishing because they felt that the lake has been over exploited. Others felt that the project would bring a lasting solution to the monkey menace and the problems of other pests and rodents due to the intensive nature of oil palm growing.

It is also expected that those farmers who may not participate in oil palm cultivation would benefit in a number of ways. In the first instance, the subsistence farmer is likely to abandon traditional methods of farming in response to the new opportunities that will come with the oil palm project. There is likely to be an increased demand for food stuff, which would have to be met from increased production. Other positive externalities will include, increased purchasing power and a stimulus for the market economy.

4.9.10 Indicators

This project is expected to have far reaching effects on the island. Some of the effects are quantifiable but others are not. This section has concentrated on quantifiable indicators, which can easily to be monitored. The project is expected to have an impact on poverty through employment opportunities such as education, health, infrastructure improvement and food production. Table 35 below provides the indicators which are self-explanatory.

Table 35: Quantifiable Indicators for monitoring project effects on Bugala Island.

Activities	Current status	Indicators
Agriculture	90 percent of people live in the rural area	Number of people in agriculture
	Intercropping	Rate of mono cropping
	Subsistence	Modern farms
	Hardly any palm oil production	Number of farmers growing palm oil
Employment	5% of population in formal employment	Number of people formally employed
		Increased income
Fishing		Number of people engaged in fishing sector
Health	4 health centre	Number of health centres
	4 dispensaries	Number of dispensaries
		Number of trained personnel
Education	80%can read and write	Increased level of literacy level
		Increased no of primary and secondary schools

Source: KLG/UBOS (2000), UBOS, 2002, EIA ,2001

4.10ECONOMIC ASSESSMENT OF THE ENVIRONMENTAL IMPACTS

4.10.1 Introduction

The project under review is a planned development of a nucleus oil palm estate on Bugala Island in the northwestern part of Lake Victoria. The project will affect a heterogeneous land use/land cover type including crop, forest vegetation and grassland. The environment and natural resource costs of establishing the oil palm estate will therefore be a sum total of a number of cost elements including (i) the direct loss of standing tree biomass, (ii) loss of tourist attractions and the implied loss of eco-tourism revenue, (iii) loss of carbon sequestration and biodiversity values and, (iv) loss of the community use value of the area including loss of firewood, herbal medicines, wild meat, fodder and thatch. This study involved an estimation of the above losses and their cost-benefit implications.

The study used both quick inventory data and Integrated Stock Survey and Management Inventory data to determine the environmental and natural resource cost implications associated with altering the land use in the project area. Whereas the study appreciated that forest production systems are in a continuous state of flux and could, therefore, change in manner unrelated to the physical disturbances associated with the project, the study limited itself to estimating the current and direct environment and natural resource costs of implementing the proposed oil palm project.

4.10.2 Economic value of environmental impacts

The proposed project will affect a varied landscape ranging from closed *Piptadeniastrum-Uapaca* medium altitude moist evergreen forests, open moist savanna grasslands, swamp forests, wetlands and mixed crop-forest vegetation. These various landscapes provide important sources of sawn timber, various community uses, biodiversity and carbon sequestration values.

The key groups and forest, wetland or grassland production systems which will be affected by the proposed project are shown in Table 10.

4.10.2.1Timber production

The project will affect about 3,599 hectares of forest and about 554 hectares of mixed crop and forest vegetation. This area has a potential to produce timber.

A recent Integrated Stock Survey and Management Inventory in the area indicated an average stocking rate of 66 trees (dbh greater or equal to30 cm) per hectare and about half of this (i.e., 33 trees) of the same diameter range per hectare for the high forests and swamp forests and mixed

crop forest vegetation respectively. This stocking rate translates into a potential monocyclic yield of 135 m^3 and 67.5 m^3 of bole volume per hectare respectively. Most of the standing volume is Class II timber priced at Ushs 28,000 per m^3 overbark, implying that the potential loss in timber value will be Ushs 14.65 billion derived by summing up the value of the total monocyclic yields from the two categories of forests respectively.

4.10.2.2Poles

The estimated pole size tree standing stock (for trees of less than 30 cm dbh but equal to or greater than 10 cm dbh) in the proposed impact area is 229 tree per hectare yielding approximately1,657 running metres of poles per hectare. This study did not compute a separate value for bush pole size trees in the impact area in view of the remoteness of the area and the relatively low commercial demand for poles. The value of poles was assumed subsumed under community forest use values, noting that most use of poles in the impact area is actually subsistence rather than trade.

The study, however, would like to highlight the significance of poles in as far as they comprise the future stock of timber.

4.10.2.3Community derived values

This section considered community use of forests, wetlands and savanna grasslands as sources of firewood, building poles, wild game, honey, thatch and other non-timber forest products. Estimation of community values for the impact area was however, based on secondary data on community uses of the above resources since there wasn't adequate time to undertake a comprehensive survey on this matter in all the impact area.

The community use value of the forest was based on the Bwindi Study in South Western Uganda. This study estimated the net annual worth of community uses of forests to be equal to Ushs 144,000 per household per year. This figure was used to estimate the community use of the above-mentioned resources for the 1,088 households in the impact area at Ushs 156,672,000 per year.

If this flow of benefits accrued over a 25 year period (to compare with an assumed 25 year life span of the palm trees), the implied present value of community use benefits for a discount rate of 10 percent would be about Ushs 2,082,600 per household or Ushs 2.266 billion for the total 1,088 households in the impact area.

4.10.2.4Biodiversity values

Literature review on the biodiversity value of the proposed impact area indicated that it is one of the most important biodiversity refugia in Uganda. The area is actually contiguous to core conservation forests of high biodiversity value.

This study consulted and used secondary data from a number of earlier studies namely Ruitenbeek (1989) on the Social Cost Benefit Analysis of the Korup Project; Pearce and Moran (1994) on the Economic Value of Biodiversity; Howard, Peter (1995) on the Economnic Value of Uganda's Protected Areas and Peasah, A. (1994) on Resource and Environmental Accounting Framework for Ghana's Forestry Sector.

Pearce and Moran (1994) for example calculated the value of land for biodiversity conservation (particularly for the medicinal value of biodiversity) to be USD 21 per hectare per annum for the upper limit. For a discount rate of 5 percent over a long time horizon, this figure translated to a biodiversity related present value of land of USD 420 per hectare (equivalent to Ushs 819,000) or USD 2.7 million equivalent to Ushs 5.3 billion for the total forested portion of the impact area.

4.10.2.5Carbon sink functions

The Meteorology Department together with the Forest Secretariat with financial and technical support from Plan Vivo have initiated a proto-carbon credit marketing project in Bushenyi District as a pilot project of the Clean Development Mechanism of the UN Framework Convention on Climate Change. Ecotrust Uganda and CARE are implementing the project. The project is expected to generate the first set of data to characterise Uganda's capacity to sequester carbon.

The carbon sink capacity of the impact forest in this study, is therefore, largely based on secondary information. The Centre for Social and Economic Research on the Global Environment (CSERGE, 1993) put the carbon stocking capacity of tropical evergreen forests at 144.0 tonnes of carbon per hectare (tC/ha) for total above ground biomass and 66.0 tones per hectare for soil and below ground biomass or a total of 210 tones of carbon per hectare.

The International Pilot Project for Carbon Sequestration and Community Forestry in Chiapas, Mexico estimates that protection of threatened closed forests can prevent emissions of up to 300 tC/ha, while careful management and restoration of tropical evergreen forests could increase carbon storage by around 120 tC/ ha. The pilot project also quotes the average cost of sequestering carbon at around US$ 10 per tC.

If the CSERGE estimates are adopted, the conversion of 3,599 ha of tropical high and swamp forest into oil palm plantations will extinguish the opportunity to sell 755,790 tC equivalent in proto-carbon credits (at US $ 10 per tC). The project will extinguish a futher opportunity to sell 77,560 tC equivalent in proto-carbon credits if the 554 hectares of mixed crop and forest vegetation is also converted into palm oil. The above opportunity costs will however, be reduced by 70 tC per hectare if the project adopts agro-silvicultural farm designs including maintaining timber and fruit trees on the palm oil estate. The implied net loss in carbon sequestration value of the impact area will therefore, be 532,640 tC equivalent to US $ 5,326,400 for the 4,153 hectares of forest.

4.10.2.6Incremental management costs

The District Forest Service will need to commit up to three forest staff including a Forest Officer, a Forest Ranger and driver plus a departmental vehicle and accessories to monitor the implementation of the mitigation measures proposed in the project EIS. The cost of staff time in the field was therefore, computed using standard daily subsistence allowances for the three categories of staff effort for a period of at-least 18 months (based on a 22 day/month working schedule). A total of Ushs 7,904,160 including Ushs 6,526,080 as staff costs and Ushs 1,378,080 as cost of fuel and vehicle maintenance will be the cost associated with assigning personnel time to oil palm project related activities.

This cost is not reflected in the district's medium term expenditure framework and is therefore new and additional and should be met by the developer (i.e. Vegetable Oil Development Project).

4.10.2.7 Land take

The cost of land has already been taken into consideration in the feasibility analysis. This study recommends that the value of land is included in the extended cost-benefit assessment along with other extended project costs (computed above) which otherwise are normally ignored in conventional project analysis.

5.0 ENVIRONMENTAL MANAGEMENT PLAN

In developing a spatial plan for oil palm development on Bugala Island, the following considerations were made:

Ecological sensitivity

Areas such as permanent wetlands, shoreline, fishing villages/landings sites, forests and important bird areas have been avoided in order to minimise loss of biodiversity, fisheries, soil and water pollution and other hazards such as soil erosion.

Proximity to infrastructure

The processing mill and housing for the nucleus estate development will require access to infrastructure and social services. In some areas, access routes shall be constructed.

Proximity to outgrowers

Oil palm growing is a fairly new undertaking on Bugala Island, and most inhabitants do not have a sound understanding of either management or establishment requirements for successful crop productivity. It is, therefore, essential that all farmers can be readily accessed by the nucleus estate and strictly supervised during the initial stages.

Efficiency in land management

The land acquired/available on Bugala Island is spatially fragmented, a potential problem for efficient management of any large-scale oil palm venture. The target for the nucleus estate area is 6,500 ha, preferably of contiguous land, in order to optimise management and economic benefits. There is currently no unfragmented parcel of land of this size acquired on the island. The proposed area for the nucleus estate is the largest single parcel of land at 4,282 ha.

Agro-climatic considerations

In general these climatic factors, of great importance in defining successful oil palm cultivation, are better fulfilled in the central to southern and eastern parts of the island.

Availability of land

Only land offered for sale or already acquired has been considered.

5.1 VEGETATION

5.1.1 Monitoring indicators and regimes

The effect of the proposed project may be monitored indirectly through, water quality changes, soil erosion levels, micro-climatic changes, rate of soil fertility depletion etc. This is because all ecosystems – whether forest or wetland or aquatic ecosystems are interlinked and depend on each other in one way or another. What affects any taxa on an ecosystem is bound to have an impact on another taxon in a different ecosystem depending on the degree of damage.

5.1.2 Detailed baseline monitoring

With the exception of species of conservation concern like *Melastomastrum segregatum, Ficus cordata* and *Lasianthus sesseliensis* which are restricted range species, the rate of exploitation of other species by the local population for both commercial and domestic use can also be indicative of the implications the project is having on the livelihood and survival of the local population. These should be used as indicators to show the effect of the proposed vegetation changes on the plant resources in the area. It should be emphasised that these should be long term monitoring plans as the project is on-going although they should be done regularly.

- There is need to engage an expert to monitor vegetation changes bi-annually to assess data on the floral diversity. This will help to determine whether there are unfavourable impacts on the vegetation and counter them in time.
- Ecologically sensitive sites such as lakeshores and rivers systems should be left intact. A 200m and 30m strip on either side is stipulated for lakeshores and rivers respectively by the National Environment (Wetlands, Riverbanks and Lakeshores Management) Regulations.
- Monitoring programmes should focus on the rare and restricted range species. These include *Smilax anceps, Andesma vogelianum, Embelia schimperi* and *Lasianthus sessensis*.

5.1.3 Monitoring during the development phase

- Monitoring of the impacts on the vegetation should start as soon as the project starts. It is recommended that the removal of vegetation should be done gradually and cautiously so as not to cause adverse impacts on the environment in the form of soil erosion, damage to sensitive natural systems such as riverine forests.

- Appropriate disposal of the woody debris and planting with cover crop grass like *Paspalum notatum* should be carried out.

5.1.4 Monitoring during the operational phase

The local people should be sensitised on the need to develop alternative energy sources. This would include establishment of afforestation programs on sites where the oil palm will not grow, encouragement of agroforestry programmes, and proper utilisation of the Forest Reserves especially the production zones to meet people's timber and other forest products requirements in a sustainable manner. This should be continuous for the whole operation phase of the project and all relevant offices should be involved. These include the District Agriculture Officer, The District Forest Officer and the District Environment Officer.

5.1.5 Monitoring cost estimates

For the EMP to be successful there is need to identify individuals and institutions with competence to carry out the monitoring exercises and identification of likely sources of funding. Costs (Table 40) are based on number of staff and frequency of visitation/inspection and additional costs involved such as fuel. A minimum of three persons from each office is suggested.

5.2 FAUNA

Based on available records a monitoring programme can be set up for the above taxa and the monitoring done at regular intervals to gauge the long-term effects of the project on the species. It is important though that more detailed baseline information be obtained especially on the amphibians and reptiles. Recommendations are given in Table 37-Table 40.

5.2.1 Avifauna

The study proposes a 6-monthly monitoring plan in the project area during the clearing phase and an annual monitoring programme for 10 years during the operational phase. The results from monitoring programme will help in decision-making and correction of negative impacts.

5.2.1.1 Rationale

Birds have been shown to be effective indicators of biodiversity in plant and animal groups (Bibby et al, 1992). Diamond and Filion 1987, Furness et al., 1993, also indicated that birds are an appropriate group to serve as bio indicators of environmental conditions for example, understorey birds are reliable indicators of forest condition (Waltert, 2000), whereas waterfowl are good

bioindicators of aquatic ecosystems (Diamond Filion 1987). Pearson (1995) listed criteria for a good indicator group for monitoring and birds fulfil most of them.

Patterns of bird distribution are such that in most cases, it is possible to select habitats and sites that support many species because some sites are exceptionally important for maintaining the taxa dependent upon the habitats and ecosystems in which they occur.

Birds are taxonomically well-known, widespread, conspicuous, diverse, stable and often habitat-specific, which make them to be readily surveyed and manipulated. They are a higher taxon that occupies a breadth of habitat and a broad geographical range; and some of the populations are specialised within a narrow habitat. Adverse effects of degradation of the natural environment are reflected in the reduction of avian diversity (Magurran, 1988).

5.2.2.2 Clearing phase

A monitoring programme on bird population, relative abundance and species richness that entail the following be adopted:

1. Presence or absence of Paradise Flycatcher and Olive Sunbird in the forested valleys meant as a refugia in the project area in DIZ;
2. Presence or absence of at least four pairs of Fish Eagles because they dispersed at low densities across wide areas;
3. Great White Egret in the project area since they can be affected due to siltation of the fringing wetlands and lakeshores;
4. Presence or absence of Grey Parrots and Red-chested Sunbird in and around the project area since they birds of regional conservation concern in the project area;
5. Presence or absence of at least 50% of the birds' species recorded in the project area.

The developer may contract an ornithologist to perform this task at six monthly intervals each time over 4 days period. Numbers of birds at a particular site normally fluctuate, while others like the raptors dispersed at low densities across wide areas. However, the total absence of species normally residents would indicate that there is a change in the habitat. In the case of monitoring parameters suggested above, it would be necessary to obtain information on the habitat types and size of the patches left the valleys and the wetlands.

5.2.2.3 Operational phase

During this phase, the same parameters indicated under the clearance phase can be continued but at annual intervals for the first 5 years of the project. This is minimum time to monitor a change in avifauna diversity and relative abundance.

In addition, TSCs should be done in the project area to establish changes in avifauna if any. These TSCs need not be done at the exact spots where the previous ones were done as long as representative sections of the project area are covered.

Public education programme to counteract possible adverse impacts of human population influx on the avifauna should be part of a wider Environmental Management Plan (EMP) for the project. It should be aimed at sensitising the local communities about the benefits of conserving wildlife. In the case of birds, communities should be made to appreciate that birds form part of the overall food web and hence contribute to the regulation of populations of pest such as insect and rodents. Forests, wetlands and grassland outside the project area constitute a buffer for avifauna hence the human population needs to be highly sensitised about the value of biological diversity.

Bugala Island has a great potential in avitourism that is still unexploited. It is important to include avitourism in Environmental Management Plan so as to enhance the conservation of birds.

The monitoring costs up to the end of five years of operations are estimated at approximately US$ 94,000 (ninety four thousand only).

5.2.2.4 Conclusion

Although the forests in the project area are being degraded systematically by human activity, they are still valuable as bird conservation areas.

Most of the species identified in the project area occur in neighbouring Forest Reserves and private land.

Given that the project is planned to be established in a mixture of high and low value areas, it is recommended that the project can go ahead with proposed mitigation measures to ensure that the negative impacts are avoided and positive impacts are optimised. It is also recommended that avifauna of the outer islands be studied so as to understand the unique bird communities of the entire Ssese Islands.

5.3 HYDROLOGY

Some mitigation measures have been recommended, which when implemented will eliminate or reduce to acceptable levels the negative hydrological impacts of the oil palm project. In order to assess the effectiveness of these measures, or to identify further corrective action and to detect any impacts that may not have been identified in this study, it is important that an Environmental Monitoring Plan (EMP) for the project be implemented.

This should be focused on:

5.3.1 Water resources

It is anticipated that ground water recharge may be reduced. Therefore, it will be necessary to monitor the water table, yields and quality from wells, springs, streams and the lake. It is recommended that weekly, monthly and seasonal checks where applicable should be made and water samples be sent to DWD for analysis for nitrates, metals, faecal coliforms, pesticides and other harmful chemical that are used in the project. Limit levels of these contaminants are outlined in the NEMA standards. These monitoring should be continued until NEMA deems it unnecessary to continue.

5.3.2 Soil and water conservation

It is recommended that mechanical and agronomic soil and water conservation measures should be incorporated into the oil palm fields. In addition to this, DWD should take weekly sample of the runoff water originating from the fields and analyse it for Total Suspended Solids (TSS), nutrients and chemicals during the construction period and thereafter monthly. The Kalangala District Agricultural Office should check for the proper operation of the conservation structures bi-monthly.

The monitoring will allow time series trends in the water levels, yields and quality during the course of construction and through the operational phase to be identified and where necessary responded. Important sites for monitoring are given in Table 36.

Table 36: Suggested Sites for Monitoring

	Water level	Yields/flow rate	Water Quality and fish catch
Site	Location	Location	Location
1	Head waters of stream in the Nucleus Estate	Head waters of stream in the Nucleus Estate	Head waters of stream in the Nucleus Estate
2	Mid slope of a stream in the nucleus estate	Mid slope of a stream in the nucleus estate	Mid slope of a stream in the nucleus estate

	Water level	Yields/flow rate	Water Quality and fish catch
3	Mouth of the stream at the lake	Mouth of the stream at the lake	Mouth of the stream at the lake/ lake water at the mouth of stream. Fish catch
4	Well/spring on the ridge in the Nucleus estate	Well/spring on the ridge in the Nucleus estate	Well/spring/bore hole on the ridge in the Nucleus estate
5	Well/spring mid slope in the nucleus estate	Well/ spring mid slope in the nucleus estate	Well/ spring /bore hole mid slope in the nucleus estate
6	Well/spring on the shores of the lake in or near the nucleus estate	Well/spring on the shores of the lake in or near the nucleus estate	Well/spring/bore hole on the shores of the lake in or near the nucleus estate

5.4 SOCIO-ECONOMIC

5.4.1 Areas for monitoring

This report and the 2000 EIA Report identified some social issues that may arise with establishment of the project.

Food shortage, increase in environmental sanitation related diseases, strain on medical services are regarded as short term negative impacts during the take off stage of the project, but the situation is expected to improve as people begin to earn income from the oil palm and when the project/government strengthens health services and more farmers begin to grow more crops as a result of increased demand for food in the project area.

However, there are negative social impacts of long-term nature and these include increased HIV/AIDS incidences, prostitution, alcoholism, increase in crime rate, depletion of energy resources and disruption of the native culture.

It is proposed that, periodic social surveys are conducted to find out the extent of each of the social problems identified and perhaps also to identify those which have not been identified.

5.4.2 Monitoring schedule

An initial social survey is proposed at the beginning of the project followed by a medium term survey after the established of the nucleus estate. Other surveys could be conducted later, depending on the results of the medium term survey.

It is also proposed that, during the medium term survey, the positive socio economic impact of the project be assessed as well.

Table 38 shows monitoring of compliance during the initial period (construction period) and medium term (after the nucleus estate is established). The recommended actions with [*] will be undertaken during the medium term.

5.4.3 Resettlement Framework

The preparation of a resettlement plan is not required at this stage since blocking of plots does not necessitate resettlement of people. The project will only be required to prepare a resettlement policy framework if it becomes necessary to resettle people, perhaps during road construction. If that occurs, the preparation of the resettlement plan should be done in line with the World Bank's

Involuntary Resettlement Policy OP 4.12, Land Act and other relevant Government of Uganda policies.

The resettlement framework establishes the resettlement and compensation principles, organisational arrangements and design criteria to be applied to the projects that will be prepared during project implementation in compliance with the laws of Uganda and the World Bank's safeguards policy on involuntary resettlement.

The project resettlement/compensation plans should be subsequently prepared consistent with this policy framework and should be submitted to the World Bank for approval.

According to World Bank Operation Policy 4.12 on involuntary resettlement this resettlement policy framework should cover the following:

1. Policy principles and objectives governing resettlement preparation and implementation,
2. A description of the process for preparing and approving resettlement plans,
3. Land acquisition and likely categories of impact,
4. Eligibility criteria for defining various categories of project affected persons,
5. A Legal framework comparing the borrower laws and regulations and Bank policy requirements and measures proposed to bridge any gaps between them,
6. Methods of valuing affected assets,
7. Organisational procedures for delivery of entitlements, including, for projects involving private sector intermediaries, the responsibilities of the financial intermediary, the government, and the private developer,
8. A description of the implementation process, linking resettlement implementation to civil works,
9. Description of grievance redress mechanisms,
10. A description of mechanisms for consultations with, and participation of, displaced persons in planning, implementation, and monitoring,
11. Arrangements for monitoring by the implementing agency and, if required, by independent monitors.

5.4.4 Budget

Monitoring compliance will be done simultaneously with the socio survey so it is at the same cost. It is proposed that 20,000 USD be budgeted for each of the surveys, as they will consist of

household surveys. Preferably surveys should be done by independent people/firms financed by the project.

Monitoring of disease incidence as a result of poor environmental sanitation and hygiene is usually done by health workers on weekly/monthly basis as a requirement by the Ministry of Health. It is suggested that the project teams up with the district medical staff to monitor this and may not require separate budget as long as it is covered under the routine project expenditure.

5.5 GENERAL RECOMMENDATIONS

The project needs to undertake separate environmental impact studies for the different components of infrastructure that will be developed. These include the installation of powerlines and roads development, which will be undertaken on Bugala Island.

In view of the numerous environmental management related issues identified, it is recommended that the project employ an environmental specialist on a permanent basis. This will facilitate the implementation of the environmental management actions recommended in sections 5 and 6.

6.0 ENVIRONMENTAL MONITORING PLAN

Table 37:Baseline monitoring requirements

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
AQUATIC ECOSYSTEM			
Habitat characterisation	One characterisation Survey	Only once	Only once, before beginning of the project
Water quality	Sampling & chlorophyll-a analyses	Quarterly for 12months	
Phytoplankton & invertebrate ecology	Diversity & abundance measurement	Quarterly for 12months	
Fisheries biology and production	Fishery biology & yield assessment surveys	Quarterly for 12months	
VEGETATION/ECOLOGY			
Conservation Status of 'interest' flora	Continued and directed surveys in pristine sections of forests	Collection of voucher specimens of interest species for confirmation of identifications at herbarium	As deemed appropriate
HYDROLOGY			
Water Level in wells and streams and Ground water	Monitor water levels in wells and streams and ground water	Measure levels of water in wells, bore holes, and streams and observation wells	Daily until beginning of construction
Yields / Flow rates	Monitor trends of the yields and flow rates	Measure shallow well, spring and bore hole yields and stream flow rates	Weekly until the beginning of construction
Water quality	Monitor water quality in the wells, steams springs and the lake	Collect samples from the screams, wells springs and the lake and analyse for TSS, SS and nutrients, pH	Monthly until the beginning of construction
Fish species, number and catch	Monitor the trends in fish spices, number and catch and restock where necessary	Fish stock survey. Fish catch evaluation	Weekly until beginning of construction
AVIFAUNA			
Avifauna of Outer Ssese Islands	A survey of avifauna of other islands that form part of Kalangala District	Detailed TSCs, mist-netting and point counts should be carried out at representative habitats and various sites within the remaining islands.	Four days a month for eight months before clearing stage.
LAND USE/COVER			
Decline in natural habitats such as forest, wetlands	Accurate information on extent and quality of representative habitats	Satellite/aerial photographs	Every 2 years

Table 38:Monitoring requirements during establishment

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
Mammals			
Loss/conversion of habitat	Some areas of natural habitat types need to be maintained in the plantation area	Species composition and relative abundance need to be monitored in both the converted areas and in the natural areas	At least twice before start of project, and thereafter once every six months (dry and wet season).
Some mammals potentially pests	Pest-control strategy needs to be worked out in conjunction with UWA and the Local Government	Specific monitoring should be focused on the plantation/crops for any crop-raiding by mammals	Twice a year, during growing and harvest/ripening season
Butterflies			
Loss/conversion of habitat	Habitat for endemic/restricted range species should be protected where it is established the species exist in the project area	Species composition in different habitats needs to be monitored with specific focus on endemic and restricted range species	Twice before habitat conversion, and thereafter twice
Poisoning in case of pesticide use	Use of pesticides should be limited especially in areas where restricted range or endemic species occur	Survey should be conducted on general species composition and relative abundance before and after any use of pesticides	Twice every year
Amphibians and reptiles			
Loss/conversion of habitat	Habitat integrity especially at the lakeshores need to be protected	Species composition and distribution need monitoring before and during the project period	Once before project starts, at least twice a year during project period
Alteration of habitat quality	Monitoring of habitat quality especially hydrology, vegetation and water level in semi-aquatic habitats	Habitat quality needs to be determined before start of project and constantly during project period	Once before start of Project, and once every year during project period.
INDUSTRIAL CHEMISTRY/ OCCUPATIONAL HEALTH			
Accidents and ill-health while clearing land	Appropriate tree felling methods (power-saws etc); use of trained personnel and appropriate farm machinery (trained tractor drivers and maintained tractors)	Record – keeping of accidents and maintenance records, Inspection of tools, records of ill-health	Weekly
Degradation of air quality	Prevent dust emissions; plough field – wet soil conditions preferred.	Visual assessments of air quality; and dust on crops personal air sampling if necessary	Daily visual assessment; weekly collection of complaints

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
Noise from farm machinery	Timing of noisy activities during field clearing and ploughing	Monitor working hours; monitor residents complaints	Daily checks, weekly collection of complaints
Field planting	Proper dispensing of rock phosphate from store to field; collection of polythene bags holding seedlings before holing proper disposal of polythene bags.	Physical and visual checking	Throughout field planting operations
Upkeep of immature & mature oil palm (use of herbicides)	Controlled use (dispensing etc) of paraquat dichloride and glyphosate; Use of safety gear while carrying out circle spraying in nucleus estate; Personal hygiene practice; Training.	Determination of total cholinesterase level among sprayers	Every 6 months
Removal of young male and female inflorescences (Ablation/Castration)	Regular removal by hand gloves initially and use of ergonomic chisel for adult plants	Checking on gloves and inspection of chisels	Monthly
Harvesting/pruning	Use of ergonomic knives firmly fixed on poles for cutting fronds; and stacking fronds in designated areas.	Maintenance and inspection of tools record keeping of ill-health	Monthly
During construction of oil mill			
Access to site	Constructions of safe means of access	Monitor routes and construction equipment	Daily
Falls and ill-health during construction	Proper excavation methods; Use of scaffolds and safe means of access; Proper use of raising and lowering equipment-mechanical; Provision of first-aid and all necessary personal protective equipment	Systematic keeping of all records and daily activities, accidents and maintenance of personal protective equipment	Daily at commencement then weekly till end of construction.
Construction Noise	Timing of noisy activities	Monitoring working hours; monitoring residents' complaints.	Weekly checks on working hours and monthly collection of ill-health records
Access to site	Constructions of safe means of access	Monitor routes and construction equipment	Daily
Falls and ill-health during construction	Proper excavation methods; Use of scaffolds and safe means of access; Proper use of raising and lowering equipment-mechanical;	Systematic keeping of all records and daily activities, accidents and maintenance of personal protective equipment	Daily at commencement then weekly till end of construction.

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
	Provision of first-aid and all necessary personal protective equipment		
Construction Noise	Timing of noisy activities	Monitoring working hours; monitoring residents' complaints.	Weekly checks on working hours and monthly collection of ill-health records
AQUATIC ECOSYSTEM			
Water quality, phytoplankton & invertebrate ecology	As above without habitat survey	Monthly for at least 12 months	
Fisheries biology and production	As above without habitat survey	Monthly for at least 12 months	
SOCIO-ECONOMIC			
Food shortage	▪ District to encourage community to produce more ▪ Improved agricultural extension services	▪ Number of campaigns for grow more food crops	
	▪ By law on minimum household food production	▪ By laws	
	▪ Land allocated for food crop production ▪ Intercropping of food crop with oil palm trees	▪ Visual inspection	
Strain on medical services	▪ Establish medical unit in the nucleus estate ▪ Providing mobile medical facilities ▪ Strengthening medical facilities near the project area	▪ Medical facility observed at the nucleus estate ▪ Mobile medical facilities observed ▪ Medical facilities near project area have drugs, basic equipment and trained basic staff	
Increase in incidence of HIV /AIDS	▪ Projects starts HIV/AIDS in the workplace programme ▪ District expands HIV/AIDS programme to the project area	▪ Number Project HIV/AIDS education and awareness materials and campaigns ▪ District HIV/AIDS campaigns and materials ▪ Incidence of people diagnosed with HIV/AIDS in the nearby health units ▪ Number of HIV/AIDS death cases in health units	District Authorities, BIDCO

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
Increased sanitation / hygiene related diseases	▪ Hygiene and sanitation campaign programmes by project / district ▪ Increased safe water coverage	▪ Hygiene and sanitation awareness materials ▪ Observation of good practices of hygiene and sanitation ▪ % Increase in safe water coverage. ▪ Number of hygiene and sanitation campaigns ▪ Number of incidences and death cases due to hygiene and sanitation related diseases	
Increased cases of criminals, prostitutes, alcoholism	▪ Establish recreational facilities ▪ Establish a police post ▪ Encourage income generating activities for those not participating in the project	▪ Observation of recreational facilities ▪ Observation of a police post ▪ Number of men and women engaged in income generation activities but are not participating in the project activities.	
Depletion of energy resources /increase in charcoal burning	▪ Establish awareness programmes on energy saving cook stoves	▪ Observation of energy saving cook stoves ▪ Number of awareness campaigns and awareness material on energy saving devices/ cook stoves	
VEGETATION/ ECOLOGY			
Woody debris disposal	Conversion of woody debris into timber, fuel wood or charcoal	Ensure proper disposal of woody debris as suggested	Every 2 months
Sensitive natural systems e.g. riverine forests	Should be preserved in their pristine state	Ensure regular checks on workers to ensure they don't cut down such areas.	As the project goes on
Soil erosion Control	Reduce erosion to minimum levels thru planting *Calliandra* and *Puerelia* as cover crop or *Paspalum* on road sides	Visual and on-spot inspection of project area	Every 2 wks
Removal of existing natural vegetation	Slow and gradual process to reduce adverse environment effects	Ensure close supervision of exercise	As the processes go on
Decline in timber production	Encourage forestation initiatives among the local people. Ensure sustainable utilisation of forest resources from production	Ensure people pick up recommended forestation programmes in order to be able to meet their energy requirements.	As the project goes on

Potential issues	Recommended action	Monitoring requirements	Frequency of monitoring
	zones of forest reserves under FD.	requirements.	
HYDROLOGY			
Water Resources	Provide alternative supplies to well, spring and steam where necessary	Monitor quality and yield of alternative supplies; monitor yields/flow rates, water levels, of original water sources and ground water levels; keep complaint records	Weekly
Water Quality/release of suspend matter from soil erosion	Settlement ponds; containment	Visual checks and laboratory measurements of suspended matter	Daily visual inspection; weekly laboratory sample analyses upstream and down stream
Water quality: Contaminant spills/runoff	Containment, good handling practices	Visual and laboratory checks of downstream water quality; inspection of handling practices and storage facilities	Daily visual inspection of oil, fuel and grease; weekly laboratory checks for oil, fuel, grease, acids and other chemical;
Fish stock, numbers and catch	Monitor and restock where necessary	Fish stock survey. Fish catch evaluation	Weekly
AVIFAUNA			
Relative abundance & species richness	Survey of key species	Mist-netting, TSC & visual observation	Every six months
Release of suspended solids	Construction of Settlement ponds & ditches; no clearing vegetation along the lakeshore.	Visual checks and laboratory measurement of suspended matter; presence of water birds	Monthly samples
Degradation of habitats	Controlled & systematic habitat clearance	Habitat patches & corridors to be monitored	Visual assessments & collection of complaints.
Breeding colonies of birds	Implement mitigation measures	Monitor breeding pairs and nests in the breeding grounds	Every six months
LAND USE/COVER			
Large scale clearance of private forests	Establishment of other similar areas of forest elsewhere	Satellite/aerial photographs	Annual
Loss of wetland areas	Avoidance of wetland area; 200m strip left intact at the lake shoreline; a 30m strip at riverbanks	Satellite/aerial photographs	Annual

Table 39:Monitoring requirements during operational phase

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
INDUSTRIAL CHEMISTRY/OCCUPATIONAL HEALTH			
Noise	Monitor noise levels, working hours and complaints; use of hearing protective devices; preventive maintenance of equipment.	Some level meter	Monthly; audiometric testing annually
Air quality	Use of appropriate dust masks. Priority given to technical control of dust generated i.e., efficiency and effectiveness if fans cyclones etc.	Personal dust samplers	Annually; including lung function testing (vitalography) if necessary
Traffic safety	Defined routes and speed limits	Visual checks of driver behaviour, accident record	Maintenance and accident records. Random checks of drive behaviour
Boiler plants	Upwind from sources of flames; separation from hazardous areas. Statutory examination and certification.	Inspection following maintenance	During installation weekly and keeping of records
Waste-water treating facilities	Peripheral location; down mind from concentration of people	Inspection of plant lay out design	Before constructions and monthly
Storage tanks	Separation of tanks from each other tanks from other facilities	Inspection of plant layout – design stage.	Prior to construction and monthly
Pipe alleys	Looped arrangement of fire fighting water, cooling tower, boiler fed water and water steam	Inspection of plant lay-out	Prior to cons traction
Electrical power lines	Below ground if possible avoid passing over facilities looped arrangements for critical user.	Inspection of installation drawings	Prior installation and weekly, or monthly.
Fire hydrants or monitors, safety showers, hose carts; other fire fighting equipment.	Close but not too close to the hazardous areas; no obstruction for monitors; good path for retreat.	Visual and critical inspections and examinations	Monthly for the hydrants annually for fine extinguishers, randomly for readiness and fitness
Water quality contaminant spills/run off	Containment; good handling practices	Laboratory checks of water quality including final effluent release from sedimentation pond	Weekly at beginning then monthly for all necessary characteristics others tests on ad hoc basis.

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
AGRO-ECONOMICS			
Poverty reduction through increased employment opportunities	Survey on ▪ Number of people formally employed ▪ Increased income	Survey	2nd year, once
Poverty reduction through agriculture	Survey on ▪ Number of people in agriculture ▪ Rate of monocropping ▪ Modernisation of farms ▪ Number of farmers growing palm oil		4th year, once 7th year, once
Impact on livelihoods	Survey on ▪ Number of people engaged in fishing sector	District Authorities	
Enhanced health services	Survey on ▪ Number of health centres ▪ Number of dispensaries ▪ Number of trained personnel	District Authorities	
Improvement in education services	Survey on ▪ Increased level of literacy ▪ Increased no of primary and secondary schools	District Authorities	
AQUATIC ECOSYSTEM			
Monitoring during first two years of oil palm plantation development Water quality Phytoplankton & Invertebrate Ecology Fisheries biology and production	As above	Quarterly for 24 months	
Monitoring during palm oil production Water quality Phytoplankton & Invertebrate Ecology Fisheries biology and	As above	Monthly till production peaks	

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
Production			
Factory effluents	Factory effluent monitoring		
VEGETATION/ ECOLOGY			
Sensitive natural systems e.g. riverine forests	Should be preserved in their pristine state	Ensure regular checks on workers to ensure they don't cut down such areas.	As the project goes on
Soil erosion control	Reduce erosion to minimum levels through planting *Calliandra* and *Puerelia* as cover crop or paspalum on road sides	Visual and on-spot inspection of project area Planting of cover crops	Every 2 weeks
Decline in timber production	Encourage forestation initiatives among the local people. Ensure sustainable utilisation of forest resources from production zones of forest reserves under FD.	Ensure people pick up recommended forestation programmes in order to be able to meet their energy requirements.	As the project goes on
HYDROLOGY			
Water Resources	Monitor and provide alternative supplies to well, spring and steam where necessary	Monitor yields/flow rates, water levels, of original water sources and ground water level; keep complaint records	Weekly
Water quality/release of suspended matter from soil erosion	Settlement ponds; containment, during the first year until situation reverts to normal	Visual checks and laboratory measurements of suspended matter	Monthly laboratory sample analyses upstream and down stream
Water quality: Contaminant spills/runoff	Containment, good handling practices	Visual and laboratory checks of downstream water quality; inspection of handling practices and storage facilities	Daily visual inspection of oil, fuel and grease; Monthly laboratory checks for oil, fuel, grease, acids and other chemical;
Fish stock, numbers and catch	Monitor and restock where necessary	Fish stock survey; Fish catch evaluation	Monthly in the first two years thereafter quarterly
AVIFAUNA			
Avitourism	Implement Tourism action plan	Monitor tourist number in Bugala Island & calculate annual tourism revenue	Tourist records to be kept by month
Use of pesticide	Controlled use of pesticides	Monitor bird poisoning; relative abundance	Daily observation
Public Education Programmes	Sensitising local communities	Good environmental practises by the communities	Every three months

Potential issues	Recommended action	Monitoring requirements	Frequency & period of monitoring
LAND USE/COVER			
Large scale clearance of private forests	Establishment of other similar areas of forest elsewhere	Satellite/aerial photographs	Annual
Loss of wetland areas	Avoidance of wetland area	Satellite/aerial photographs	Annual

Monitoring agencies and cost estimates

Table 40: Responsibilities and cost estimates for monitoring programme

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
Mammals			
Loss/conversion of habitat	Species composition and relative abundance in both the converted areas and natural areas	Forest Department/UWA, BIDCO	5,000/year
Some mammals potentially pests	Specific monitoring should be focused on the plantation/crops for any crop-raiding by mammals	MAAIF, UWA, Local Govt.	2,500/year
Butterflies			
Loss/conversion of habitat	Species composition in different habitats, with specific focus on endemic and restricted range species	Forest Dept., MAAIF, UWA	4,000
Poisoning in case of pesticide use	Survey on general species composition and relative abundance before and after any use of pesticides	MAAIF, UWA, Forest Department, BIDCO	
Amphibians and reptiles			
Loss/conversion of habitat	Species composition and distribution before and during the project period	Forest Dept., UWA, Developer, Consultant	4,000
Alteration of habitat quality	Habitat quality needs to be determined before start of project and constantly during project period	MAAIF, Directorate, Wetlands Inspection Division/MWLE	
AGRO-ECONOMICS			
Poverty reduction through increased employment opportunities	• Number of people formally employed • Increased income	District Authorities	1,800

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
Poverty reduction through agriculture	▪ Number of people in agriculture • Rate of monocropping ▪ Modernisation of farms ▪ Number of farmers growing palm oil	District Authorities	1,800 x 2 = 3,600
Impact on livelihoods	▪ Number of people engaged in fishing sector	District Authorities	
Enhanced health services	▪ Number of health centres ▪ Number of dispensaries ▪ Number of trained personnel	District Authorities	
Improvement in education services	▪ Increased level of literacy ▪ Increased no of primary and secondary schools	District Authorities	
AQUATIC ECOSYSTEM			
Habitat characterisation	One characterisation survey;	FIRRI	500
Water quality	Sampling & chlorophyll-a analyses;	FIRRI	10,000
Phytoplankton & invertebrate ecology	Diversity & abundance measurement	FIRRI	3,000
Fisheries biology and production	Fishery biology & yield assessment surveys	FIRRI	12,000
Water quality Phytoplankton & invertebrate ecology	As above without habitat survey	FIRRI	100,000
Fisheries biology and production	As above without habitat survey		
Monitoring during first two years of oil palm plantation development ▪ Water quality ▪ Phytoplankton & invertebrate ecology ▪ Fisheries biology and production	As above	FIRRI	50,000
Monitoring during palm oil production ▪ Water quality ▪ Phytoplankton & invertebrate ecology ▪ Fisheries biology and production	As above	FIRRI	Approx. 200,000

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
Factory effluents	Factory effluent monitoring	FIRRI	
SOCI-ECONOMIC			
Increased cases of criminals, prostitutes, alcoholism	▪ Establish affordable recreational facilities ▪ Strengthen police/law enforcement units ▪ Encourage income generating activities for those not participating in the project	District Authorities, BIDCO, VODP	20,000
Depletion of energy resources /increase in charcoal burning	▪ Establish awareness programmes on energy saving cook stoves.	District Authorities, BIDCO	2,000
Increased HIV/AIDS infection	▪ Strengthen the district HIV AIDS programme ▪ Establish workplace HIV /AIDS programme	BIDCO	15,000
Increased hygiene and sanitation diseases	▪ Hygiene and sanitation campaigns ▪ Increase safe water sources	2,000 65,000	District GOU
Strain on medical services	▪ Mobile medical units ▪ Strengthened medical services ▪ Establish more medical units	VODP District /GOU GOU	-
Food shortage	▪ Improved agricultural extension services ▪ Grow more food campaign	District District / VODP	5,000
VEGETATION/ ECOLOGY			
Woody debris disposal	Ensure proper disposal of woody debris as suggested	Forest Department (FD); District Environment Office (DEO)	8,000
Sensitive natural systems e.g. riverine forests	Ensure regular checks on workers to ensure they don't clear such areas.	BIDCO, District Agriculture Office (DAO), District Environment Office (DEO)	2,000
Soil erosion Control	Visual and on-spot inspection of project area	DAO & DEO	2,000
Displacement of existing land cover	Ensure close supervision of exercise	DAO & DEO	2,000
Decline in timber production	Ensure afforestation programmes in order to meet energy requirements	FD & DAO	5,000

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
LAND USE/COVER			
Decline in natural habitats such as forest, wetlands	Accurate information on extent and quality of representative habitats	Forest Department, District Authorities, NEMA	2,000/2years
HYDROLOGY			
Ground Water table	Measure Ground water levels	BIDCO	500*12 = 6,000
Well, spring and stream water levels	Measure water levels in the wells and streams	DWD WRAP, Entebbe	500*12 = 6,000
Water quality	Sampling and measurement of TSS, nutrients, soil particle sizes, visual SS assessment and laboratory analysis	DWD WRAP, Entebbe	1,000*12 = 12,000
Yields	Discharge rates and levels in springs and wells	BIDCO	500*12 = 6,000
Conservation structures	Visual assessment of performance of system, dimension recording	District Agricultural Office Kalangala	100*12 = 1,200
Stream flow	Discharge measurement of streams	BIDCO	500*12 = 6,000
Fish stock, numbers and catch	Monitor the trends in fish spices, number and catch	Fisheries Department, Entebbe	300*12 = 3,600
AVIFAUNA			
Avifauna of other Ssese Islands	Detailed TSCs, Mist-netting and point counts should be carried out at representative habitats and various sites within the remaining islands.	MUIENR, Nature Uganda, Environmental Officer	20,000
Relative abundance & species richness	Mist-netting, TSC & visual observation	MUIENR/Forest Department,	8,000
Release of suspended solids	Visual checks and laboratory measurement of suspended matter; presence of water birds	DWD WRAP,	3,000
Degradation of habitats	Habitat patches & corridors to be monitored	MUIENR, NEMA, Nature Uganda, Forest Department	2,000
Breeding colonies of birds	Monitor breeding pairs and nests in the breeding grounds	Nature Uganda, MUIENR	4,000
Avitourism	Monitor tourist number in Bugala Island & calculate annual tourism revenue	UTB, Nature Uganda	2,000

Potential issues	Monitoring requirements	Suggested agency	Estimated cost (USD)
Use of pesticide	Monitor bird poisoning; relative abundance	Environmental Manager, NEMA, Ministry of Agriculture, WARM	5,000
Public Education Programmes	Good environmental practises by the communities	NEMA, Environmental Manager, District Environment Officer	50,000
GENERAL			
Environmental impacts of roads development	EIA for roads development	BIDCO	20,000
Environmental impacts of powelines installation	EIA for powerlines	BIDCO	20,000
Effective implementation of Environmental Management Plan	Employ environmental manager	BIDCO	24,000 per year

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THE REPUBLIC OF UGANDA

Ministry of Agriculture, Animal Industry and Fisheries
Vegetable Oil Development Project

ENVIRONMENTAL IMPACT STATEMENT

FOR THE PROPOSED OIL PALM PROJECT, BUGALA ISLAND, KALANGALA DISTRICT

October 2003

VOLUME III: APPENDICES

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APPENDIX 1: LANDS ACQUIRED FOR VEGETABLE OIL DEVELOPMENT PROJECT - OIL PALM COMPONENT IN BUGALA, KALAN GALA

Ssese Block No.	Plot No.	Size of Land (Hectares)
9	4	40.73
9	6	43.02
10	4	12.15
10	2	44.52
12	21	4.05
12	6 & 35	93.08
25	13	12.15
27	4	20.19
68	2	60.60
69	16	412.34
91	1	18.60
91	4	32.40
92	2	2.45
92	3	4.05
92	4	4.05
92	6	2.02
92	10	237.05
93	5	10.10
93	4	467.82
93	8	8.10
94	1	105.62
96	8	8.50
98	17	60.59
108	6	404.68
110	4	10.02
110	3	40.47
110	1	65.15
111	2	18.21
111	9	42.00
113	5	127.90
114	2	6.05
114	3	8.10
114	4	154.60
114	1	8.10
115	1	8.10
116	1	131.10
123	2	137.50

Source: Vegetable Oil Development Project, MAAIF

APPENDIX 2: RESETTLEMENT POLICY FRAMEWORK

A. INTRODUCTION

Uganda is essentially an agricultural country. Over 80% of its population lives in rural areas and depends mostly on traditional agriculture and related activities. Agriculture contributes approximately 50% of GDP. The envisaged Bugala Island Oil Palm Development Component (OPDC) of Vegetable Oil Development Project (VODP) seeks to increase productivity of smallholder farmers, to increase farm incomes, to reduce food insecurity, and to enhance management of soil fertility in order to bring about economic growth in this undeveloped remote region of Uganda. The project will stop foreign exchange drain and concentrate on the development of country's core strength, the agricultural sector.

Ssese Islands average population density is relatively low except in a few localities where there are highly concentrated settlements. The problem of population pressure on scarce land resources does not, therefore, arise. Every effort should be made in the design and screening stages of the different components of the OPDC to avoid negative impacts on people, land, and property, including peoples' access to natural and other economic resources, as far as possible.

After establishment, the project and its subcomponents will expand only on outgrowers' own land, hereafter referred to as sub projects. The necessity for land acquisition, compensation and resettlement of local people will, therefore, not arise.

Notwithstanding the above, in line with the World Bank's Involuntary Resettlement Policy OP 4.12, the Government of Uganda has already put in place policies, principles and guidelines for compensation for any involuntary resettlement. The resettlement framework establishes the resettlement and compensation principles, organizational arrangements and design criteria to be applied to the sub projects of OPDC during project implementation in compliance with the laws of Uganda and the World Bank's safeguards policy on involuntary resettlement, whether or not the need arises.

The subproject resettlement/compensation plans will be subsequently prepared consistent with this policy framework and will be submitted to the World Bank for approval if it becomes necessary in future to do so. All efforts will be deployed to minimize the need for resettlement at the subproject design stage.

In line with the World Bank Operation Policy 4.12 on involuntary resettlement this resettlement policy framework will cover the following:

- Policy principles and objectives governing resettlement preparation and implementation;
- A description of the process for preparing and approving resettlement plans;
- Land acquisition and likely categories of impact;
- Eligibility criteria for defining various categories of project affected persons;
- A Legal framework comparing the borrower laws and regulations and World Bank policy requirements and measures proposed to bridge any gaps between them;

- Methods of valuing affected assets;
- Organizational procedures for delivery of entitlements, including, for projects involving private sector intermediaries, the responsibilities of the financial intermediary, the government, and the private developer;
- A description of the implementation process, linking resettlement implementation to civil works;
- Description of grievance redress mechanisms;
- A description of mechanisms for consultations with, and participation of, displaced persons in planning, implementation, and monitoring;
- Arrangements for monitoring by the implementing agency and, if required, by independent monitors.

B. POLICY PRINCIPLES AND OBJECTIVES GOVERNING RESETTLEMENT PREPARATION AND IMPLEMENTATION

The impacts due to involuntary resettlement from development projects may give rise to economic, social and environmental changes resulting in production systems being dismantled. People face impoverishment when their productive assets or income sources are lost, or when they are relocated to environments where their productive skills may be less applicable, resulting in increased competition for resources. Community institutions and social networks may be weakened, kin groups dispersed, and cultural identity, traditional authority and the potential for mutual help diminished or lost.

The resettlement policy may be triggered because the project activity causes land acquisition, namely: a physical piece of land is needed and people may be affected because they are cultivating that land, they may have buildings on the land, they will use the land for watering and grazing of animals or they may otherwise access the land economically or in any other way which may not be possible during and after the project is implemented. People affected will be appropriately compensated for their loss (of land, property or access) either in kind or in cash, of which the former is preferred.

Therefore, the objectives of this framework are the following:

i) Involuntary resettlement and land acquisition should be avoided where feasible, or minimized; exploring all viable alternative sub projects designs.

ii) Where involuntary resettlement and land acquisition is unavoidable, resettlement and compensation activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to give the persons displaced by the project the opportunity to share in project benefits. Displaced and compensated persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.

iii) Displaced and compensated persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to

pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

Here, the affected people, according to the World Bank policy, refer to people who are directly affected socially and economically by the World Bank assisted investment projects, caused by:

(a) the involuntary taking of land and other assets resulting in :
  (i) relocation or loss of shelter;
  (ii) loss of assets or access to assets;
  (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or
(b) the involuntary restriction of access to legally designated parks and protected areas results in adverse impacts on the livelihood of the displaced persons.

The resettlement policy applies to all components under the project, whether or not they are directly funded in whole or in part by the World Bank.

The policy applies to all displaced persons regardless of the total number affected, the severity of impact and whether or not they have legal title to land. Particular attention should be paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, indigenous groups and ethnic minorities or other displaced persons who may not be protected through Ugandan land compensation legislation.

In particular for VODP-OPDC, the policy requires that resettlement plans be developed for smallholders for subprojects of VODP-OPDC that entail acquisition of land and for which displacement or restriction of access may result. Implementation of any subproject requiring resettlement plans cannot commence before necessary measures for resettlement and compensation are in place according to steps identified in the resettlement plan. These measures will include provision for compensation and other assistance required for relocation, prior to displacement, and preparation and provision of resettlement sites with adequate facilities, where required. In particular, the taking of land and related assets may take place only after compensation has been paid and, where applicable, resettlement sites, new homes, related infrastructure, public services and moving allowances have been provided to displaced persons. For sub projects resulting in loss of shelter and/or requiring relocation, the policy further requires that measures to assist the displaced persons be implemented in accordance with the sub project's resettlement plan of action.

The policy aims to have the affected persons perceive the process and any compensation to be complete, fair and prompt.

C. DESCRIPTION OF THE PROCESS FOR PREPARING AND APPROVING RESETTLEMENT PLANS

To address the impacts under this policy, sub project resettlement plans must include measures to ensure that the displaced persons are;

a) informed about their options and rights pertaining to resettlement;

b) consulted on, offered choices among, and provided with technically and economically feasible resettlement alternatives;

c) provided prompt and effective compensation at full replacement cost for losses of assets and access attributable to the sub project.

Before implementation of the subproject, three interrelated documents will have to be prepared, namely,

a) A socio-economic study (this study will include determination of impacts);

b) Resettlement plan;

c) A valuation report of land and landed properties of the site

The purpose of the socio-economic study is to carry out a social assessment of potentially affected populations/communities. Under this study a comprehensive census would be carried out to identify potentially affected people on the individual and household levels, vulnerable groups (women, children, the elderly, female headed households, etc.). The social assessment would focus on identification of stakeholders (demographic data), mechanisms for involvement of stakeholders, identification of affected people and the impact on their property and production systems, institutional analysis and the system for monitoring and evaluation. Detailed calculation of household economies and identification of all impacts will be necessary in the social assessment and will be the determinant in the potential compensation process.

The components of the sub project resettlement/compensation plan will be:

- Description of the subproject
- Sub project objectives
- Potential impacts
- Relevant findings of the socio-economic study
- Legal framework
- Institutional framework
- Eligibility
- Valuation of and compensation of losses
- Resettlement measures
- Site selection, site preparation, and relocation
- Housing, infrastructure and social services
- Environmental protection and management
- Community participation
- Integration with host populations
- Grievance procedures
- Organizational responsibilities
- Implementation schedule
- Costs and budget
- Monitoring and evaluation

The local communities who are to be assisted by VODP, will be advised during the subproject identification/preparation stage whether or not the resettlement policy will be triggered. At that stage the local community may decide to drop the implementation of the subproject in the effected area on that basis. If they chose to continue with the subproject implementation in that area, however, then they will be advised to prepare a resettlement plan, and will be assisted to do so. The resettlement plan will then be forwarded for screening and approval through the District Council in compliance with the project institutional administrative arrangements.

The Ministry of Agriculture will have representatives to provide the necessary technical support required at this level.

Resettlement plans that are approved at the district level will be subject to final screening by the Project Coordinator of VODP. Environmental Assessment (EA) reports and resettlement plans would also be reviewed and approved by the World Bank to ensure compliance with World Bank safeguards.

Therefore, each subproject area that is proposed to be included in future under this project would be screened and classified according to its environmental and social impact. The screening and classification process will follow already established criteria and the mitigation measures proposed vis à vis environmental and social issues will be in compliance with all Government of Ugandan environmental policies and World Bank safeguard policies. Certain activities will not be funded by the project, including those likely to trigger selected safeguards for e.g. disputed areas, cultural property, indigenous peoples and natural habitats.

The Screening Process

The screening process will take the form of:

General sub project classification:

a. Expanded land areas or
b. consolidation in order to make more rational use of land

1) Classifying the sub projects by activity into the following categories;

Identification of the sub-project, and determination of whether the sub-project will entail

a. repair/rehabilitation or
b. new construction.

In general sub-projects that repair and/or rehabilitate existing infrastructure will not trigger the resettlement policy. Those that entail new construction are more likely to trigger the policy if the activity involves acquisition of land and if displacement or restriction of access may result. Types of activity that might require resettlement plans may include

a. expansion or
b. consolidation of land areas to improve use

2) Identifying and evaluating potential impacts for each proposed sub project according to whether land is acquired and whether displacement or loss of access may result.

3) Triggering of the resettlement policy will be one criterion by which sub projects can be rejected.

4) Alternatively, triggering of the resettlement policy would require a preliminary determination of whether the sub project should be proposed or not, based on an assessment of the intensity of the impact and on the mitigation measures that would need to be developed and proposed. The farmer group may then determine whether or not to proceed with the project even where extensive/cumbersome mitigation measures are deemed necessary in the sub project.

5) Determining the need for land acquisition and, if deemed necessary, whether it is essential to obtain legal title to the land. Under the right-of-occupancy land tenure system, legal title as expressed in a property deed is not always necessary.

6) Use of the Socio Economic Study to identify affected people on the household level and vulnerable groups in the sub project impact area(s) and to calculate household economies.

7) Using the environmental assessments

8) Ensuring that land acquired is not, (i) in disputed areas, (ii) cultural property, (iii) negatively affecting indigenous peoples and (iv) is not in natural habitats. This is a pre-condition for approval.

The screening process should be used by the local communities assisted by VODP in the preparation of sub projects to enhance the likelihood of approval by the Worl Bank. At the level of the VODP, project proposals will be reviewed according to the same criteria. The VODP would also review the sub project Environmental Assessment (EA) reports.

Furthermore, the VODP should as a guideline consider the cumulative factor and not approve sub projects that have individual high impact intensity. For example, where land acquisition is required to such an extent that it would require more than 20% of a community's or individual household's total land under cultivation or when the mitigation measures are so cumbersome that their efficacy cannot be ensured or they cost more than 20% of the investment budget, district authorities should in general reject such proposals.

Before a decision to approve a sub project requiring a resettlement plan is taken, the VODP will need to approve the resettlement plan of the sub project together with the overall environmental and social screening process that has been applied for that sub project and also approve or disapprove of any proposed mitigation measures.

The sub projects are expected to be small in scale and, though impacts may not be significant for a single sub project, a review must be made at a level higher than the community level on the possible cumulative and synergistic impact of all sub projects. If the impact is significant, individual mitigation measures per sub project should be assessed to determine their adequacy relative to the overall impact. When the overall impact of sub projects is being considered at the local, national and/or regional levels, additional mitigation measures may be deemed necessary. These would have to be integrated into the resettlement plans of sub projects and the monitoring and evaluation plan of the project.

Capacity will be built at the community levels by providing technical assistance to allow communities to screen their sub-project ideas for environmental and social concerns. This training will also include the capacity to develop mitigation measures to meet environmental and social impacts and to prepare implementation of such measures. Capacity will also be built at the decentralized (departmental) levels of the district as well as at national level of the Ministry of Agriculture, Animal Industry and Fisheries to enable them effectively carry out their roles at both the district and national level. District teams that are required to work with local communities should be targeted for capacity building in terms of training to enhance both their skills and numbers.

Communities and/or farmer groups may use the screening process whether or not proposed sub-projects will entail acquisition of land in order to identify affected people, if any.

OIL PALM DEVELOPMENT PROJECT

SUBPROJECT LAND REQUIREMENT AND ACQUISITION FORMS

(a) Existing land resources

1. Name of Village:.....

Postal Address: P. O. Box.....District .....

2. Current land tenure/ownership in the sub project area .....Ha.

- Freehold.....
- Mailo .....
- Leasehold .....
- Community land, e.g. belonging to religious organizations: .....
- Customary .....
- Bonafide occupancy.....

TOTAL LAND RESOURCES .....

3. Subproject land requirement.....

4. Agreement to meet subproject land requirement, as per Outgrower's Meeting of (day/month/year) and confirmed by Local Council III meeting of (day/month/year)

Table 1: Sample form for agreement regarding identification of land needed for a sub-project:

Ownership of land	**With compensation (Ha)**	**Without compensation (Ha)**	**Sub-total(Ha)**
Freehold			
Mailo			
Leashold			
Customary			
Bonafide occupant			
Grand-total allocation			

Table 2: Assessment of overall current land use

Ownership	Current land use in ha						Remarks
	Fallow	Cropped			Grazing/ pasture	Forest	Mixed (specify)	
Freehold								
Bonafide occupants								
Leasehold								
Customary								
TOTAL								

Table 3:Assessing current use of earmarked land

Ownership	Current land use in ha.							Remarks
	Fallow	Cropped			Grazing/ pasture	Forest	Mixed (specify)	
Freehold								
Bonafide occupants								
Leasehold								
Customary								
TOTAL								

Table 4: Analyzing subproject land allocation from individual land with corresponding compensation

	Name of individual	With compensation Ha	Compensation rate /ha UShs.	Compensation per individual UShs.
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
Total				

The Table 1 gives an overview of the land resources available in the area.

Table 2 shows the current land use in overall terms while the next gives the current land use of that land which is earmarked for allocation to the development project. Table 3 specifies the contribution of individuals to the land earmarked for the subproject, and the agreed compensation.

D. Eligibility criteria for defining various categories of affected persons

At this stage it would not be possible to attempt to quantify the estimated likely number of people who may be affected since the sub projects have not been created.

However, the likely displaced persons can be categorized into three groups, namely;

i) **Affected Individual** - An individual who suffers loss of assets or investments, land and property and/or access to natural and/or economical resources as a result of the sub projects and to whom compensation is due. For example, an affected individual is a person who farms, or who has built a structure on land that is now required by a sub project for purposes other than farming or residence by the initial individuals.

ii) **Affected Household** - A household is affected if one or more of its members is affected by project activities, either by loss of property, land, loss of access or otherwise affected in any way by project activities. This provides for:

a) any members in the households, men, women, children, dependent relatives and friends, tenants.
b) vulnerable individuals who may be too old or ill to farm along with the others
c) relatives who depend on one another for their daily existence.
d) Other vulnerable people who cannot participate for physical or cultural reasons in production, consumption, or co-residence.

Compensation will not be limited to people who live together in a co-resident group, since this might leave out people whose labor contributions are critical to the functioning of the "household".

iii) **Affected local community** - A community is affected if project activities affect their socio-economic and/or social-cultural relationships or cohesion. For example project activities could lead into such improvement of socio-economic welfare that class-consciousness arises coupled with cultural erosion etc.

iv) **Vulnerable Households** - vulnerable households may have different land needs from most households or needs unrelated to the amount of land available to them.:

a) female headed households
b) Non-farming
c) Elderly
d) The infirm or ill
e) Orphans

Each category of vulnerable person or household must be compensated according to the nature of the economic loss suffered by loss of access to or use of the land acquired by the sub-project.

The World Bank's OP4.12 suggests the following three criteria for eligibility;

a) Those who have formal legal rights to land (including customary and traditional rights recognized under the laws of Uganda);

b) Those who do not have formal legal rights to land but have a claim to such land or assets- provided that such claims are recognized under the laws of Uganda or become recognized through a process identified in the resettlement plan.
c) Those who have no recognizable legal right or claim to the land they are occupying.

Those covered under a) and b) above are to be provided compensation for the land they lose, and other assistance in accordance with the policy. Persons covered under c) above are to be provided with resettlement assistance in lieu of compensation for the land they occupy, and other assistance, as necessary, to achieve the objectives set out in this policy, if they occupy the project area prior to a cut-off date established by the Government of Uganda and acceptable to the World Bank. Persons who encroach on the area after the cut-off date are not entitled to compensation or any other form of resettlement assistance. All persons included in a), b) or c) above are to be provided with compensation for loss of assets other than land.

The entitlement cut-off date refers to the time when the assessment of persons and their property in the project area is carried out, i.e., the time when the project area has been identified and when the socio-economic study is taking place. Thereafter, no new cases of affected people will be considered. Persons who encroach the area after the socio-economic survey (census and valuation) are not eligible for compensation or any form of resettlement assistance.

Eligibility for Community Compensation

Local communities permanently losing land and/or access to assets on under customary rights will be eligible for compensation.

E. MEASURES PROPOSED TO BRIDGE ANY GAPS BETWEEN THE BORROWER LAWS AND REGULATIONS WITH WORLD BANK POLICY REQUIREMENTS

LAND TENURE AND OWNERSHIP

The Land Act states that all land in Uganda shall vest in the citizens of Uganda and shall be owned according to the following land tenure systems:

a. customary, characteristed by local customary regulation and governed by rules generally accepted as binding by the class of people to which it applies.
b. freehold, involves holding of registered land in perpetuity and using that land for any lawful purpose.
c. mailo, a special type of freehold system
d. leasehold, under which the tenant is granted exclusive possession of the land, usually for a specific period.

Former 'public' or 'government' lands fall under the customary tenure. Government (including Local Government) may acquire land in the public interest under conditions prescribed by parliament. It is also the responsibility of Government to 'hold in trust for the people and protect' any land to be reserved for ecological and touristic purposes for the common good of all citizens.

Communities and individuals may be permitted restricted and regulated use of some of these reserved areas.

In accordance with provisions of the Ugandan legal framework, a process for preparing and approving resettlement plans should be based on the compensation policy in place. The Local Councils should therefore be able to:

- Review the proposal to prepare a resettlement plan

- Discuss the proposal in their organs
- Prepare and agree on proposals of the resettlement plan
- Approve the resettlement plan subject national legislations especially The Land Act of 1998.

Land Tenure for Sub Projects

The current land tenure system in the area includes leasehold, customary (former 'public/government' lands) and private mailo land. The majority of the residents in the area do not have land titles and most of them are squatters. According to The Land Act 16 of 1998 Section 30, this means, they are lawful owners or "Bona fide occupants". Others are tenants by occupancy. "Bonafide occupants" is defined as follows:
a person who before the coming into force of the constitution

a) had occupied and utilised or developed any land unchallenged by the registered owner or agent of the registered owner for twelve years or more or

b) had been settled on land by government or agent of the government which may include a local authority." Most of the people are in the category (a) and some are tenants by occupancy.

Both 'bonafide occupants' and tenants by occupancy can transact business by using land as security.

F. Methods of valuing affected assets

Valuations methods would depend on the type of asset. The asset types identified in the Land Act 16 of 1998 are;

i) land
ii) Buildings on the land
iii) Standing crops on the land
iv) Any other thing that may be prescribed

The Land Act prescribes that assessment of compensation takes into account the following:

v) In the case of a customary owner, the value of land shall be the open market value of the unimproved land;
vi) The value of buildings on the land shall be taken at open market value for urban areas and depreciated replacement cost for the rural area;
vii) The value of standing crops on the land, excluding annual crops which could be harvested within the period of notice given to the tenant
viii) the market value when it is known

The District Land Boards are charged with compiling and maintaining a list of rates of compensation payable with regard to land assets. These lists are reviewed annually and are used by District Land Tribunals in determining amount of compensation payable.

In addition to compensation assessed, the Land Act stipulates payment of a disturbance allowance of fifteen percent or if less than six months' notice is given, of thirty percent of the assessed sum of compensation.

The sub projects would value and duly compensate for assets and investments, including land, crops, buildings, and other improvements, according to the provisions of the resettlement plan. Compensation rates would be market rates as of the date and time that the replacement is to be

provided. The current prices for cash crops would have to be determined. Compensation would be based on valuation at or before the entitlement cut off date in compliance with this policy. Homestead sites such as bush are community property. Only structures on the site belong to individuals. The permanent loss of any homestead site will be covered by community compensation, which will be in-kind only.

Compensation for Land

Compensation is intended to enable farmer whose land is acquired and used for sub project purposes to balance the loss of land, labor, and crop. For this reason, and for transparency, land is defined as an area:

- In cultivation
- Being prepared for cultivation, or
- Cultivated during the last agricultural season

This definition recognizes that the biggest investment a farmer makes in producing a crop is his or her labor. A farmer works in his/her land ,most of the months of the year. The major input for producing a crop is not seed or fertilizer, but the significant labor put into the land each year by the farmer. As a result, when land acquired has a standing crop, the farmer will be compensated in full for the expected market value of the crop. This compensation will cover loss of investment of labor and purchased inputs for the production year in question.

Table 5: Forms of compensation

Cash Payments	Compensation will be calculated and paid in the national currency. Rates will be based on the market value of land when known, or estimated when not known, plus compensation for the value of standing crops.
In-kind Compensation	Compensation may include items such as land, houses, other buildings, building materials, seedlings, agricultural inputs and financial credits for equipment.
Assistance	Assistance may include moving allowance, transportation and labor

As an approximate rule, in a country with ample land and labor-intensive agriculture, the contribution of land can be imputed as about 25% of the gross market value of output. The present value of this future income stream in perpetuity, when discounted back to the present at a discount rate of 12% amounts to approximately twice the average annual value of output. Therefore a person who gives up a parcel of agricultural land for use by a sub-project could be adequately compensated in cash in the amount of twice the average value of gross annual output (plus the additional value of the standing crop, if any). Compensation in kind would take the form of provision of an alternative parcel of equal size and quality. If cash compensation is used, financial institutions should encourage the use of their facilities to reduce likelihood of loss or theft when beneficiaries are compensated in cash. Each recipient in consultation with the project implementation unit will decide upon the time and place for in-kind compensation payments.

A subproject that interferes with grazing land will not be approved for financing by the project unless the affected people have been offered alternative land as compensation in kind and acceptable to the affected people.

Compensation for buildings and Structures

Compensation will be paid by replacing structures such as huts, houses, farm outbuildings, latrines, and fences on alternative land provided as in-kind compensation. Cash compensation would be available as a preferred option for structures (i.e. extra buildings) lost, that are not the main house or house in which someone is living. The going market prices for construction materials will be determined. Alternatively, compensation will be paid in-kind for the replacement cost without depreciation of the structure.

Compensation will be made for structures that are:

- Abandoned because of relocation or resettlement of an individual or household, or
- Directly damaged by construction activities.

Replacement values will be based on:

- Related structures and support services
- Average replacement costs of different types of homestead buildings and structures based on collection of information on the numbers and types of materials used to construct different types of structures (e.g. bricks, rafters, bundles of straw, doors etc.);
- Prices of these items collected in different local markets;
- Costs for transportation and delivery of these items to acquired/ replacement land or building site;
- Estimates of construction of new buildings including labor required.

Compensation for Sacred Sites

The use of sacred sites, ritual sites, tombs and cemeteries is not permitted under this project.

Compensation for vegetable gardens and beehives

These are planted primarily for use within the household. Until a replacement garden starts to bear, the family losing gardens or beehives will have to purchase vegetables and honey in the market. The replacement costs therefore, will be calculated based on the local market rates for these products at the time.

Beehives are placed in various locations in the bush by some individuals that specialize in honey gathering. If such hives would be disturbed by the sub project activities, or access to the hives denied, beekeepers can move them, and the bees will adapt to the new locations. Activities of beekeepers would be valued and duly compensated based on value of one season's production costs of honey for each hive that is moved and any reasonable costs associated with moving the hive.

Large fruit and crop trees

Large fruit/trees, e.g. mangoes, important as a source of:

- Subsistence food for families
- Petty market income in some areas, and
- Shade
- Timber and poles

Given their significance to the local subsistence economy, which this project intends to enhance, trees will be compensated on a combined replacement/market value. Trees used for commercial purposes will be compensated at market value based on historical production records. If households chose to resettle, they will be compensated for the labor invested in the trees they leave behind. The compensation rate will be based on information obtained from the socio-economic study. From this study, a compensation schedule for trees can be developed incorporating the following goals:

- Replace subsistence production yields of the trees as quickly as possible;
- Provide subsistence farmers with trees to extend the number of months of the year during which fruit is produced and can be harvested as a supplemental source of food for their families during their 'hungry season';
- Provide farmers with the opportunity to derive additional production income from trees bearing more valuable fruits at off-season periods;
- Provide cash payments to farmers to replace pre-subproject income derived from the sale of excess production until replacement trees produce the equivalent (or more) in projected cash income.

No compensation will be paid for minor pruning of trees. Compensation for removal of limbs will be prorated on the basis of the number of square metres of surface area removed. The total surface area of the tree will be calculated using the following formula: $(\frac{1}{2}$ diameter of canopy$)^2 \times 3.14$.

G. ORGANIZATIONAL PROCEDURES FOR DELIVERY OF ENTITLEMENTS

This section sets out organizational procedures for delivery of entitlements, including, for projects involving private sector intermediaries, the responsibilities of the financial intermediary, the government, and the private developer.

Compensation (and resettlement) will be funded like any other activity eligible under the projects' administrative and financial management rules and manuals. Payments will be included in the costing of the project, and finances for the payments will be made available to the communities and/or farmer groups through the usual flow of funds. For sub-projects involving payment of compensation, monitoring activities will include confirmation that payments were received by those entitled to them.

The compensation process will involve several steps and would be in accordance with the sub-project resettlement plans, significantly;

- **Public Participation:** Local communities would initiate assessment of the appropriateness of compensation at the concept stage of the sub project. Affected individual/households will be invited to become involved in design activities.
- **Notification:** Affected individuals and households will be identified during a Participatory Rural Appraisal () process and notified. The user will be informed through both a formal notification in writing and, as many as people are illiterate, by verbal notification delivered in the presence of the village chief or his or her representative. In addition, the local council members, and individuals who control fishing areas, wild trees, or other important resources may accompany the survey teams to identify sensitive areas.
- **Documentation of Holdings and Assets:** Local Government councilors and project officers to arrange meetings with affected individuals and/or households to discuss the compensation process. For each individual or household affected, the project officers completes a compensation dossier containing necessary personal information on the

affected party and those that s/he identifies as household members, total land holdings, inventory of assets affected, and information for monitoring their future situation. This information is confirmed and witnessed by local government councilors; Dossiers will be kept current and will include documentation of lands surrendered. This is necessary because it is possible that an individual will surrender several parcels of land over time and will eventually become eligible for resettlement. All claims and assets will be documented in writing.

- **Agreement on Compensation and Preparation of Contracts** – All types of compensation are clearly explained to the individual or household. The project officer draws up a contract listing all property and land being surrendered, and the types of compensation (cash and/or in-kind) selected. A person selecting in-kind compensation has an order form, which is signed and witnessed. The compensation contract is read aloud in the presence of the affected party and the appropriate local council chairman and other local leaders prior to signing.
- **Compensation Payments** – All payments and transfers in kind will be made in the presence of the affected party and the local authorities.

Community Compensation Payments

Compensation will be in-kind only for a community as a whole in the form of reconstruction of the facility to at least the same standard or better standard to that being built by local NGO's. Examples of community properties that may qualify for compensation include:

- School building (public)
- Public toilet
- Well or pump
- Market place
- Road
- Storage warehouse

H. THE IMPLEMENTATION PROCESS LINKING RESETTLEMENT IMPLEMENTATION TO CIVIL WORKS

Before any project activity is implemented, people who are affected and have been determined to be entitled to compensation will need to be compensated in accordance with the resettlement policy framework. For sub projects involving land acquisition, it is further required that these measures include other assistance required for relocation, prior to displacement, and preparation and provision of resettlement sites with adequate facilities, where required. In particular, the taking of land and related assets may take place only after compensation has been paid and, where applicable, resettlement sites and moving allowances have been provided to displaced persons. For sub projects requiring relocation or loss of shelter, the policy further requires that measures to assist the displaced persons be implemented in accordance with the sub project's resettlement plan of action.

The measures to ensure compliance with this policy directive would be included in the resettlement plans that would be prepared for each sub project involving resettlement or compensation. The timing mechanism of these measures would ensure that no individual or affected household would be displaced due to civil works activity before compensation is paid and resettlement sites with adequate facilities are prepared and provided for to the individual or household affected. Once the resettlement plan is approved by the local and national authorities, it should be sent to the World Bank for review and approval.

I. GRIEVANCE REDRESS MECHANISMS

At the time the resettlement plan is approved and individual compensation contracts are signed, affected individuals would have been informed of the process for expressing dissatisfaction and to seek redress. The grievance procedure will be simple, administered as far as possible at the local level to facilitate access, flexible and open to various proofs taking into cognizance the fact most people are illiterate and poor, requiring a speedy, and fair resolution of their grievances. Communities and/or farmer groups will in general be a party to the contract and would not be the best organizations to receive, handle and rule on disputes. Therefore, taking these concerns into account, all grievances concerning non-fulfillment of contracts, levels of compensation, or seizure of assets without compensation should be addressed to the district authorities either in writing or in person.

In some cases it may take people time to realize that they are aggrieved and want to seek redress. Therefore, the grievance procedures will give people up to the end of the next full agricultural season after surrendering their assets to set forth their case.

All attempts would be made to settle grievances.

It is anticipated that the PRA process in land acquisition would avoid, or at least minimize complaints arising from the loss of land and resources as a result of implementing any subproject. However, should any complaint still arise, it will be addressed as follows:

- The appropriate local council would discuss the matter, and attempt to come to an understanding with both parties;
- If the matter is still unresolved the case would then be referred to the District Land Tribunal.

The type of compensation will be an individual choice although efforts will be made to encourage in-kind compensation if the loss amounts to more than 20% of the total loss of subsistence assets.

Depending on the nature and significance of grievances; VODP will incorporate interrelated approaches, which are based on the following two different legal institutional structures: -

(a) central/local government legal-institutional structures: i.e. fully utilizing existing laid down legal institutional mechanisms e.g. the :
    - The Local government Act and organizational structure
    - The Land Act and organizational structure
(b) Institutional structure to be created by VODP for the outgrowers scheme such as the Oil Palm Growers Trust, or at community level, the village as a whole or farmer committees duly elected by other farmers

Aggrieved parties would then be able to air grievances either through central/ local government organs or strictly through the outgrowers' institutional structure.

J. MECHANISMS FOR PARTICIPATION OF DISPLACED PERSONS IN PLANNING, IMPLEMENTATION AND MONITORING

Public consultation and participation are essential because they afford potential displaced persons the opportunity to contribute to both the design and implementation of the sub projects. This fits perfectly with the demand driven nature of the VODP project. The sub projects would be initiated, planned, designed, implemented and operated by farmers or farmer groups who are members of

the rural community and therefore, are an integral part of and play a crucial role in the community that may be affected. Furthermore, the local communities should have a sense of ownership of the project for it to be successful. In addition, their wealth of knowledge of local conditions are invaluable assets to the project. In recognition of this, particular attention would be paid to public consultation with potentially affected individuals/households when resettlement concerns are involved.

Public consultations have taken place during a project appraisal undertaken by IFAD, and during environmental impacts studies undertaken in 1995, 2001 and 2003. The participation strategy would evolve around the provision of a full opportunity for involvement. This process would not be an isolated one because the design of the project ensures continuous public participation and involvement at the local level. Therefore, public consultation would be an on-going activity taking place throughout the project cycle. For example, public consultation would also occur during the preparation of (i) the socio-economic study (ii) the resettlement plan and (ii) the environmental assessment and (iv) during the drafting and reading of the compensation contract.

Public participation and consultation would take place through meetings, radio programmes, request for written proposals/comments, filling in of questionnaires/forms, public readings and explanations of sub project ideas and requirements, making public documents available at the district, sub county, parish and village levels at suitable locations like the offices of local leaders/elders. This combination of measures would take into account various levels of literacy prevalent in these communities by allowing enough time for responses and feedback.

Monitoring of this process would be through the overall monitoring and evaluation mechanism of the Oil Palm Development Component (OPDC). Each resettlement plan would incorporate a monitoring plan.

K. ARRANGEMENTS FOR MONITORING

This section deals with arrangements for monitoring by the implementing agency and, if required, by independent monitors.

The objective will be to make a final evaluation in order to determine if the people who were affected by the project are now **living at a higher standard than before, living at the same standard as before, or they are actually poorer than before**. For sub-projects triggering the resettlement safeguard, indicators tracking the households affected by the acquisition of land will be assessed in comparison to those of households not affected as well as to the baseline before the start of the project. The resettlement plans will indicate parameters to be monitored, institute monitoring milestones and provide resources necessary to carry out the monitoring activities.

In order to assess whether these goals are met, the resettlement plans will indicate parameters to be monitored, institute monitoring milestones and provide resources necessary to carry out the monitoring activities.

Questionnaire data will be entered into a database for comparative analysis at VODP. The project will maintain a complete database on every individual impacted by the project land use requirements including relocation/resettlement and land impacts or damages. Each individual will have a compensation dossier recording the pre-project and post re-settlement situation

For example the following parameters and verifiable indicators will be used to measure the performance of the resettlement plans:

- Individual or household's initial situation, all subsequent sub project use of assets/improvements, and compensation agreed upon and received.
- Percentage of individuals selecting cash or a combination of cash and in-kind compensation;
- Proposed use of payments;
- The number of contention cases out of the total cases;
- The number of grievances and time and quality of resolution;
- Ability of individuals and families to re-establish crops or other alternative incomes
- Agricultural productivity of new lands
- Number of impacted locals in the workforce
- Seasonal or inter annual fluctuation on key foodstuffs
- General relations in the local communities

The following indicators will be used to monitor and evaluate the implementation of resettlements plans;

Table 6: Verifiable indicators for monitoring and evaluation

Monitoring	**Evaluation**
Outstanding compensation or resettlement contracts not completed before next agricultural season.	Outstanding individual compensation or resettlement contracts.
Communities unable to set village-level compensation after two years.	Outstanding village compensation contracts.
Grievances recognized as legitimate out of all complaints lodged.	All legitimate grievances rectified
Pre-sub project production and income (year before land used) versus present production and income of resettled people, off-farm-income trainees, and users of improved agricultural techniques.	Affected individuals and/or households compensated or resettled in first year that have maintained their previous standard of living at final evaluation.
Pre-subproject production versus present production (crop for crop, land/land for land/land).	Equal or improved production per household.

Financial records will be maintained by the VODP to enable calculation of the final cost of resettlement per individual or household. Each individual receiving compensation will have a dossier containing;

- Individual bio-data information,
- Number of people s/he identifies as household dependents
- Amount of land available to the individual or household when the dossier is opened.

Additional information will be acquired for individuals eligible for resettlement/compensation:

- Level of income and of production
- Inventory of material assets and improvements in land, and
- Debts.

Each time land is acquired by the project; the dossier will be updated to determine if the individual or household is being affected to the point of economic non-viability and eligibility for compensation/resettlement or its alternatives. These dossiers will provide the foundation for

monitoring and evaluation, as well as documentation of compensation agreed to, received, and signed for.

As is usually the case, some compensation procedures and rates may require revision at some time during the project cycle. VODP will maintain flexibility, especially on

- Indicators monitored by the VODP to determine whether goals are being met, and
- grievance procedure for the local community to express dissatisfaction about imple

APPENDIX 3: PEST MANAGEMENT PLAN

Integrated pest and disease management methods are cost effective and minimise the use of potentially dangerous chemicals in oil palm plantations. The use of chemicals will be restricted to the nursery and early growth stages.

PEST/DISEASE	MANAGEMENT OPTION	ENVIRONMENTAL ISSUES	MITIGATION
Disease			
▪ Pythium seedling rot ▪ Curvularia seedling blight	▪ Use of resistant varieties ▪ Use of clean certified seed ▪ Since these diseases attack the seedlings in the nursery, the soil should be sterilised before being used ▪ Avoid over wetting the soil during watering ▪ Use of the biofungicide marfu-p or maneb or other similar permitted fungicide	▪ Exposure of workers to chemical ▪ Maneb rapidly degrades, so posses no threat to the environment	Applicators should be well protected during spraying.
Corticium leaf rot	▪ Rots are associated with the feeding activities of insect pests such as beetles, so to minimise attacks by beetles ▪ Plant palm oil at least 1mile from any saw mill (saw dust is a breeding ground for beetles) ▪ Burn all old logs in the vicinity of the plantation ▪ Use of natural predators of beetles, such as the scoliid wasp (scolaria procer 111) ▪ Pull out the decaying (infected) palm tree spear and drench the bud region beneath with maneb or other similar fungicide. ▪ Use of bio-fungicide marfu-p in the early stages of growth	Scoliid wasps can co-exist with other insects in the area where they are introduced and do not attack other insects	
▪ Pestalotiopsis leaf spot ▪ Cercospora leaf spot	▪ Use of clean certified resistant seeds ▪ Use of chemicals only recommended in early growth stages of oil palm. In the mature stage, spraying is not recommended because the damage caused is below economic injury level and does not warrant use of	Exposure of workers to chemicals, if used	Applicators should be well protected

PEST/DISEASE	MANAGEMENT OPTION	ENVIRONMENTAL ISSUES	MITIGATION
	expensive chemicals ▪ Dithane M45 at a monthly interval or maneb or other similar permitted fungicide may be used in extreme cases		
Blast disease	▪ Use of resistant varieties of oil palm ▪ Control the activities of beetles in the plantation ▪ Plant palm oil at least 1mile from any saw mill (saw dust is a breeding ground for beetles) ▪ Burn all old logs in the vicinity of the plantation ▪ Use of natural predators of beetles, such as the scoliid wasp (scolaria procer 111) ▪ Use of chemicals against blast disease is not economical ▪ In the event it becomes necessary systemic insecticides will be used	▪ Given climatic patterns, blast disease is not expected to occur. ▪ In the event that insecticides have to be used concerns are: ▪ exposure of workers ▪ toxicity to non-target organisms e.g. birds	▪ Carefully restricted application e.g., trunk injection; ▪ Protection of applicators
Ganoderma lucidum	▪ No known successful treatment or cure ▪ At replanting the palm will be shredded or burnt and completely removed from the field	▪	▪
Pests			
Apogonia; valanga (Corticium leaf rot; Curvularia seedling blight)	Use of dimethoate or other similar permitted chemical during the early stages of attack	▪ Kills non-target organisms ▪ Exposure of workers	Applicators should be protected
Red spider mites (Cercospora leaf spot)	▪ Practice proper phytosanitation ▪ Use of monocrotophos	▪ Highly hazardous to humans ▪ Leaches into underground water sources ▪ Leaves residues in kernels ▪ Kills non target organisms	▪ Use trunk injection
Rats (Pestalotiopsis leaf spot)	▪ Tin band the trees to prevent the rats from climbing up ▪ The predator barn owl (*Tyto alba*) controls rats below the critical level (less than 5%). Nest boxes may be installed in plantations, one box per 25ha of oil palm. ▪ Brodifacoum may be used only if the cereal baits are placed inside wire traps to avoid killing non-target	Brodifacoum baits, if not properly used, can kill none target organisms.	Protected wire mesh traps be used together with the baits if brodifacoum has to be used.

PEST/DISEASE	MANAGEMENT OPTION	ENVIRONMENTAL ISSUES	MITIGATION
	vertebrates.		
Nettle Caterpillars (blast disease)	Natural enemies (parasitoids) may be used; these include entomopathogenic micro-organisms such as the β Nudaurelia virus and the fungus *cordyceps aff militaris.* The β virus is effective in controlling the larvae stages; the fungus is effective against the pupa stage.	The parasitoids do well in oil palm plantations as they have a mutual relationship with the vegetation in the plantation ecosystem e.g., *Cassia elephantopus* and *Borreria nata*	
Snails (Pythium seedling rot)	The damage caused is below economic injury level, and does not warrant the use of pesticides. However, if necessary, brodifacoum cereal based baits may be used to reduce the number of snails significantly		
Monkeys	▪ Use of human effigies (scarecrows) ▪ Use of tin clangers		
Zonocerus variegates (crickets)	Use of insecticides	▪ Crickets are not expected to be a significant issue ▪ In the event that insecticides have to be used concerns are: ▪ exposure of workers ▪ toxicity to non-target organisms e.g. birds	
Recilia mica (Homoptera)	The entire surrounding of the pre-nursery and nursery should be kept clean weeded in order to prevent the development of *Recilia mica*		

APPENDIX 4: AGROCHEMICAL INFORMATION SHEETS

ABBREVIATIONS

ADI	Acceptable Daily Intake
ARD	Acute Reference Dose
EC	Emulsifiable concentrate(s)
EPA	Environmental Protection Association (USA)
GUS	Groundwater Ubiquity Score GUS = log10(half-life) x (4 – log(Koc))
Koc	Soil sorption constant
LC	Lethal concentration
LC50	the concentration (in water, food or air) that results in 50% mortality
LD	Lethal dose
LD50	the dose that results in 50% mortality
NOAEL	No observable adverse effect level
NOEC	No observable effect concentration
NOEL	No observable effect level
ppm	parts per million

BRODIFACOUM

Basic Identification Information About This Chemical

Chemical Name:	Brodifacoum
Use Type:	Rodenticide
Chem Class:	Coumarin

Other Names for this Chemical

3-(3-(4'-(Bromo-(1,1-biphenyl)-4-yl)-1,2,4,4-tetrahydro-1-naphthyl)-4-hydroxycoumarin , 3-(3-(4'-Bromo-(1,1-biphenyl)-4-yl)-1,2,3,4-tetrahydro-1-naphthalenyl)-4-hydroxy-2H-1-benzopyran-2-one , 56073-10-0 (CAS Number) , 56073100 , 56073100 (CAS Number) , Broadifacoum , Brodicafume , Brodifaccum , Brodifacoum , Brodifacoum (ANSI) , Brodifacum , Havoc , Klerat , PP 581 , Ratak Plus , Talon , Volid , WBA 8119

TOXICITY INFORMATION FOR BRODIFACOUM

Note: Information for many chemicals is incomplete and may not be fully representative of effects on humans.

Summary Toxicity Information

PAN Bad Actor Chemical [1]

Acute Toxicity [2]	Carcinogen	Cholinesterase Inhibitor	Ground Water Contaminant	Developmental or Reproductive Toxin	Endocrine Disruptor
	Not likely	?	No	?	?

Indicates high toxicity in the given toxicological category.

? Indicates no available weight-of-the-evidence summary assessment.

1. **PAN Bad Actors** are chemicals that are one or more of the following: highly acutely toxic, cholinesterase inhibitor, known/probable carcinogen, known groundwater pollutant or known reproductive or developmental toxicant. NOTE! Because there are no authoritative lists of Endocrine Disrupting (ED) chemicals, EDs are not yet considered PAN Bad Actor chemicals.

2. The acute toxicity reported on this page is of the pure chemical ingredient only and may not reflect the acute toxicity of individual pesticide products.

Detailed Toxicity Information

Acute Toxicity [2]

WHO Acute Hazard	Ia, Extremely Hazardous
TRI Acute Hazard	Not Listed
Material Safety Data Sheets	Not Available
Acute rating from U.S. EPA product label	Highly Toxic
U.S. NTP Acute Toxicity Studies	No NTP Studies
View Studies	
Cholinesterase Inhibitor	No

2. The acute toxicity reported on this page is of the pure chemical ingredient only and may not reflect the acute toxicity of individual pesticide products.

Cancer Information - listings

IARC Carcinogens	Not Listed
U.S. NTP Carcinogens	Not Listed
California Prop 65 Known Carcinogens	Not Listed
U.S. EPA Carcinogens	Not Listed
TRI Carcinogen	Not Listed

Endocrine Disruption

Illinois EPA list	Not Listed
Keith list	Not Listed
Colborn list	Not Listed
Benbrook list	Not Listed

Reproductive and Developmental Toxicity

CA Prop 65 Developmental Toxin	Not Listed
U.S. TRI Developmental Toxin	Not Listed
CA Prop 65 Female Reproductive Toxin	Not Listed
CA Prop 65 Male Reproductive Toxin	Not Listed
U.S. TRI Reproductive Toxin	Not Listed

Chemicals of Special Concern

PAN Bad Actors	Yes
PAN Dirty Dozen list	Not Listed

International Regulatory Status

Worldwide Registration for Brodifacoum
Number of countries where this chemical is:
Banned, Restricted or Cancelled: 0
Not legal for import: 0

UNEP Persistent Organic Pollutant (POP)	Not Listed
UNEP Prior Informed Consent Chemical (PIC)	Not Listed
WHO Obsolete Pesticide	Not Listed

U.S. and California Regulatory Status

U.S. EPA Registered	Yes
U.S. EPA Hazardous Air Pollutant	Not Listed
U.S. EPA Minimum Risk Pesticide (25b list)	No
CA Registered	Yes
CA Groundwater Contaminant	Not Listed
CA Toxic Air Contaminant	Not Listed

Water Pollution Potential

PAN Ground Water Contaminant Rating	Insufficient Data

No water quality standards or criteria have been established for this chemical by the U.S. or Canadian governments; however, there may be criteria established for related chemicals.

ECOTOXICITY FOR BRODIFACOUM

Note! Information for many chemicals is incomplete and may not be fully representative of effects on the environment. Click on underlined terms for definitions and additional information.

Aquatic Ecotoxicity

Summary of Acute Toxicity for Organism Group

Organism Group	Average Acute Toxicity	Acute Toxicity Range
Annelida	Moderately Toxic	Moderate Toxicity
Fish	Moderately Toxic	Moderate to Very High Toxicity

Terrestrial Ecotoxicity

No data on terrestrial ecotoxicity.

DIMETHOATE

One of the most widely-used insecticides in the world, dimethoate is a particular concern to those exposed occupationally during manufacture, formulation and use. It is acutely toxic, has possible links to cancer and is suspected of causing birth defects.

Dimethoate is a widely used organophosphorus (OP) insecticide applied to kill mites and insects systemically and on contact(1). It was introduced in the 1950s, originally patented by American Cyanamid(2), and is now produced by 39 companies around the world(3). Dimethoate is used against a broad range of insects such as thrips, aphids, mites, and whiteflies (4), and on a number of crops including citrus, cotton, fruit, olives, potatoes, tea, tobacco and vegetables (5). It is also permitted for the control of the flies in livestock accommodation (6), home gardens and food storage(7) . Like all OPs, dimethoate acts by interfering with the activities of cholinesterase, an enzyme essential for the proper functioning of the nervous system of insects and humans (8).

Production and use

Dimethoate is used in a large number of products. In the US, it has 166 approved labels (9). Its trade names include Afidox (produced by Lucava), Cekutoate (Cequisa), Perfekthion (BASF), Rogor (Isagro), Dimezyl (Agriphar), Hilthioate (Hindustan), and Teeka (Nagarjuna Agrichem)(10). The large number of producers and products reflect the fact that it is one of the most commonly used insecticides in agriculture. In 1998, there were 16,250 metric tonnes of sales globally, with a value of $US 180 million(11).

In 1993, dimethoate applications to orchard crops in the US accounted for 35% of the total active ingredient used in agricultural applications, totaling approximately 725,000 pounds (329,000 kg)(12). Applications made to 10 crops accounted for more than 80% of the total dimethoate applied in the US during 1993. These crops included cotton (17.1%), alfalfa (15.4%), oranges (7.7%), wheat (7.0%), apples (6.9%), grapefruit (6.9%), lemons (6.4%), peas/beans (5.68%), lettuce (3.9%) and field maize (3.1%)(13).

In the UK, dimethoate use in 1998 was 377,030 spray hectares on arable crops (14), an increase from 291,578 treated hectares in 1996(15). It is mostly used against aphids on wheat (322,883 spray hectares in 1998), making it the second most widely used insecticide in wheat (accounting for 14% of all insecticides used), and the 23rd most widely used active substance in UK agriculture in 1998(16).

Acute toxicity

Dimethoate is moderately toxic (World Health Organisation class II) by ingestion, inhalation and dermal absorption(17). Most oral LD50s (dose at which half the sample is dead) in rats range from 150-400 mg/kg body weight(18). For mice, rabbits and guinea pigs, the LD50s are 160, 300 and 350 mg/kg respectively(19). As with all OPs, dimethoate is rapidly absorbed through the skin, and easily absorbed through the lungs(20).

The population as a whole is not generally subject to exposure to dimethoate from air, water or food(21); however occupational exposure may occur during manufacture, formulation and use. This mainly occurs through inhalation and dermal absorption, although occupational exposure can occur by accident or as a result of incorrect handling(22).

Where humans are exposed to dimethoate, there are many effects: when inhaled, the first effects are usually respiratory and may include a bloody or runny nose, coughing, chest discomfort, difficult or short breath, and wheezing due to constriction or excess fluid in the bronchial tubes. Skin contact may cause skin sensitisation. Eye contact will cause pain, bleeding, tears, pupil constriction and blurred vision. Following exposure by any route, other systemic effects may begin within a few minutes or be delayed for up to 12 hours. These may include pallor, nausea, vomiting, diarrhoea, abdominal cramps, headache, dizziness, eye pain, and blurred vision. Severe poisoning will affect the central nervous system producing lack of coordination, slurred speech, loss of reflexes, weakness, fatigue, involuntary muscle contractions, twitching, tremors of the tongue or eyelids, and eventually paralysis of the body extremities and the respiratory muscles(23).

Chronic effects

In humans, repeated or prolonged exposure to OPs may result in the same effects as acute exposure, including the delayed symptoms. Other effects reported in workers repeatedly exposed include impaired

memory and concentration, disorientation, severe depressions, irritability, confusion, headache, speech difficulties, delayed reaction times, nightmares, sleepwalking and drowsiness or insomnia(24).

Teratogenicity (birth defects)

Dimethoate is a suspected human teratogen(25). It has been demonstrated as teratogenic in dogs and cats: for example, one study found that a dosage of 12 mg/kg/day given to pregnant cats increased the incidence of extra toes on kittens. The same dosage given to pregnant rats produced both birth defects related to bone formation, stunting and defects related to malfunction of the bladder(26). These results contradict previous statements made, for example, the UK Advisory Committee on Pesticides (ACP) evaluation in 1993 concluded 'dimethoate was not overtly teratogenic in rats or rabbits'(27), and in 1988 the International Programme on Chemical Safety (IPCS) stated 'on the basis of available data on experimental animals, dimethoate is not considered to be a teratogen'(28). In 1994, BASF rejected claims made in Chile of a link between unusually high levels of genetic defects among babies born in the fruit-growing region of Rancagua with the usage of the insecticide dimethoate. BASF denied there was any evidence to support the claim(29).

Reproductive effects

Dimethoate may affect reproduction: in a multiple generation study in mice, reproductive performance was impaired at high doses but only in the presence of marked cholinergic effects. In an inadequate mouse multigeneration study in 1965, there was no overt effect on reproductive capacity at dietary levels up to 50 ppm(30). However, another study showed that dimethoate at 60 mg/litre drinking water did affect mating of five generations of mice tested(31).

Mutagenicity

There is no consensus on mutagenicity. In 1989, the WHO concluded that dimethoate was found to be mutagenic in a variety of in vitro and in vivo studies(32). In contrast, the various mutagenicity studies reviewed during ACP evaluation indicated that dimethoate possesses mutagenic potential in vitro, but is not mutagenic in vivo(33). One study found dimethoate to be mutagenic in a continuous four generation in vivo experiment(34), contradicting the previous statement, whilst the US Environmental Protection Agency stated there was positive mutagenicity associated with dimethoate(35).

Cancer

Dimethoate is classified as a possible human carcinogen by the US EPA, based on tumors in mice, the compound-related (no dose response) weak effect of combined spleen, skin and lymph tumors in male rats, and positive mutagenic activity associated with dimethoate(36). The IPCS concluded in 1989 that the available data were inadequate to assess the carcinogenic potential of the compound. The ACP 1993 evaluation concluded that dimethoate was not carcinogenic in rats or mice(37), however, an increase in malignant tumours has been reported in rats given oral doses of five,15 or 30 mg/kg dimethoate for 511 to 627 days(38). It seems there is a lack of data assessing the carcinogenic potential of dimethoate.

Effects on wildlife

The toxicity of dimethoate for aquatic organisms and birds is moderate to high(39). One study found that it causes temporary rhythm alterations in some bird seed-eating species. Whilst these effects may not be fatal, they may be critical for the birds' food-finding ability and in making them more vulnerable to predators(40). Dimethoate has also been found to affect wood mice behaviour(41) and to cause jumping, erratic movement imbalance and death in fish(42).

Dimethoate is highly toxic to bees on an acute contact basis(43), particular concern has been expressed over this(44). The LD50 (oral and topical) for bees is 0.1-0.2 µg/bee(45). Products containing dimethoate warn not to apply to crops in open flower nor when flowering weeds are present(46).

Fate in the environment

Dimethoate is a mobile, yet relatively non-persistent OP insecticide. The primary route of dissipation appears to be microbially-mediated degradation in anaerobic (oxygen-rich) soil, particularly under moist conditions, with a half-life (time taken to degrade to half its initial strength) of 2.4 days(47). The 1999 ACP review discussed its previous concerns over environmental fate and behaviour. They concluded that dimethoate was unlikely to leach because it is so rapidly degraded in soil, is non-volatile, was slightly

persistent in sediment/water systems with a DT50 of 13-17 days and did not significantly partition to sediment(48).

Resistance

The peach potato aphid is known to be resistant to dimethoate in the UK. However, other aphid species and leaf miner do not exhibit such resistance(49).

The cocktail effect

It appears dimethoate creates a metabolite called demethoxon that plays a dominant role in the toxicity of dimethoate for insects and mammals. Dimethoxon is also used as an insecticide known as omethoate. Omethoate, is about 10 times more toxic and is more of a potential inhibitor to cholinesterase activity than dimethoate(50). This is an important issue as, in the past, the intake of dimethoate and omethoate have been considered separately, and consumer exposure from individual crop uses has remained below the Acceptable Daily Intake (ADI). However, if the total diet is taken into account, the ADI could be exceeded for toddlers by both dimethoate and omethoate residues and for infants by dimethoate residues. The Pesticides Safety Directorate is in the UK is currently examining the issue of combined residues(51).

Conclusions

Unlike organochlorine pesticides, OPs such as dimethoate do not persist in the environment. Instead, their problem lies in their health effects on humans and other organisms. There is little concrete evidence regarding the chronic effects of dimethoate, for example on its carcinogenicity, however its acute effects on the nervous systems of humans and wildlife have been widely observed. Even though safer alternatives to OP insecticides are available, dimethoate still remains one of the most widely used insecticides in the world. Further safer alternatives should be developed, and an alternative approach based on the encouragement of natural pest enemies widely adopted. (***HM***)

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DITHANE M-45 (MANCOZEB)

TRADE OR OTHER NAMES
Some trade names include Dithane M-45, Manzate 200, Mancozeb, Fore, Green-Daisen M, Karamate, Mancofol, Zimaneb, Manzeb, Policar, Dithane- Ultra Nemispot, Nemispor, Riozeb, Mancozin, Manzin. Common names include mancozeb and manzeb.

REGULATORY STATUS
Mancozeb is registered as a general use pesticide by the U.S. Environmental Protection Agency (EPA). In July 1987, the Environmental Protection Agency announced the initiation of a special review of the ethylene bisdithiocarbamates (EBDCs), a class of chemicals to which mancozeb belongs. This Special Review was initiated because of concerns raised by laboratory tests on rats and mice. The EPA was concerned about

a. potential effects on the general population from dietary exposure to residues left on food crops and
b. potential occupational health risks to workers who handle and/or apply EBDC pesticides.

As part of the Special Review, EPA reviewed data from market basket surveys and concluded that actual levels of EBDC residues on produce purchased by consumers are too low to affect human health. The EPA concluded its Special Review in April, 1992 with new label requirements for protective clothing to be worn by industrial and agricultural workers, and with the establishment of a 24-hour reentry period for agricultural workers. Many homegarden uses of EBDCs have been canceled because the EPA has assumed that home users of these pesticides do not wear protective clothing during application. Toxicity data reviewed by the EPA as part of their Special Review of EBDCs are included in this document under "Toxicological Effects."

Containers of this fungicide bear the signal word "CAUTION"

INTRODUCTION
The EBDCs are fungicides used to prevent crop damage in the field and to protect harvested crops from deterioration in storage or transport. Mancozeb is used to protect many fruit, vegetable, nut and field crops against a wide spectrum of diseases, including potato blight, leaf spot, scab (on apples and pears) and rust (on roses). It is also used for seed treatment of cotton, potatoes, corn, safflower, sorghum, peanuts, tomatoes, flax and cereal grains. Mancozeb is not taken up from the soil by plants. It is a combination of two other chemicals of this class, maneb and zineb. Mancozeb is available as dusts, liquids, water dispersible granules, as wettable powders, and as ready-to-use (R-T-U) formulations.

TOXICOLOGICAL EFFECTS

ACUTE TOXICITY
Mancozeb has a very low acute toxicity to mammals. No toxicological effects were observed in a long term study with rats fed doses of 5 mg/kg. The major routes of exposure to mancozeb are through the skin or from inhalation. In spray or dust forms, the EBDCs are moderately irritating to the skin and respiratory mucous membranes. Symptoms of poisoning from this class of chemicals include itching, scratchy throat, sneezing, coughing, inflammation of the nose or throat, and bronchitis. There is no evidence of 'neurotoxicity,' nerve tissue destruction or behavior change, from the EBDCs. However, dithiocarbamates are partially chemically broken down, or metabolized, to carbon disulfide, a neurotoxin capable of damaging nerve tissue.

The amount of a chemical that is lethal to one-half (50%) of experimental animals fed the material is referred to as its acute oral lethal dose fifty, or LD50. The oral LD50 for mancozeb ranges from 4,500 to 11,200 mg/kg in rats. When applied to the skin of rabbits, its dermal LD50 is 5,000 to 15,000 mg/kg. It is a mild skin irritant and sensitizer, and a mild to moderate eye irritant in rabbits. Agricultural workers handling crops treated with mancozeb have developed sensitization rashes.

CHRONIC TOXICITY
In a two-year study dogs were fed doses of 0, 0.625, 2.5 or 25 mg/kg of mancozeb. Lower iodine uptake was observed after 24 months in dogs fed the two highest doses, while no difference was observed between those dogs fed 0 and 0.625 mg/kg.

Mancozeb is comparable to another chemical, maneb, on which the following long-term studies have been conducted. A two-year feeding study on rats indicated that 6.25 mg/kg of maneb in the diet is the no

observable effect level (NOEL) for rats. However, the next and highest level that was fed to rats in this two-year study did produce signs of poisoning. A one-year feeding study in dogs concluded that 20 mg/kg/day is a NOEL for dogs. Toxic effects were seen in the dogs at daily doses of 75 mg/kg and 250 mg/kg.

The ethylene bisdithiocarbamate pesticides (EBDCs), which include mancozeb, are generally considered to have low short-term mammalian toxicity. A major toxicological concern, however, is ethylenethiourea (ETU), an industrial contaminant and a breakdown product of mancozeb and other EBDC pesticides. In addition to having the potential to cause goiter, a condition in which the thyroid gland is enlarged, this metabolite has produced birth defects and cancer in experimental animals. ETU has been classified as a probable human carcinogen by the EPA. ETU can be produced when EBDCs are used on stored produce, and also when fruit or vegetables with residues of these fungicides are cooked.

REPRODUCTIVE EFFECTS

In a three-generation rat study with mancozeb at a dietary level of 50 mg/kg there was reduced fertility but no indication of embryo toxic or teratogenic effects. In another study in which pregnant rats were exposed to mancozeb by inhalation, toxic effects on the pups were observed only at doses (55 mg/m3) that were also toxic to the dams.

Teratogenic Effects

No teratogenic effects were observed in a three-generation rat study with mancozeb at a dietary level of 50 mg/kg. Specific developmental abnormalities of the body wall, central nervous system, eye, ear and musculoskeletal system were observed in experimental rats which were given 1,320 mg/kg of mancozeb on the 11th day of pregnancy. When it was inhaled at concentrations of 0.017 milligrams per liter (mg/l), mancozeb was not teratogenic to pregnant rats. Teratogenic activity was found in mice given 1,320 mg/kg of maneb.

In pregnant rats fed 5.0 mg/kg/day, the lowest dose tested, developmental toxicity was observed in the form of delayed hardening if the bones of the skull in offspring. ETU has also been shown to be teratogenic in hamsters, but not in mice.

Mutagenic Effects

A data gap exists in the information available on the mutagenicity of mancozeb and ETU. Mancozeb was found to be mutagenic in one set of tests, while in another it did not cause mutations. Mancozeb is thought to be similar to maneb, which was not mutagenic in a test called the Ames Test.

CARCINOGENIC EFFECTS

Ethylenethiourea (ETU), a metabolite of the class of chemicals in which mancozeb is included, has caused cancer in experimental animals and has been classified as a probable human carcinogen by the EPA.

ORGAN TOXICITY

Several studies of the effects of EBDCs on test animals have shown rapid reduction in the uptake of iodine and swelling of the thyroid (i.e. goiter). In one study, a marked reduction of iodine uptake was measured 24-hours after administration of a large dose of maneb, another EBDC fungicide. A 90-day study of the effects of ETU, a common metabolite of the EBDCs on rat thyroids revealed a NOEL of 5 ppm (0.25 mg/kg/day).

FATE IN HUMANS AND ANIMALS

The EBDC fungicides break down in mammalian tissues into ethylene thiourea, ETU, a metabolite which has caused goiter and cancer in laboratory animals.

Research shows that mancozeb is rapidly absorbed into the body from the gastrointestinal tract, distributed to various target organs and almost completely excreted in 96 hours. ETU is the major metabolite. After a single dose, less than one ppm ETU residues were measured in the thyroid and liver. After 24 hours, these residues were not detectable. Blood detection of ethylene bisdithiocarbamate is rarely possible, although there are methods for detecting the metabolite ethylene thiourea in urine.

ECOLOGICAL EFFECTS

Effects on Birds

Mancozeb is slightly toxic to birds on an acute basis. The lethal concentration fifty (LC50) is the concentration of a material in air or water that kills half of a population that is experimentally exposed to the chemical for a given time period. The five-day LC50 for mancozeb in bobwhite quail and mallard ducklings is greater than 10,000 ppm. The EPA is currently reviewing data on the effects of mancozeb on bird reproduction.

Effects on Aquatic Organisms

Mancozeb is generally toxic to fish. It is highly poisonous to warmwater fish and at least moderately toxic to coldwater fish. Many end-use product labels warn of its toxicity to fish. The EPA is currently reviewing data on the potential toxic effects of mancozeb on aquatic organisms.

Effects on Other Animals (Nontarget species)

Mancozeb is harmful to wildlife but not hazardous to honey bees. The 72-hour LC50 for mancozeb in crayfish is greater than 40 ppm; the 48-hour LC50 is 3.5 ppm in tadpoles.

ENVIRONMENTAL FATE

The EBDCs are generally unstable in the presence of moisture, oxygen, and in biological systems. They rapidly degrade to ETU. This rapid degradation lowers the need for concern about the environmental fate of EBDCs and focuses such concern on ETU. The EPA has either called for or is currently reviewing data on the behavior of ETU in the environment.

Breakdown of Chemical in Soil and Groundwater

Because mancozeb is practically insoluble in water it is unlikely to infiltrate groundwater. Studies do indicate that ETU, a metabolite of mancozeb, has the potential to move through the soil as a result of groundwater movement, in a process called leaching. ETU has been detected at 16 ppb in only one out of 1,295 drinking water wells tested.

The breakdown of mancozeb in soil is assumed to be comparable to that of maneb, which has a half-life of four to eight weeks under normal field conditions.

Breakdown of Chemical in Water

Mancozeb degrades in water with a half-life of one to two days at pH 5, 7 and 9. It should be kept out of lakes, streams and ponds and should not be applied where runoff is likely to occur. This fungicide should not be stored or thrown away near or in water, since storage or disposal of mancozeb in or near bodies of water can cause contamination.

Breakdown of Chemical in Vegetation

When used as directed, mancozeb is not poisonous to plants. A 24-hour reentry interval is required in mancozeb-treated crops because: the fungicide is registered on crops which may present a great deal of residue exposure and the mancozeb metabolite, ETU, has been shown to produce tumors, birth defects, cell mutations and thyroid effects. The EBDCs can be broken down during the cooking process as well as by natural environmental processes.

PHYSICAL PROPERTIES AND GUIDELINES

Keep mancozeb out of reach of children, unprotected persons, livestock, and pets. Breathing of dust or spray mist from mancozeb should be avoided. Contact with skin, eyes and clothing should also be avoided. Protective clothing including long pants, long sleeve shirt, gloves, hat and boots should be worn during mixing, loading, application and early reentry into treated fields. Do not feed treated crop foliage to livestock. Water, food or feed can be contaminated by storage or disposal of mancozeb near these commodities. Empty containers should not be reused. They should be buried away from water supplies.

Mancozeb is a grayish-yellow powder with a musty odor which is practically insoluble in water as well as most organic solvents. It is a polymer of maneb combined with zinc. While it is relatively stable and noncorrosive under normal, dry storage conditions, it is decomposed at high temperatures by moisture and by acid. Mancozeb may produce flammable products upon decomposition. It is also unstable in acidic conditions. It should be stored in its original sealed containers in well-aired, dry storehouses or in shaded, aired places. The temperature of the material should not go above 25 to 30 degrees C. Mancozeb

containers must be stacked so that air can move freely at the bottom and sides of piles. As long as the product is stored in its unopened and undamaged original containers in well-ventilated places, its biological activity will remain stable for 2 years.

Mancozeb is stable under most conditions. It may burn, but does not readily ignite, and containers may explode in the heat of a fire. Thermal decomposition products may include toxic oxides of carbon, nitrogen and sulfur. Suspensions of mancozeb dust in the air can ignite or explode.

Occupational Exposure Limits:

OSHA: 5 mg/m^3 ceiling
ACGIH: 5 mg/m^3 TWA
NIOSH: 1 mg/m^3 recommended TWA; 3 mg/m^3 recommended STEL
TLV: 5 mg (Mn)/m^3

Physical Properties:

CAS #:	8018-01-7
H20 solubility:	Dispersible, but practically insoluble in water
Solubility in other solvents:	Practically insoluble in most organic solvents
Melting point:	Decomposes without melting
Vapor pressure:	Less than 10 to the minus 5 power mbar at 20 degrees C
Chemical Class/Use:	Carbamate fungicide; Ethylene bisdithiocarbamate (EBDC)

Last Modified: 12/19/2001

Source: EXTOXNET (Extension Toxicology Network), Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis.

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GLYPHOSATE

CHEMICAL NAME: GLYPHOSATE Isopropylamine salt of N-(phosphonomethyl) glycine

CAS REGISTRY NUMBER: 1071-83-6

CHEMICAL FAMILY: Phosphonate/organic phosphorus compound

MOLECULAR FORMULA: C3 H8 NO5 P

DESCRIPTION: Colourless or white, odourless crystals

USAGE: A Schedule 5 herbicide in the form of the mono(isopropyl ammonium) salt. A broad spectrum (non selective) post-emergent plant growth regulator used for the control of grasses, sedges and broadleaved weeds.

A systemic herbicide that translocates to the roots of plants. Used as the active constituent in many commercial herbicide products. Formerly a Monsanto-held patent, glyphosate products are now formulated by a number of pesticide producers. Used in forestry, farming and pastoral activities, local councils, weed control and transport agencies, as well as domestic and industrial uses.

HEALTH EFFECTS: HUMAN AND TEST ANIMAL DATA

Short Term (Acute Toxicity)

Acute Toxicity (standard animal tests): Oral Toxicity: low

LD50 (rat, oral): 4873 mg/kg. LD50 (mouse, oral): 1568 mg/kg.

Lethal oral doses produce severe stress, breathing difficulties, blood in the lungs, convulsions and death.

LD50 (rabbit, dermal): Greater than 5000 mg/kg.

LC50 (rat): greater than 12.2 mg/kg in air (4 hour exposure)

Can cause slight skin irritation, severe eye irritation. Dust may cause mild to moderate irritation of nose and throat.

Toxicity of glyphosate formulations may be due to presence of surfactants and other additives/contaminants.

Long Term (Chronic Toxicity)

No chronic effects from human exposure reported in peer reviewed literature. [1]

Mouse feeding studies noted non-neoplastic changes including necrosis of hepatocytes male mice and hypertrophy in female mice.[2] (Non-cancerous liver damage) potential for adverse human health impacts of glyphosate formulations requires more investigation.

Carcinogenicity

Long term animal studies did not show carcinogenic activity.[3]

No information on human cancer risk is available.

Glyphosate is readily nitrosated to N-nitrosoglyphosate. Whilst this compound has not been assessed for carcinogenicity potential, at least 3/4 of another 120 N-nitroso compounds showed carcinogenic potential. Nitrosation occurs in the stomach by reaction of nitrite in human saliva. Standard carcinogenic tests using rats would not detect this effect since rats do not secrete nitrite in their saliva.[4]

In 1986, the oncogenic potential of glyphosate was not fully understood. A review of a mouse cancer study noted a slight increase in renal tubular adenomas and a one- year feeding study in dogs observed a reduction of weight of pituitary gland in mid to high doses. The United States Environment Protection Agency reveiwed thses studies and concluded that the mice feeding study did not represent a safety concern because such high doses of glyphosate had been administered to the test animals. (up to 3% of total diet). They did require an additional rat study conducted at high dose levels.

In 1991, following review of the new rat study, the US EPA placed glyphosate in Group E. Evidence of non-carcinogenciity for humans.[5]

Reproductive Effects

Animal studies did not produce any effects. Diets of up to 30 mg/day did not produce any reproductive effects in male or female rats, over three generations. No teratogenic effects were observed in rabbits given

up to 350 mg/kg/day on days 6-27 of pregnancy. Toxic effects noted at the highest dose in both treated animals and their offspring. [6]

No information on human reproductive risk is available.

Mutagenicity

Not mutagenic in a standardised series of tests using bacteria, cultured mammalian cells and whole animals.[7] One study showed very weak mutagenic activity in an in vitro mammalian cell test. [8]

No information on human genetic risk.

Damage to cell structure and function

Glyphosate, or some additive to commercial glyphosate products, may cause damage to DNA via sister chromatid exchange. [9]

Glyphosate can affect the capacity of cells to produce energy. This occurs due to disruption of cell membrane structure. [10]

Further investigation of potential for cell and sub-cellular impacts is required

Synergism Potential

All commercial pesticide products are mixtures of chemical compounds. They contain the active constituent/s (a.i.) and other compounds such as solvents, surfactants, lubricants, preservatives, solubilizers and suspending agents. They may also contain impurities and/or contaminants. Some commercial glyphosate products contain the solvent POEA, which is contaminated with the carcinogen 1,4-dioxane, a common solvent used in laboratories and contained in many consumer products. According to the manufacturer, the levels of this contaminant are kept below 1 part per million (ppm). Another contaminant is N-Nitrosoglyphosate. According to the manufacturer, levels of this contaminant are kept below 0.1 ppm.

No information is available on the human toxicity of pesticide mixtures containing glyphosate. It is often mixed with other pesticides. [11]

HEALTH EFFECTS: WILDLIFE

General Toxicity

The US EPA regards glyphosate as being slightly toxic to birds, aquatic vertebrates and fish and moderately toxic to embryo and larvae.

Acute toxicity to freshwater fish: Rainbow trout 86 mg/L.

Chronic toxicity to freshwater fish: Fathead minnow with maximum threshold concentration (MATC). >25.7 mg/L.

Avian toxicity (reproductive study): Mallard ducks > 1000ppm.

The use of glyphosate for vegetation control and the resulting decreased habitat complexity caused a decrease in invertebrate populations and songbird numbers (especially insectivores). One US study found the total abundance of songbirds was 36% lower on clear-cut treated with herbicides for at least three years. The effect related to the complexity of vegetation.[12]

Frog Toxicity

Toxicity to wildlife has mainly focussed on its acute toxicity to frogs. The Final Report, Acute toxicity of a herbicide to selected frog species[13] investigated the toxicity of technical grade glyphosate and the glyphosate-based herbicide, Roundup 360. The method used was through acute bioassays with frog species common to the south-west of Western Australia. The report found that:

- Technical grade glyphosate and Roundup 360 can be acutely toxic to adult frogs and tadpoles in laboratory bioassays tadpoles were many times more sensitive to the herbicide formulation tested than adult frogs tadpoles were approximately an order of magnitude more sensitive to the formulation than to technical grade glyphosate the above results and the results of other studies reported in the literature tend to suggest that the surfactant used in the formulation is more harmful to aquatic animals than the glyphosate
- The acute toxicity value (48 hour LC50 or Lethal Concentration) to the juvenile Crinia insignifera was 51.8 mg/L for Roundup 360 (the commercial formulation containing the solvent) the acute toxicity value (48 hour LC50 or Lethal Concentration) to the juvenile Crinia insignifera was 83.6 mg/L for glyphosate alone the toxicity of Roundup to fish changes significantly with temperature and pH, with greatest toxicity at high temperature and pH. A potential hazard exists for frogs and tadpoles in

shallow water bodies. Further study is required to determine the actual concentrations and persistence of the formulation in aquatic environments As a result of this study; commercial herbicide products containing the herbicide glyphosate have been reformulated, with the toxic surfactant replaced by another compound/s.

Limitations of the study: Replicating real world conditions in a laboratory is impossible and as a result, laboratory studies can only provide a guide to toxicity potential, not a definitive prediction. Professor Tyler of the University of Adelaide (Zoology) noted: [14]

The WA toxicity trial involved placing the animals in an exposure chamber where there would be some skin contact with the solution. However, under normal application in the environment, the application method (of boom spraying) may result in atomised spray, which may increase overall exposure potential for the animals.

All bioassays were conducted at 20 +/- 2 degrees C under ambient laboratory light. Temperatures in real world conditions may be as high as 42 degrees C (in the Northern Territory) and certainly well above 30 degrees C in northern NSW summer months.

The WA study looked at three frog species, with the bulk of the investigation focussed on two species, Crinia insignifera and Litoria moorei. Under real world conditions, many thousands of species of amphibians, invertebrates and other aquatic creatures may be exposed to herbicides and risks to the viability of their communities is not well understood. The studies have not been done.

Australia's biodiversity is well documented and to assert negligible risk to the environment based on a small laboratory study on two localised frog species is not scientifically defensible.

The WA study investigated acute poisoning potential only. No attempt was made to investigate sub-lethal, chronic, reproductive, endocrinal or immunological effects, which may also pose significant risks to the viability of aquatic communities.

The WA study did indicate a 48 hour LC50 of 83.6 mg/L for glyphosate alone for Crinia insignifera. This is a significant level if reproduced by normal applications in the environment. Thus it is not just the formulation that may pose unacceptable risks to wildlife. The data generated by the WA study indicates both commercial formulation and the active constituent alone pose risks.

ENVIRONMENTAL IMPACTS: PLANT RESISTANCE

Australian research [15] reports that fescue and perennial ryegrass cultivars, soybean and *convolvulus arvenis* L. Lines displayed varying degrees of resistance to glyphosate. Genetic engineering of crops such as soy now allows this and other commercially important food crops to be sprayed with glyphosate, thus extending the potential global market for glyphosate-based products.

ENVIRONMENTAL FATE AND TRANSPORT

Elimination, Bioaccumulation and Residues in Food and Animals.

Slowly absorbed through the digestive system and rapidly eliminated.[16] A urine test for glyphosate in urine is available.

Does not bio-accumulate in animal tissue but residues can be detected after exposure. Glyphosate and its metabolite, aminomethylphosphonic acid (AMPA) have been identified in the tissues, urine and faeces of rats and rabbits, in the liver in poultry, pigs and cattle and the kidney of pigs and cattle.[17] Has been detected in rice. [18]

Persistence

The persistence of glyphosate in the environment is variable. It is strongly bound to clay particles and is considered moderately persistent in soil. Degradation via microbial action is moderately slow. Half lives range from a few days to several months or years. The more sand in the soil, the slower the inactivation via the bounding to clay.

Application of glyphosate to sandy loam resulted in weakening of subclover planted 120 days after application. A significant decrease in nodule numbers and root weights of the plants was observed. This indicated that breakdown of glyphosate in soils with a high sand content is slow. Study recommended care in advocating glyphosate use in soils with high (>80%) sand content. [19]

Nitrosation: N-nitrosoglyphosate was generated in soils treated with sodium nitrate (20 ppm) and glyphosate (740 ppm) at elevated levels. The highest level generated was noted in soil of low organic matter and clay content. The formation of N-nitrosoglyphosate was not observed in soils treated with lower levels, nitrite nitrogen (2ppm) and glyphosate (5ppm).[20]

The manufacturer claims that the product is completely biodegradable, breaking down into natural products in both soil and water. Stated half-life of 60 days in the soil, a time frame described as rapid by manufacturer. Other information indicates that breakdown time is extremely variable from a half-life of 24 days in forest soils in Ontario to 249 days in Finland.[21]

Very little leaching capacity. Low potential to contaminate ground water as it is tightly bound to soil

Glyphosate and its metabolites are considered as residues of concern in plants. [22] Maximum Residue Limits (in mg/kg or parts per million/ppm) have been set for a number of commodities.

GENETICALLY ENGINEERED RESISTANCE TO GLYPHOSATE

Resistance has been genetically engineered into food crops such as soya beans so that this core food crop can be sprayed with glyphosate without killing it. This means that up to 200 times more glyphosate residue may be present in soy-based foods.

MANUFACTURER AGREES TO CHANGE ADS

In the USA, Monsanto has agreed to change its advertisements for glyphosate-based products. As part of the agreement, Monsanto will discontinue the use of the terms "biodegradable" and "environmentally friendly " in all advertising in New York State.

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MANEB

A. USE AND ENVIRONMENTAL FATE

Maneb is a carbamate compound used as a fungicide on vegetables, nuts, ornamentals, and grains. From 1990 to 1995, the reported use of maneb in California ranged from 354,023 to 1,632,259 pounds per year (DPR 1990-1995).

Maneb is unstable in the environment and degrades rapidly to ethylenethiourea (ETU) in water and soil (EXTOXNET 1993). Maneb degrades completely in water in one hour under anaerobic conditions (EXTOXNET 1993). Maneb's solubility in water is 7.0 mg/L at 25°C (Wauchope et al. 1992). Although maneb's half-life in soil is 60 days, it is unlikely to leach into groundwater because of high binding potential to soil and low solubility in water (EXTOXNET 1993). ETU does biodegrade, but is more stable and soluble in water and less binding to soil, and therefore may be more likely to leach and enter groundwater (EPA 1988). ETU degrades rapidly in soil under aerobic conditions, with a half-life of less than 2 days, but a half-life of up to 149 days under anaerobic conditions (EPA 1988).

The CDHS (California Department of Health Services) has not set an action level for maneb or ETU in drinking water (Milea 1998).

B. TOXICITY TO AQUATIC ANIMALS

Thirteen tests on the acute toxicity of maneb to aquatic animals were evaluated. All tests were accepted. Genus Mean Acute Values (GMAVs) were calculated using data from accepted acute toxicity tests and were ranked in ascending order (Tables 15 and 16). Freshwater maneb GMAVs ranged from 330 µg/L for rainbow trout fry *Oncorhynchus mykiss* to 3,700 µg/L for guppy *Poecilia reticulata*. Saltwater GMAVs ranged from 110 µg/L for copepod *Nitocra spinipes*, to 3,800 µg/L for pink shrimp *Penaeus duorarum*.

Table 15. Ranked Genus Mean Acute Values (GMAV) from accepted maneb acute toxicity tests on freshwater species.

Rank	GMAV (µg/L)	Organism	Genus and species
1	330*	Rainbow trout (fry)	*Oncorhynchus mykiss*
2	520	Freshwater fish (bleak)	*Alburnus alburnus*
3	1,000	Cladoceran	*Daphnia magna*
4	2,978*	Rainbow trout (egg)	*Oncorhynchus mykiss*
5	3,700	Guppy	*Poecilia reticulata*

* GMAV based on a geometric mean of more than one LC_{50} or EC_{50} for this species.

Table 16. Ranked Genus Mean Acute Values (GMAV) from accepted maneb acute toxicity tests on saltwater species.

Rank	GMAV (µg/L)	Organism	Genus and species
1	110	Copepod	*Nitocra spinipes*
2	>1,000	Oyster	*Crassostrea virginica*
3	1,600	Killifish	*Fundulus similis*
4	3,800	Pink shrimp	*Penaeus duorarum*

The EPA (1985) guidelines recommend eight freshwater taxa for which data should be available to derive a freshwater Final Acute Value (FAV) and eight saltwater taxa to derive a saltwater FAV (Tables 17 and 18). Usually, the four lowest GMAVs are the most significant determinants in calculating a FAV. The four lowest freshwater GMAVs for maneb were for rainbow trout *Oncorhynchus mykiss* eggs, freshwater fish *Alburnus alburnus*, cladoceran *Daphnia magna*, and rainbow trout fry *O.mykiss*. The four lowest saltwater GMAVs for maneb were for copepod *Nitocra spinipes*, eastern oyster *Crassostrea virginica*, killifish *Fundulus similis*, and pink shrimp *Penaeus duorarum*. Acceptable maneb data were available for only four of the freshwater and four of the saltwater taxa. Because of the lack of data, freshwater and saltwater FAV values were not calculated for maneb. No chronic toxicity tests were available for maneb.

Family	Available Species	Suggested Species
1. One Salmonid	Rainbow trout	----------
2. Another family in class Osteichthyes	Freshwater fish (Bleak)	----------
3. Another family in phylum Arthropoda or Chordata	Guppy	----------
4. One family not in phylum Arthropoda or Chordata	N/A*	Rotifer
5. One insect family or any phylum not already represented	N/A	Midge
6. One planktonic crustacean	Cladoceran	----------
7. One benthic crustacean	N/A	Amphipod
8. One insect	N/A	Stonefly

*N/A = Species not available.

Table 18. Eight families of saltwater aquatic animals recommended by EPA (1985) for use in deriving the saltwater FAV, representative species for which maneb acute toxicity data were available, and suggested species to provide the necessary data.

Family	Available Species	Suggested Species
1. Two families in phylum Chordata	Longnose killifish	----------
2.	N/A*	Sheepshead minnow
3. One family not in phylum Arthropoda or Chordata	Eastern oyster	
4. Three other families not in phylum Chordata	Copepod	----------
5.	Pink shrimp	----------
6.	N/A	Dungeness crab
7. A mysid or penaeid	N/A	Mysid
8. One other family not already represented	N/A	Rotifer

*N/A = Species not available.

C. TOXICITY TO AQUATIC PLANTS

Three tests on the toxicity of maneb to aquatic plants were evaluated and one was accepted to derive a Final Plant Value (FPV). The FPV is the lowest concentration of a pesticide that demonstrates a biologically important toxic endpoint (EPA 1985). The lowest biologically toxic endpoint for maneb was an EC50 value of 3,200 µg/L for green alga *Chlorella pyrenoidosa.* The FPV for maneb is 3,200 µg/L. Current data indicates that this fungicide is generally less toxic to aquatic plants than to aquatic animals. It is likely that freshwater criteria that will protect aquatic animals will also protect aquatic plants, but more data are necessary before this can be determined conclusively.

Hazard Assessment Acute maneb toxicity data were available for only four of the eight freshwater and four of the eight saltwater taxa recommended by EPA (1985) (Tables 17 and 18). This is too large of a data gap to justify calculating interim FAVs. Four additional acute toxicity tests using freshwater species such as those suggested in Table 17 are required to calculate freshwater criteria using EPA (U.S. Environmental Protection Agency) methods. Four additional acute toxicity tests using saltwater species such those suggested in Table 18 are required to determine saltwater criteria using EPA methods. In order to calculate freshwater and saltwater FCVs, paired acute-chronic tests are needed for fish and invertebrates. Calculation of the freshwater FCV requires paired acute-chronic tests from a fish, an invertebrate, and an acutely sensitive freshwater species. Calculation of the saltwater FCV requires paired acutechronic tests from a fish, an invertebrate, and an acutely sensitive saltwater species.

No monitoring data are available for maneb in the Sacramento-San Joaquin River system. Maneb can be detected in water in concentrations as low as 9 µg/L (Miller 1998). The reporting limit is sufficiently low to be able to indicate acute toxicity. As no chronic toxicity values were available it is not known whether the reporting limit is adequate to indicate chronic toxicity. Currently, there is one test method for maneb, which is non-specific. This method screens for a large group of chemicals and it remains problematic to distinguish between maneb and other similar compounds, such as ziram and mancozeb.

METALDEHYDE

Trade and Other Names: Some trade names include Antimilace, Antimitace, Ariotox, Cekumeta, Deadline, Halizan, Limatox, Meta, Metason, Namekil, Ortho Metaldehyde 4% Bait, Slug Death, Slug Pellets, Slug-Tox and Slugit Pellets.

Regulatory Status: Metaldehyde is a slightly toxic compound, and products containing it will be in EPA Toxicity Class II or III. All product labels must include the following statement on the front panel, "This pesticide may be fatal to dogs or other pets if eaten. Keep pets out of treated areas", as well as the signal word CAUTION or WARNING. Because of its potential short-term and long-term health effects on wildlife, metaldehyde is a Restricted Use Pesticide (RUP). RUPs may be purchased and used only by certified applicators.

Chemical Class: **Not Available**

Introduction:

Metaldehyde is a molluscicide used in a variety of vegetable and ornamental crops in the field or greenhouse, on fruit trees, small-fruit plants, or in avocado or citrus orchards, berry plants, and banana plants. It is used to attract and kill slugs and snails. It is applied in the form of granules, sprays, and dusts, or pelleted or grain bait, typically to the ground around the plants or crops. It works primarily in the stomach by producing toxic effects after it is ingested by the pest. It may be formulated with or without calcium arsenate and is also available in a mixed formulation with thiram.

Formulation: It is applied in the form of granules, sprays, and dusts, or pelleted or grain bait, typically to the ground around the plants or crops.

It may be formulated with or without calcium arsenate and is also available in a mixed formulation with thiram.

Toxicological Effects:

- **Acute toxicity:** Metaldehyde is slightly to moderately toxic by ingestion, with reported oral LD50 values of 227 to 690 mg/kg in rats, 207 mg/kg in cats, 100 to 1000 mg/kg in dogs, 200 mg/kg in mice, 175 to 700 mg/kg in guinea pigs, and 290 to 1250 mg/kg in rabbits. A child died after ingesting 3000 mg (approximately 75 to 100 mg/kg for a 30 to 40 kg child) of metaldehyde. Via the dermal route, it is also moderately toxic. The dermal LD50 for this molluscicide in rats is from 2275 mg/kg to greater than 5000 mg/kg. Metaldehyde is moderately toxic by inhalation; the 4-hour inhalation LC50 in rats is 0.2 mg/L, and the 2-hour inhalation LC50 in mice is 0.35 mg/L. Irritation of the skin, eye, and mucous membranes of the upper airways and gastrointestinal tract may result from contact with metaldehyde. Within a few hours of accidental or intentional ingestion, the following symptoms appeared in humans: severe abdominal pain, nausea, vomiting, diarrhea, fever, convulsions, coma, and persistent memory loss. Other symptoms of high acute exposure include increased heart rate, panting, asthma attack, depression, drowsiness, high blood pressure, inability to control the release of urine and feces, incoordination, muscle tremors, sweating, excessive salivation, tearing, cyanosis, acidosis, stupor, and unconsciousness and eventual death in extreme cases. Kidney injury and liver cell death ('necrosis') may also occur. Mental deficiencies and memory loss from ingestion poisoning may persist for 1 year or more. It is thought that the formation of acetaldehyde in the gastrointestinal tract is responsible for the narcotic effects observed with metaldehyde exposure.
- **Chronic toxicity:** Dosages which are not toxic when given singly do not cause illness when repeated. Long-term, repeated skin exposure to metaldehyde may result in dermatitis (skin inflammation) in humans. Prolonged eye exposure can cause conjunctivitis. In 2-year toxicity studies and three-generation reproductive studies in rats, changes in liver enzyme activity and increased liver and ovary weight at dietary doses of about 12.5 mg/kg/day were found; 50% of female rats given this dose showed paralysis. Effects on the brain (e.g., impairment of memory) may also be possible with chronic exposure at very high levels.
- **Reproductive effects:** During a three-generation study of rats exposed to chronic ingestion of metaldehyde, adverse effects were seen on reproduction and on the survival rate of offspring. Doses of 50 and 250 mg/kg/day interfered with the reproduction of female rats in another three-generation test. These data suggest that metaldehyde is likely to cause reproductive effects only at high levels.

- **Teratogenic effects:** Dietary doses of 10, 50, and 250 mg/kg of metaldehyde were not teratogenic in three generations of experimental female rats. There were some increases in relative liver weights in some offspring. This evidence suggests that metaldehyde is unlikely to cause teratogenic effects.
- **Mutagenic effects:** Metaldehyde has been reported to be a suspected mutagen. However, there was no evidence of mutagenicity when metaldehyde was tested on five strains of bacteria. The evidence regarding mutagenicity of metaldehyde is inconclusive.
- **Carcinogenic effects:** Dietary doses as high as 250 mg/kg/day over a 2-year period did not increase the incidence of tumors in male and female rats . The study suggests that metaldehyde is not carcinogenic.
- **Organ toxicity:** Metaldehyde or its breakdown byproducts, 'metabolites,' may cause problems in the central nervous system by an unknown mechanism. It may also cause lesions in kidneys and the liver following systemic distribution, as well as inflammation of the skin, eye, and mucous membranes of the airways and gastrointestinal tract with direct contact.

- **Fate in humans and animals:** Metaldehyde is readily absorbed into the bloodstream from the gastrointestinal tract. Metaldehyde's primary decomposition product in the body is acetaldehyde. Its metabolites can cross the blood-brain barrier, as evidenced by their effect on the level of consciousness of animals.

Ecological Effects:

- **Effects on birds:** Death of birds feeding in metaldehyde-treated areas has been reported, although the precise acute oral LD50 values or subchronic dietary LC50 values were unavailable. Excitability, tremors, muscle spasms, diarrhea, and difficult or rapid breathing was observed in poultry that were exposed to metaldehyde.
- **Effects on aquatic organisms:** Metaldehyde is reported to be practically nontoxic to aquatic organisms].
- **Effects on other organisms:** The 4% pelleted bait is reported to be toxic to wildlife. When used as directed, bait agents with 6% active ingredient are not toxic to bees. Bait pellets containing metaldehyde are attractive to dogs. Pets should be confined during application, and kept away from application and storage sites.

Environmental Fate:

- **Breakdown in soil and groundwater:** Metaldehyde is of low persistence in the soil environment, with a half-life on the order of several days]. It is weakly sorbed by soil organic matter and clay particles, and is soluble in water. Due to its low persistence, it is not a significant risk to groundwater.
- **Breakdown in water:** Metaldehyde undergoes rapid hydrolysis to acetaldehyde, and should be of low perstistence in the aquatic environment.
- **Breakdown in vegetation:** Many types of flowers lose their color when they come in contact with metaldehyde dust or spray.

Physical Properties:

- **Appearance:** Metaldehyde is a white or colorless crystalline solid with a mild characteristic odor and a powdery appearance.
- **Chemical Name:** r-2,c-4,c-6,c-8-tetramethyl-1,3,5,7-tetroxocane
- **CAS Number:** 108-62-3
- **Molecular Weight:** 176.20
- **Water Solubility:** 260 mg/L @ 30 C
- **Solubility in Other Solvents:** i.s. in acetic acid; s. in hot carbon disulfide; s. in ethyl alcohol; v.s. in benzene and chloroform; s.s. in ethanol and diethyl ether
- **Melting Point:** Sublimes at approx. 112 C
- **Vapor Pressure:** Negligible at room temperature
- **Partition Coefficient:** Not Available
- **Adsorption Coefficient:** 240

Exposure Guidelines:

- **ADI:** Not Available
- **MCL**: Not Available
- **RfD:** Not Available
- **PEL:** Not Available
- **HA**: Not Available
- **TLV**: Not Available

Source:

E X T O X N E T (Extension Toxicology Network)

Revised June 1996

MONOCROTOPHOS

Monocrotophos is an organophosphorus (OP) insecticide, developed by Ciba-Geigy (now Novartis) and first registered in 1965. It is a hazardous chemical especially for conditions of use in developing countries.

What is monocrotophos?

This non-specific systemic insecticide and acaricide, used to control common mites, ticks and spiders with contact and stomach action, quickly penetrates plant tissue(1). In common with other OPs, its toxic action is achieved by inhibiting acetylcholinesterase, an enzyme essential for normal nerve impulse transmission. It is widely used, mainly for foliar application to cotton. Monocrotophos is corrosive(2), and stable when stored in glass or polyethylene containers(3).

Production

The pesticide is now out of patent, and is produced by at least 15 manufacturers, although Novartis still produces an estimated 40% of total annual production(4). Monocrotophos is also manufactured and exported by companies in India, China, Brazil and Argentina. In India, for example, DowElanco makes monocrotophos in a joint venture with the Indian company NOCIL(5).

Uses and usage

The total sales of this widely-used pesticide is roughly 3% of all insecticide products.(6) It is registered in approximately 60 countries. Eight of these, accounting for 60% of sales, require detailed data on performance, chemistry, safety and environmental aspects(7). The remaining 40% are in countries which require only assessments, summaries, or very limited data. The product was withdrawn from use in the US, and in the European Union is registered in Austria, France, Spain, Italy and Greece(8).

While mainly applied against cotton pests, it is used on citrus, olives, rice, maize, sorghum, sugar cane, sugar beet, peanuts, potatoes, soya beans, vegetables, ornamentals and tobacco.

Acute toxicity

Monocrotophos is classified WHO 1b, highly hazardous, and has been responsible for deaths resulting from accidental or intentional exposure. It is highly toxic orally, as well by inhalation or absorption through the skin. Early symptoms of poisoning may include excessive sweating, headache, weakness, giddiness, nausea, vomiting, hypersalivation, abdominal cramps, diarrhoea, blurred vision and slurred speech. Inhalation or skin contact may increase the susceptibility to the pesticide without showing immediate symptoms(9). The acute oral toxicity for rats (LD50) is 23mg/kg (males) and 18 mg/kg (females). The acute dermal toxicity for a rats is 354 mg/kg(10). Tests on rabbits indicate it is slightly irritating to eyes and causes reversible corneal opacity: reports on human health indicate eye contact will cause pain, bleeding, tears, pupil constriction and blurred vision.

Severe poisoning will affect the central nervous system, producing inco-ordination, slurred speech, loss of reflexes, weakness, fatigue, involuntary muscle contractions, twitching, tremors of the tongue or eyelids and eventually paralysis of the body extremities and the respiratory muscles. In severe cases there may also be involuntary defecation or urination, psychosis, irregular heart beat, unconsciousness, convulsions and coma. Ingestion of 120 mg monocrotophos can be fatal(11). Like other OPs, monocrotophos is a potent cholinesterase inhibitor. The no effect level (NOEL) is 0.03 ppm in rats. It is slightly irritating to the skin and mildly irritating to the eyes(12,13).

Chronic effects

Monocrotophos has also been shown to cause delayed neuropathy (see page 6 for more details)(14). A study in Egypt of farmers using OPs, including monocrotophos, found that 50% of the workers showed signs of neurological effects such as superficial or deep sensory loss and decrease or lost reflexes in their ankle or ankle and knee(15). (See Pesticides Trust [now PAN *UK*] OP fact sheet for more data on neurological effects(16).)

Cancer
Monocrotophos is not carcinogenic in rats at 0.45 mg/kg/day, the highest dose tested(17). No significant

carcinogenic lesions were observed when rats were exposed to monocrotophos aerosol at concentrations from 97-308 mg/m3 for one hour(18).

Reproductive effects
Researchers have generated a rat reproductive (and offspring) NOEL of 2.7 ppm, evidenced by decreased fertility, pup viability and weight, partly attributed to depressed maternal lactation(19).

Teratogenicity (birth defects)

Rats which received doses of 2 mg/kg per day of monocrotophos produced foetuses with lower than average length and weight and maternal toxicity in the form of reduced body weight gain in pregnancy at 1.0 mg/kg. No teratogenic effects were found at 2 mg /kg/day in rats, the highest dose tested(20).

Key health issues

Concerns about the safety of monocrotophos has led to its inclusion in the Prior Informed Consent (PIC) procedure (see page 16 for more on PIC). Governments are informed that formulations which exceed 600 g/litre of active ingredient may not be safe because of their impact on human health under conditions of use in developing countries. Governments which wish to prohibit these formulations can notify the PIC secretariat. Their decisions will be circulated to exporting countries(21).

Many incidents in developing countries have been linked to monocrotophos. It is often difficult to trace an incident to a particular active ingredient: frequently a 'block' of pesticides commonly used in a region may be linked to a survey indicating occupational and other health impacts in the area. Monocrotophos has been pointed to as a cause, in the following:

- ***Brazil, Parana State*** Monocrotophos caused 107 of 412 reported incidents analysed in 1990, and the toxicology centre and health clinics also noted 1,650 incidents involving monocrotophos between 1982 and 1991(22).
- ***Paraguay*** In a region where monocrotophos is one of the most commonly used active ingredients there have been numerous cases of pesticide poisoning; monocrotophos was identified as the cause of paralysis in children in cotton-growing areas by the Ministry of Public Health and Welfare which found that 2-3 weeks of frequent exposure caused paralysis in children and acute poisoning in adults(23).
- ***Egypt*** In a cotton growing region of Egypt the health of 14 farmers who spray was compared with a control group from the same region. Monocrotophos is widely used and 61% of those surveyed showed symptoms of chronic pesticide poisoning(24).
- ***Philippines, Cordillera region*** Monocrotophos was one of the pesticides widely used by farmers in a survey that found all farmers suffered some adverse health effects(25).
- ***Indonesia*** In observations of 906 spray operations of 214 farmers commonly using monocrotophos and other OPs, over a three-month period, researcher found a significant increase-from two to fifty-fold-in the symptoms of pesticide toxicity during the spraying period. Of these spray operations, 21% brought on three or more neurobehavioural and intestinal signs of poisoning(26).

Fate in the environment

The EU has classified monocrotophos as dangerous for the environment(27). Monocrotophos has a half life of 14-21 days at pH9 and 25oC, with the rate decreasing at lower pH's and increasing at higher temperatures. Degradation on soil exposed to natural sunlight is rapid (half life less than 7 days) and on dark control samples is slower (half-life approximately 30 days). Monocrotophos is mobile in soil, and although it degrades rapidly it may possess potential for groundwater contamination.(28)

Wildlife

Monocrotophos is one of the most toxic pesticides to birds and is extremely toxic other wildlife, highly toxic to bees. It is toxic to shrimps and crabs, moderately toxic for fish and non-toxic for microorganisms. The acute LD50 for birds ranges from 0.9-6.7 mg/kg body weight, and for honey bees 33-84 ug/bee(29). There are numerous reports of avian mortality attributed to monocrotophos. The most recent occurred in Argentina, where an estimated 20,000 hawks died over an area of approximately 200km by 250 km in 1996. More than 700 dead hawks were found in one roost. Ornithologists suggested that monocrotophos used against grasshopper pests in the region was responsible, with hawks affected by direct exposure to the spray or secondary poisoning through eating contaminated grasshoppers. Scientists from Canada and the US had observed that smaller numbers of hawks were returning after migrating to South America.

Miniature satellite transmitters attached to hawks led to the discovery. The major manufacturer, Novartis, joined meetings which agreed not to use monocrotophos in the region and encouraged other local distributors to stop selling the pesticide. A campaign to inform farmers was also supported by Novartis(30).

Food residues

OPs do not have long persistence and are generally found at low levels in food. Monocrotophos is not used in the UK, and testing imported food in 1996 found low levels (0.03 mg/kg) in one sample of dried currants (of eight tested) imported from Greece. Testing by UK food industry sources found monocrotophos residues in dwarf beans (0.07 mg/kg)(31). Maximum residue limits have been set in some products in the range of 0.02-1 mg/kg, and the acceptable daily take is 0.0006 mg/kg body weight(32).

Monocrotophos and some of its metabolites have been identified in the milk, muscle, and liver of cows and in the milk of goats following ingestion of this chemical(33).

Pre-harvest intervals have been set in several countries and are generally in the order of 7-15 days for vegetables and potatoes, maize and citrus and 28-30 days for other crops(34).

Resistance

White fly resistance has caused plague-like outbreaks on cotton crops(35). Records over time show that resistance to monocrotophos of the Colorado potato beetle on Long Island, US, appeared more quickly than to almost any other pesticide, within one year of introduction(36).

Ways to reduce exposure

Full protective clothing should be worn, including a respirator when mixing and spraying tall crops. Use of flaggers should be avoided. All equipment and protective clothing should be washed thoroughly after use and clothing should be laundered separately from family clothing. Unprotected workers should be kept out of treated areas for 48 hours37. Manufacture, formulation, agricultural use and disposal of monocrotophos should be carefully managed to minimize contamination of the environment. In view of the high toxicity of monocrotophos, it should not be considered in hand-applied ULV spraying practices38.

Conclusions

Monocrotophos is a widely used, and extremely dangerous insecticide. It has now been included in the PIC procedure, in recognition of the health problems caused by formulations with a high percentage of the active ingredient. Its low cost and many applications will present a challenge to users looking for safer alternatives, or measures which will protect health.

Control actions(37)
Germany May not be handled by adolescents and pregnant and nursing women.
Indonesia Monocrotophos was banned for use in rice in 1986 because of insect resistance and certain formulations phased out in 1994.
Kuwait Severely restricted: to use on plants up to the flowering stage only.
Malaysia Registration for use only on coconut and oil palm by trunk injection.
Philippines In 1990 the Fertilizer and Pesticide Authority issued Circular No. 01, which included a severe restriction on monocrotophos for use only in bean fly control. A six month phase out period took effect from 29 September 1993.
Sri Lanka Severely restricted. Import prohibited since July 1995.
US Voluntarily withdrawn by the registrant in 1989. Before withdrawal it could be used only by certified applicators. No remaining uses are allowed. Main concern is toxicity to non-target species, especially birds.

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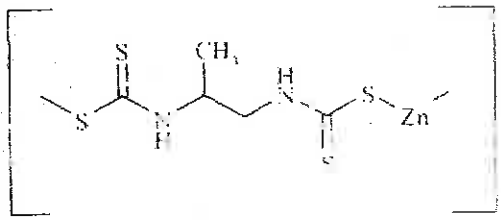
39. Control actions in Germany, Kuwait, Malaysia, Sri Lanka and the US see PIC DGD (op. cit. 11), and control actions in Philippines and Indonesia see The Pesticide Trail (op. cit. 5.), pp 79 and 56 respectively.

[This article first appeared in Pesticides News No.38, December 1997, p20-21]

PROPINEB

IDENTITY, PHYSICAL AND CHEMICAL PROPERTIES

Common name (ISO)	Propineb
Chemical name (IUPAC)	Polymeric zinc 1,2-propylenebis (dithiocarbamate)
Chemical name (CA)	[(1-methyl-1,2-ethanediyl)bis(carbamoyldithioato)](2)) zinc, homopolymer
Molecular formula	(C5H8N2Sn)x
Molecular mass	289.8 (monomer)
Structural formula	 x > 1
Solubility in water	Propineb is practically insoluble in water (<0.01 g/l at 20 °C). An exact determination o the water solubility is not possible in consequence of decomposition of propineb by hydrolysis.
Hydrolytic stability (DT_{50})	Half-life at 22°C estimated from the amounts of propylen thiourea formed: (declared) 1.DT_{50} 2.DT_{50} DT_{50} pH4 19 h 24 h approx. 1 d pH 7 approx. 19 h approx. 36 h approx. 1 d pH 9 4.9 d 2.2 d 2-5d Hydrolysis products: PTU (propylene thiourea), carbon disulfide
Dissociation constant	It is not possible to determine the dissociation constants of propineb.
Quantum yield of direct photo transformation in water at g >290 nm	Determined according to the ECETOC-method in polychromatic light. From the UV absorption data and the kinetic results of two photodegradation experiments in a merry-g round irradiation apparatus the quantum yield was calculated to be 0.0012. The resulting quantum yield and UV absorption data in aqueous solution were used to estimate the environmental half-life of PTU concerning direct photodegradation in water by two different simulation models. The results of model studies indicate that direct photo-degradation in water contributes to the overall elimination of PTU in the environment to a low extent only. The environmental half-life concerning direct photodegradation in wat ranges from about 270 days to more than 1 year, for the seasons of main use of the activ ingredient propineb. This assessment does not consider any indirect photodegradation mechanisms which are known to increase the degradation of PTU in waters that contain humic substances.
Photostability in water (DT_{50})	Rapid degradation of the active substance in laboratory experiments (DT_{50} < 1h) and its absorption properties in the sunlight emission spectrum indicate that direct photodegradation plays a role in degradation of the active substance under environmental conditions. The major photolysis product detected was propylene thiourea (PTU). PTU is quickly degraded by secondary photodegradation (influence of humic acid). Photolysis (aqueous) products: PTU (propylene thiourea). Material balance: not determinable because of the fast degradation

* decomposition pressure

END POINTS AND RELATED INFORMATION

TOXICOLOGY AND METABOLISM

Distribution	Propineb/PTU: Primarily to thyroid gland

Acute toxicity

Rat LD_{50} oral	> 5000 mg/kg bw
Rat LD_{50} dermal	> 5000 mg/kg bw
Rat LC_{50} inhalation	M >2420 mg/m^3 air F - 983 mg/m^3 air
Skin/Eye irritation	Non-irritant
Skin sensitisation (test method used and result)	Magnusson/Kligman Test: sensitising; Buehler patch test: Not sensitising

Short-term toxicity

Target / critical effect	Presence of muscular damage (no neurotoxic activity) and disturbance in hepatocyte permeability, thyroid effect, noted in rats and chickens, primarily induced by PTU, spleen weights only observed in orally treated dogs.
Lowest relevant oral NOAEL	4.3 mg/kg bw/d (subchronic dog)
Lowest relevant dermal NOAEL	250 mg/kg bw/d (subacute rabbit)
Lowest relevant inhalation NOAEC	1 mg/m^3 air
Genotoxicity	No genotoxic effects *in vitro* and *in vivo*

Long term toxicity and carcinogenicity

Target / critical effect	The most sensitive parameter indicating treatment- related effects in the long-term studies have been the thyroids of rats. Enlarged thyroids and decreased levels of protein-bound iodine were seen at 5 mg/kg bw/d.
Lowest relevant NOAEL	2.5 mg/kg bw/d (chronic rat)
Carcinogenicity	No carcinogenic potential

Reproductive toxicity

Target / critical effect - Reproduction	The teratogenic effect in rats is explained by the metal bis(dithiocarbamate) reaction mechanism, which chelates trace metals. The teratogenic dose range overlaps with the clearly toxic dose range of the dams. In rabbits no evidence of embryo/foetotoxicity was seen, even in the presence of maternal toxicity.
Lowest relevant reproductive NOAEL	30 mg/kg bw/d (fetal) 10 mg/kg bw/d (maternal)
Target / critical effect - Developmental toxicity	In a 3-generation reproduction study in rats, reduced gestation rates and numbers of pups were observed in doses which also caused maternal toxicity.
Lowest relevant developmental NOAEL	3 mg/kg bw/d

Delayed neurotoxicity	No evidence was found for delayed neurotoxic effects.
Acute toxicxity (Rat LD_{50} oral)	PTU = 537 *mg/kg* bw PU > 5000 mg/kg bw 4-Methylimidazoline = 1330 mg/kg bw
Genotoxicity (in vitro & in vivo)	PTU (no genotoxic potential) PU (no genotoxic potential)
Long term toxicity and carcinogenicity Target/critical effect	PTU: Thyrosuppressive effects, resulting in increased thyroid weights and elevated cholesterol levels in rats. Increased incidence of hepatic adenomas and carcinomas in mice. PU: Hepatic centrolobular hyperplasia in mice.
Lowest relevant NOAEL / NOEL	PTU NOEL: 0.14 mg/kg bw/d (chronic mouse) PU NOEL: 7.1 mg/kg bw/d (chronic mouse)
Carcinogenicity	PTU: No signs of carcinogenic potential in rats. Dose related increase in the rate of liver tumours (epigenetic) in mice. PU: Elevated

	incidence of liver tumours (epigenetic) in mice.
Embryotoxic and teratogenic studies Target/critical effect	PTU: Maternal toxic effects as elevated absolute und relative thyroid weights. Teratogenic effects: encephalocele, hydronephrosis, micrognathia.
Lowest relevant NOAEL / NOEL	PTU NOEL: 22.5 mg/kg bwfd (rat)
Embryotoxicity and teratogenicity	Encephalocele, hydronephrosis, micrognathia.
Effects on the thyroid	PTU NOEL: 1.3 mg/kg bw/d (rat)

Mechanistic studies

Effects on the thyroid	Propineb NOEL: 0.2 mg/kg bw/d (no functional or somatic effect on the thyroid occurred) NOAEL: 1 mg/kg bw/d (threshold level for somatic effects on the thyroid)
Medical data	No adverse effects due to contact with the active ingredient in the factory were determined in the workers during the regular occupational medical examinations. Neither disruptions of the thyroid function, nor allergic phenomena were observed. No specific signs of intoxication have been observed in either manufacturing personnel or in the general population. No specific antidote is known.

Summary

	Value	Study	Safety factor
ADI:	Propineb: 0.007 mg/kg bw/d PTU: 0.0003 mg/kg bw/d	Chronic rat Segment II study rat	100 1000
AOEL systemic:	0.003 mg/kg bw/day*	Chronic rat	100
AOEL inhalation:	0.011 mg/m3 air	subacute inhalation, rat	100
AOEL dermal:	2,5 mg/kg bw/day	subacute dermal, rabbit	100
ARfD (acute reference dose):	Propineb: 0.1 mg/kg bw PTU: 0.003 mg/kg bw	Developmental toxicity, rat Developmental toxicity, rat	100 100

* corrected by a 60% oral absorption

Dermal absorption	The relative skin absorption of technical Antracol 70 WP 24 hours after application - if any- was low and ranged in vitro from 0.04 to 1.37% in human skin and from 0.05 to 1.18% in rat skin.

FATE AND BEHAVIOUR IN THE ENVIRONMENT

FATE AND BEHAVIOUR IN SOIL

ROUTE OF DEGRADATION

Aerobic:

Mineralization after 100 days:	There was no evidence for unchanged propineb at the sampling dates, showing the very rapid degradation of the active ingredient.
Non-extractable residues after 100 days:	50%
Major metabolites above 10 % of applied active substance: name and/or code % of applied rate (range and maximum)	Propylene urea (PU): Range: <3.9 % at day 105, max. 40% (day 2)

Supplemental studies

Anaerobic:	Studies in the unsaturated zone not performed, because propineb and/or its metabolites are not expected to leach into deeper soil layers in relevant concentrations.
Soil photolysis:	Not relevant due to rapid degradation

Rate of degradation

Laboratory studies DT_{50}lab (20 DC, aerobic):

DT_{90}lab (20 DC, aerobic):	Propineb: Range: <0.7 (h) - 6 days [n=6], median: 3 (h) PU: Range: 4 - 93 days [n=8], median: 6.6 (d) PTU: Range: 1.5 - 2.6 (d) [n=2], median: 2.1 (d)
DT_{50}lab (10 DC, aerobic):	Propineb: Range: 3 (h) -19 days [n=6], median: < 10 (h) PU: Range: 18 - 75 days [n=6], median: 56 (d) PTU: Range: 5-9 (d) [n=2], median: 7 (d)
	Propineb: Range: 1.6 (h) - 13 days [n=6], median: < 7 (h) PU: Range: 8.8 -205 days [n=8], median: 14.5 (d) PTU: Range: 3.3 - 5.7 (d) [n=2], median: 4.5 (d)
DT_{50}lab (20 DC, anaerobic):	Studies on the degradation in the unsaturated zone were not performed

Field studies (country or region)

DT_{50f} from soil dissipation studies	Due to rapid degradation of the active substance and its metabolites PTU and PU, no field studies are needed.
DT_{90f} from soil dissipation studies	Not applicable.
Soil accumulation studies:	Not applicable.
Soil residue studies	Not applicable.

Adsorption/desorption

K_f /K_{oc} K_d pH dependence	Propineb: Not applicable due to insolubility and instability in water. PU: K_{oc}13-26l/kg (n=4, mean=18l/kg) K_d 0.17 - 0.63 l/kg (n = 4, mean 0.44 l/kg) No pH dependence

Mobility

Laboratory studies:

Column leaching:	Propineb and PTU not detectable.
Aged residue leaching:	Due to rapid degradation of propineb: not relevant

Field studies:

Lysimeter/Field leaching studies:	At 45 cm: 4 µg PU/l (Considering the high rates of Antracol used in the trials and the low percentages of applied radioactivity detected in the leachate of the lysimeter, it can be concluded that the expected concentration of propineb and metabolites in groundwater are below 0.1 µg/l)

Fate and behaviour in water

Abiotic degradation

Hydrolytic degradation:	At 22°C: pH 4: 24 h pH 7: 36 h pH 9: 53 h
Major metabolites:	No major metabolites
Photolytic degradation:	Propineb: DT 50 < 1 h PTU: DT 50 between 270 d and > 1 a PU: DT 50 > 1 a
Major metabolites:	No major metabolites

Biological degradation

Readily biodegradable	Yes
Water/sediment study DT_{50} water: DT_{90} water: DT_{50} whole system: DT_{90} whole system: Distribution in water / sediment systems (active substance): Distribution in water / sediment systems (metabolites):	 PTU: 4 d PU: 20 d PU: < 30 d PU: < 90 d Not relevant due to rapid degradation PTU: Values are expressed as % of the applied radioactivity Water layer hour: 1 93.9 / 93.9 6 91.2 / 90.4 day: 1 88.7 / 81.0 2 85.3 / 64.8 3 77.2 / 49.1 14 69.1 / 46.4 30 59.3 / 37.8 60 27.4 / 33.5 100 9.7/27.5 Sediment hour: 1 2.7 / 3.7 6 5.4 / 11.2 day: 1 9.9 / 18.5 2 13.0 / 33.4 7 19.4 / 44.7 14 28.2 / 49.6 30 31.0 / 50.0 60 33.1 / 56.8 100 28.2 / 55.5
Accumulation in water and/or sediment:	No accumulation

Degradation in the saturated zone

Degradation in the saturated zone	Studies on the degradation in the unsaturated zone were not performed, because propineb and/or its metabolites are not expected to leach into deeper soil layers in relevant concentrations.

3 ECOTOXICOLOGY

Terrestrial Vertebrates

Acute oral toxicity to mammals:	LD50 > 5000 mg AS /kg bw (technical AS)
Acute oral toxicity to birds:	LD50 > 5000 mg AS /kg bw (technical AS)
Dietary toxicity to birds:	LC50 > 5000 mg AS /kg food (technical AS; 5 d)
Reproductive toxicity to birds:	NOEC = 95 mg AS /kg food (test with tech. AS; 22 w)
Short term oral toxicity to mammals:	LC50 > 8000 mg AS /kg food (test with tech. AS; 28 d)

Aquatic Organisms

Acute toxicity fish:	LC50 = 133 mg AS/l (technical AS; Golden Orfe) LC50 = 0.4 mg AS/l (techn. AS; Rainbow Trout) LC50 > 100 mg PTU/l (Rainbow Trout) LC50 > 100 mg PU/l (Rainbow Trout) LC50 = 60.2 mg AS/l (WG70; Golden Orfe) LC50 = 4.7 mg AS/l (WG70; Rainbow Trout)
Long term toxicity fish:	NOEC = 0.1 mg AS/l (techn. AS; R. Trout; 28 d) NOEC ≥ 102 mg PTU/l (Rainbow Trout; 28 d)* NOEC ≥ 2.0 mg PU/l (Rainbow Trout, 63 d)*
Bioaccumulation fish:	Not required (log Pow = -0.26)

Acute toxicity invertebrate:	EC50 = 4.7 mg AS/l (technical AS; D. magna) EC50 = 18.4 mg PTU/l (D. magna)
Chronic toxicity invertebrate:	NOEC = 0.026 mg AS/l (techn. AS; D. magna) NOEC ≥ 100 mg PU/l (D. magna)*
Toxicity to algae:	ErC50 = 2.68 mg AS/l (techn. AS; chronic, 96 h) ErC50 > 100 mg PTU/l (chronic, 72 h) ErC50 > 1000 mg PU/l (chronic, 96 h)
Chronic toxicity sediment dwelling organism:	NOEC ≥ 0.1 mg PTU/l (*Chironomus riparius*) NOEC ≥ 0.1 mg PU/l (*Chironomus riparius*)*

*Prolonged exposure is only possible to PU.

Honeybees

Acute oral toxicity:	LD50 > 70 µg AS/bee (WG70)
Acute contact toxicity:	LD50 > 164 µg AS/bee

Other arthropod species

	% Effect
Poecilus cupreus	Mortality*[1]: 0 % Sublethal effect*[2]: 0% (adults; WG70, 1.33 kg AS/ha)
Coccinella septempunctata:	Mortality*[1]: 33 % Sublethal effect*[2]: 0% (larvae; WG70, 2.63 kg AS/ha)
Trichogramma cacoeciae:	Mortality*[1]: 0 % Sublethal effect*[2]: 0% (adults; WG70, 4.16 kg AS/ha)
Phytoseiulus persimilis:	Mortality*[1]: 96.5 - 100 % (adults; WG70, 0.084 - 10.5 kg AS/ha)
Predatory mites (field tests):	It has been repeatedly demonstrated in the field that even on the target plants, where mites were fully exposed to the spray treatments, predatory mites were able to survive and to recover completely within 4 weeks.

*[1] Corrected for control mortality

*[2] Relative to control

EARTHWORMS

Acute toxicity:	LD50 > 700 mg AS/kg dry weight soil* NOEC = 70 mg AS/kg dry weight soil* LC50 > 1000 mg PU/kg dry weight soil
Reproductive toxicity:	NOEC ≥ 1000 mg PU/kg dry weight soil

* Tests with WG 70 and WP 70

Soil micro-organisms

Nitrogen mineralization:	No significant influence up to 100.8 kg AS/ha*
Carbon mineralization:	No significant influence up to 100.8 kg AS/ha*

* Test with WG 70

TRICHLORFON

- Generic Name: dimethyl-(2,2,2-trichloro-1-hydroxyethyl) phosphonate
- Common Name: Trichlorfon
- Trade Names: Trichlorphon, Trichlorofon, Chlorphos, Bay 13/59, Anthon, Bovinox, Briten, Cekufon, Ciclosom, Crinex, Danex, Dipterex, Dylox, Equinoaid, Neguvon, Proxol, Trinex, Tuzon, and Leivasom.
- Year of Initial Registration: 1960
- Pesticide Type: Insecticide
- Chemical Family: Organophosphate

2. USE PATTERNS AND FORMULATIONS

- Application sites: vegetable, fruit and field crops; livestock; ornamental and forestry plantings; in agricultural premises and domestic dwellings; in greenhouses, and for control of parasites on fish in designated aquatic environments.
- Types of formulations: soluble concentrate, dust, granular, liquid, wettable powder/dust, pellets/tablets, and ready to use liquids.
- Types of methods of application: aerial and ground application as a spray, dust, granular, pellet or tablet.
- Application rates: 0.125-8.0 lbs/acre

3. SCIENCE FINDINGS

Chemical Characteristics

Technical trichlorfon is a white crystalline solid with a melting point of 81-82 degrees C. The boiling point for technical trichlorfon is 100°C at 0.1 mm Hg and the vapor pressure is 7.8 mm Hg at 20°C. The empirical formula is C4H804C13P and the molecular weight is 257.6. Trichlorfon is soluble in water (9% at 20 C), alcohols, methylene chloride and ketones and slightly soluble in aromatic solvents.

Toxicological Characteristics

- Current available toxicological studies on trichlorfon are as follows:
- Acute oral toxicity: rat, 450 mg/kg; mouse, 940 mg/kg (Tox Category II)
- Acute dermal toxicity: rat, LD50 >2 gm/kg (Tox Category III)
- Primary eye irritation, primary dermal irritation, dermal sensitization, acute inhalation, and subchronic feeding are data gaps.
- Additional data are needed to fully assess the toxicity of trichlorfon.
- Major routes of exposure: Application by ground and aerial equipment increases the potential for exposure of humans, livestock and wildlife due to spray drift. Human exposure to trichlorfon from handling, application and reentry operations would be minimized by the use of approved respirators and other protective clothing.

Physiological and Biochemical Characteristics

- Mechanism of pesticidal action: stomach and/or contact poison.
- Metabolism and persistence in plants and animals is not adequately understood and the residues of concern cannot be ascertained.

Environmental Characteristics

- Trichlorfon degrades rapidly in aerobic soils (half-lives approximately 1-27 days) under nonsterile conditions, but in sterile soils trichlorfon is stable (half-life >40 days). Trichlorfon also degrades rapidly (approximately 99% of applied degraded in 2 hours) in alkaline pond water (pH 8.5) at room temperature. but remains stable in the same pond water held under acidic (pH 5.0) conditions for 2 hours.
- The major degradate in both soil and pond water is DDVP (dimethyl 2,2-dichlorovinyl phosphate) with desmethyl DDVP also reported as a degradate in soil. Trichlorfon is very mobile in soils varying in texture from sand to silty clay with organic matter contents of 0.5-5.1o/0. Therefore, soil organic matter content does not appear to influence or only negligibly influences trichlorfon mobility in soil.
- The potential for groundwater contamination by the parent compound may be mediated by its degradation in soil; however, the potential for groundwater contamination by degradates of trichlorfon cannot be assessed due to the absence of an aged leaching study.
- Forestry and aquatic field dissipation studies did not show a potential for trichlorfon to persist in leaves, leaf litter, soil, water or sediment (and mud), nor did they show a potential for trichlorfon to accumulate in nontarget fish.

Ecological Characteristics

- Acute avian oral toxicity: 40-47 mg/kg
- Avian subacute dietary toxicity: 720-3401 ppm
- Freshwater fish acute toxicity: 1.6-180 ppm
- Acute toxicity for freshwater invertebrates: .18-7300 ppb
- Based on studies available to assess hazards to wildlife and aquatic organisms, technical trichlorfon is characterized as highly toxic to both cold water and warm water fish, very highly toxic to freshwater invertebrates and highly toxic to birds. Label precautions required by this Guidance Document should reduce the hazard to wildlife and aquatic organisms.

Tolerance Assessment

- The previously established tolerances for combined residues of trichlorfon and its cholinesterase-inhibiting metabolites are published in 40 CFR 561.190 and 40 CFR 180.198.
- The previously established ADI for trichlorfon is 0.1250 mg/kg/day and the TMRC, based on the established tolerances for residues of trichlorfon as cited under 40 CFR 180.198, is 0.0627 mg/day assuming a 1.5 kg diet; the TMRC currently accounts for only 0.84% of the ADI.
- No adequate study currently supports the previously established ADI. A new ADI will be established when the chronic toxicity data requirements are satisfied.

Summary Science Statement

- Numerous toxicology, environmental fate, product chemistry and residue chemistry data gaps preclude the Agency from making a complete assessment for trichlorfon. Refer to the Science Findings Section for the available data.

4. SUMMARY OF REGULATORY POSITION AND RATIONALE

- Use classification: not classified
- Use restrictions: 24-hour reentry interval
- Unique warning statement required on labels: Labels for all manufacturing-use products (MPs) containing trichlorfon must bear statements reflecting the hazards to man and the environment [40 CFR 162.10]. Trichlorfon is in Toxicity Category II on the basis of acute oral effects and Category III on the basis of acute dermal effects. The Agency has no valid acute inhalation, primary eye, primary dermal, or dermal sensitization data for trichlorfon manufacturing-use products.
- Based on the data reviewed by the Agency, the environmental hazard statement below is required to appear on all MPs containing trichlorfon:
- This pesticide is toxic to fish and wildlife and is extremely toxic to aquatic invertebrates. Do not discharge into lakes, streams, ponds, or public water unless in accordance with an NPDES permit. For guidance, contact your office of the environmental protection agency.
- Labels for all end-use products (EPs) containing trichlorfon must bear a statement reflecting the hazard to man and the environment [40 CFR 162 10]
- Based on data reviewed by the Agency, the following environmental hazards statements are required to appear on the EP products:
- All trichlorfon products intended for outdoor use must bear the following statement:
- This pesticide is toxic to fish and wildlife and is extremely toxic to aquatic invertebrates.
- Additional precautionary statements are required as indicated below:
- Trichlorfon products intended for direct applications to ponds:
- Consult your State Fish and Game Agency before applying this product to public waters. Permits may be required before treating such waters.
- Trichlorfon products intended for use in forestry:
- Do not apply directly to water or wetlands not under forest canopy. Runoff and drift from treated areas may be hazardous to aquatic organisms in neighboring areas.
- Trichlorfon products intended for outdoor use other than direct applications to ponds or forestry:
- Do not apply to water or wetlands. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas.
- The Agency is currently considering various approaches to address the endangered species concerning this and other chemicals. The registration standard may be amended to incorporate the results of this additional review.
- To avoid the possible misuse of trichlorfon in eating establishments the following statement is required for all EPs used in eating establishments:
- This product shall not be used in rooms or areas where food is either consumed or prepared.
- Bee precautionary language per PR Notice 68-19 is no longer required; since the data indicates that trichlorfon has a low toxicity to bees.

- The reentry statement below must appear on all trichlorfon labels with directions for use on crops:
- Do not reenter treated fields within 24 hours, unless protective clothing is worn.
- Refer to PR Notice 83-2 for additional information on reentry and worker protection labeling requirements.

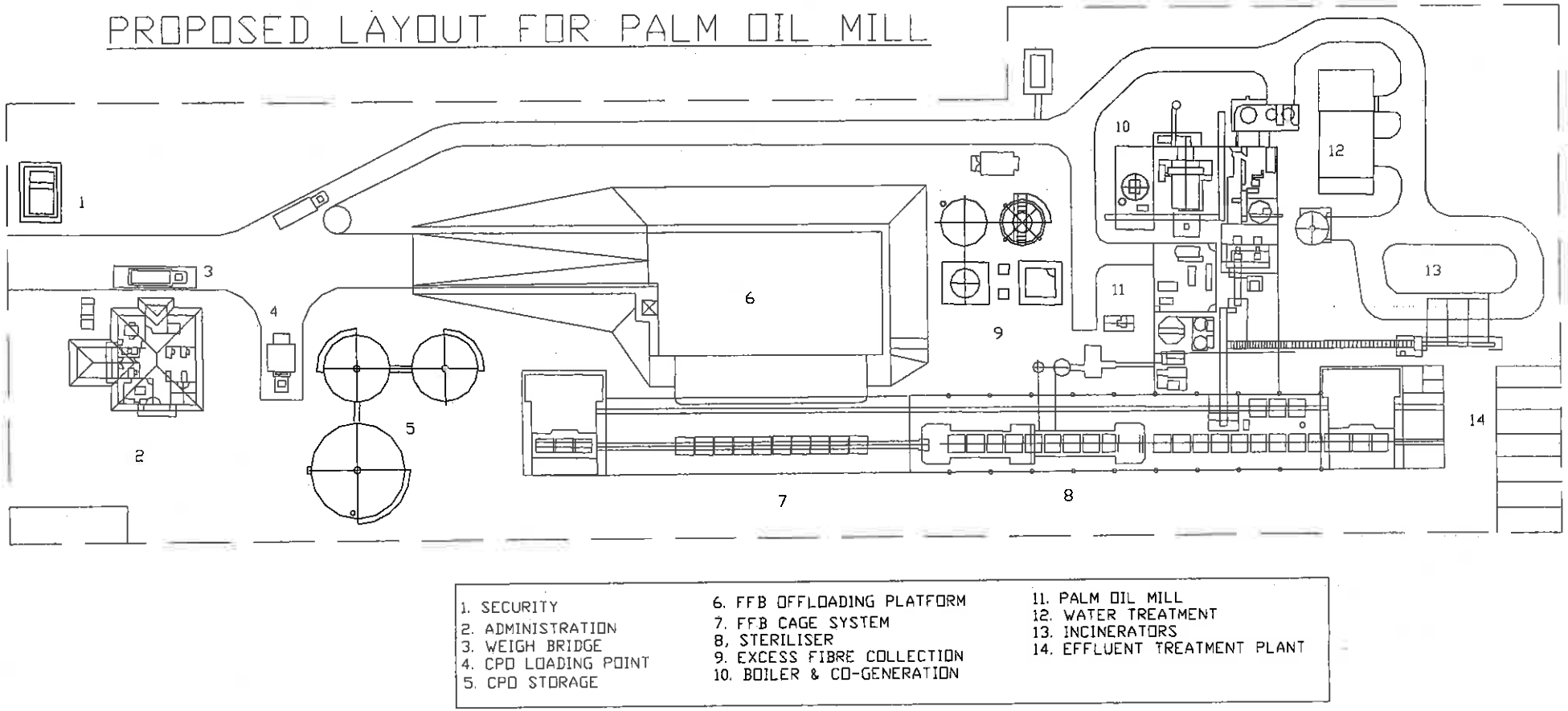
Summary of risk/benefit review:

- Dichlorvos (DDVP). a putative metabolite of trichlorfon, was originally referred and accepted for the Rebuttable Presumption Against Registration (RPAR) process because scientific studies indicated that dichlorvos was mutagenic as well as potentially carcinogenic, neurotoxic and teratogenic in laboratory animals. The RPAR Decision Document on Dichlorvos was issued by the Agency on September 30, 1982. In this document (i.e., Decision Document on Dichlorvos, Office of Pesticides and Toxic Substances, U.S. EPA, Washington, DC. September 30, 1982) the Agency evaluated the available data on dichlorvos in accordance with 40 CFR 162.11 (Criteria for Determination of Unreasonable Adverse Effects) and concluded that the existing evidence did not support the issuance of an RPAR for dichlorvos, and consequently that an RPAR for trichlorfon as a precursor of dichlorvos was also not warranted.
- The DDVP Decision Document concluded that additional data on carcinogenicity and mutagenicity were needed to complete the risk assessment for dichlorvos. DDVP was removed from the RPAR process and returned to the registration process. On March 23, 1983 the Agency issued a Data Call-In Notice under FIFRA Section 3(c)(2)(b) requesting data on potential mutagenic effects of dichlorvos be submitted by March 23, 1985. However, the Agency will wait until the continuing National Cancer Institute (NCI) dichlorovos bioassay on carcinogenicity is completed (currently scheduled for completion in 1984) and evaluated, prior to determining if additional data on the carcinogenicity of dichlorvos will be required. Since dichlorvos can be metabolized from trichlorfon, evaluation of these studies will be necessary for the completion of the trichlorfon risk assessment.
- Trichlorfon was originally referred and entered to the Rebuttable Presumption Against Registration (RPAR) process because scientific studies suggested that trichlorfon may be oncogenic, teratogenic, fetotoxic and mutagenic. In the Trichlorfon Registration Standard (June 1984) document the Agency has evaluated the available data on trichlorfon in accordance with 40 CFR 162.11 (Criteria for Determination of Unreasonable Adverse Effects) and concluded that the existing evidence does not support the issuance of an RPAR for
- trichlorfon because the existing data base is incomplete. Additional data are required to complete the risk assessment for trichlorfon. Oncogenicity, chronic feeding, teratogenic, mutagenicity, inhalation, dermal, eye irritation, neurotoxicity, and metabolism studies are required.

5. SUMMARY OF MAJOR DATA GAPS

- Product Chemistry: Data on product identity analysis and certification of product ingredient and physical and chemical characteristics are the major product chemistry gaps.
- Residue Chemistry: Additional data are required to support the tolerances for a variety of crops. Data from animal and plant metabolism studies are also required. Residue chemistry data requirements are outlined in detail in the tolerance assessment in Section 3 of this Fact Sheet.
- Toxicology: The following studies are required: acute inhalation toxicity, primary eye irritation, primary dermal irritation, dermal sensitization, 90-day feeding, 21-day dermal, 90-day dermal, 90-day inhalation, 90-day neurotoxicity, chronic toxicity, oncogenicity, teratogenicity, chromosomal aberration, general metabolism, and domestic animal safety.
- Wildlife and aquatic organisms: The following studies are required: fish early life stage and aquatic invertebrates life cycle.
- Environmental Fate: The following studies are required: hydrolysis; photodegradation in water, soil and air; metabolism studies (lab) in aerobic soil, anaerobic soil, anaerobic aquatic and aerobic aquatic environments; mobility studies including leaching and adsorption/ desorption and volatility (lab); dissipation studies (field) in soil, aquatic (sediment) and forestry; accumulation studies in fish, in aquatic non-target organisms, and rotational crops (confined).

APPENDIX 5


PROPOSED LAYOUT FOR PALM OIL MILL
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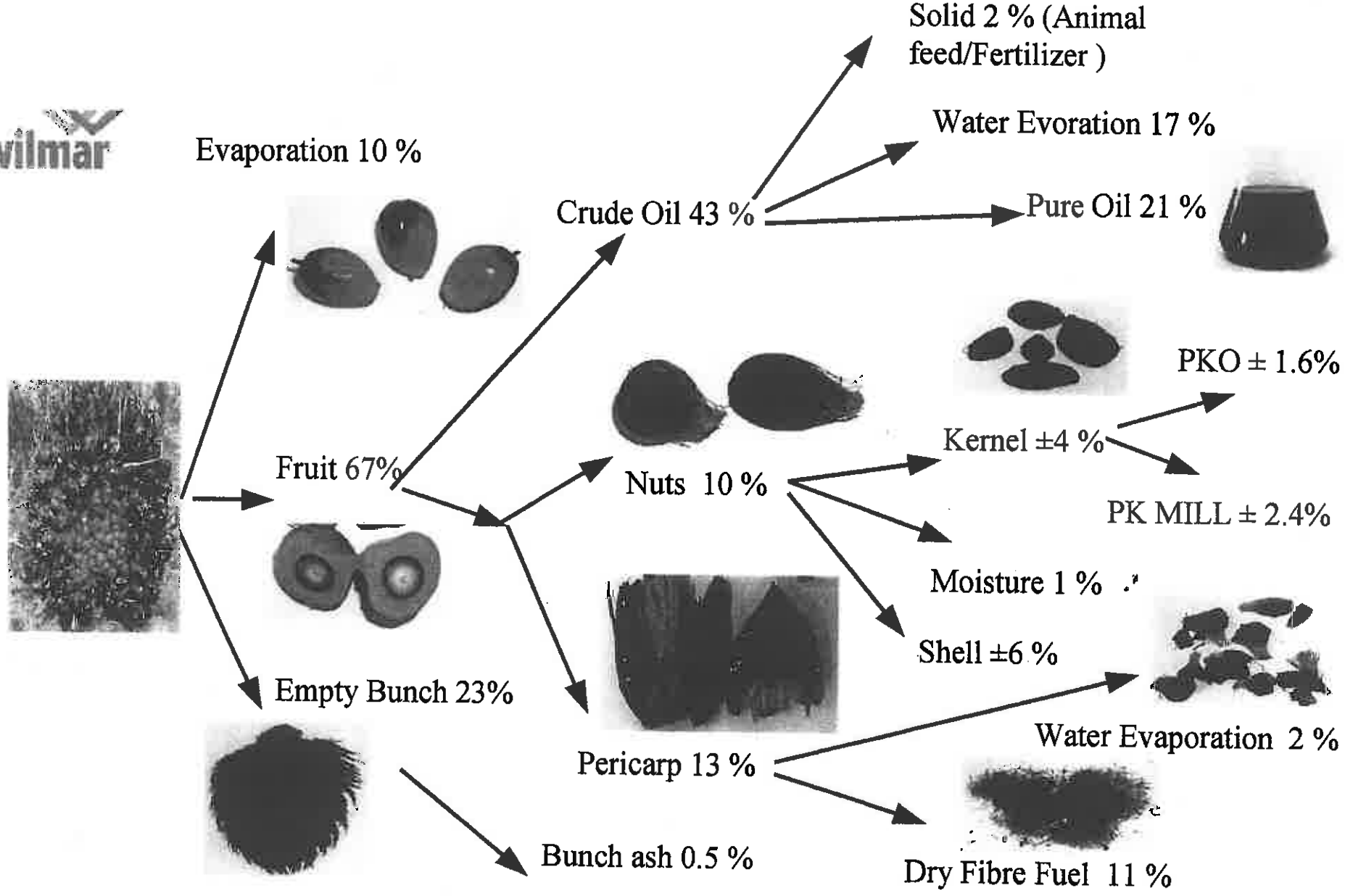
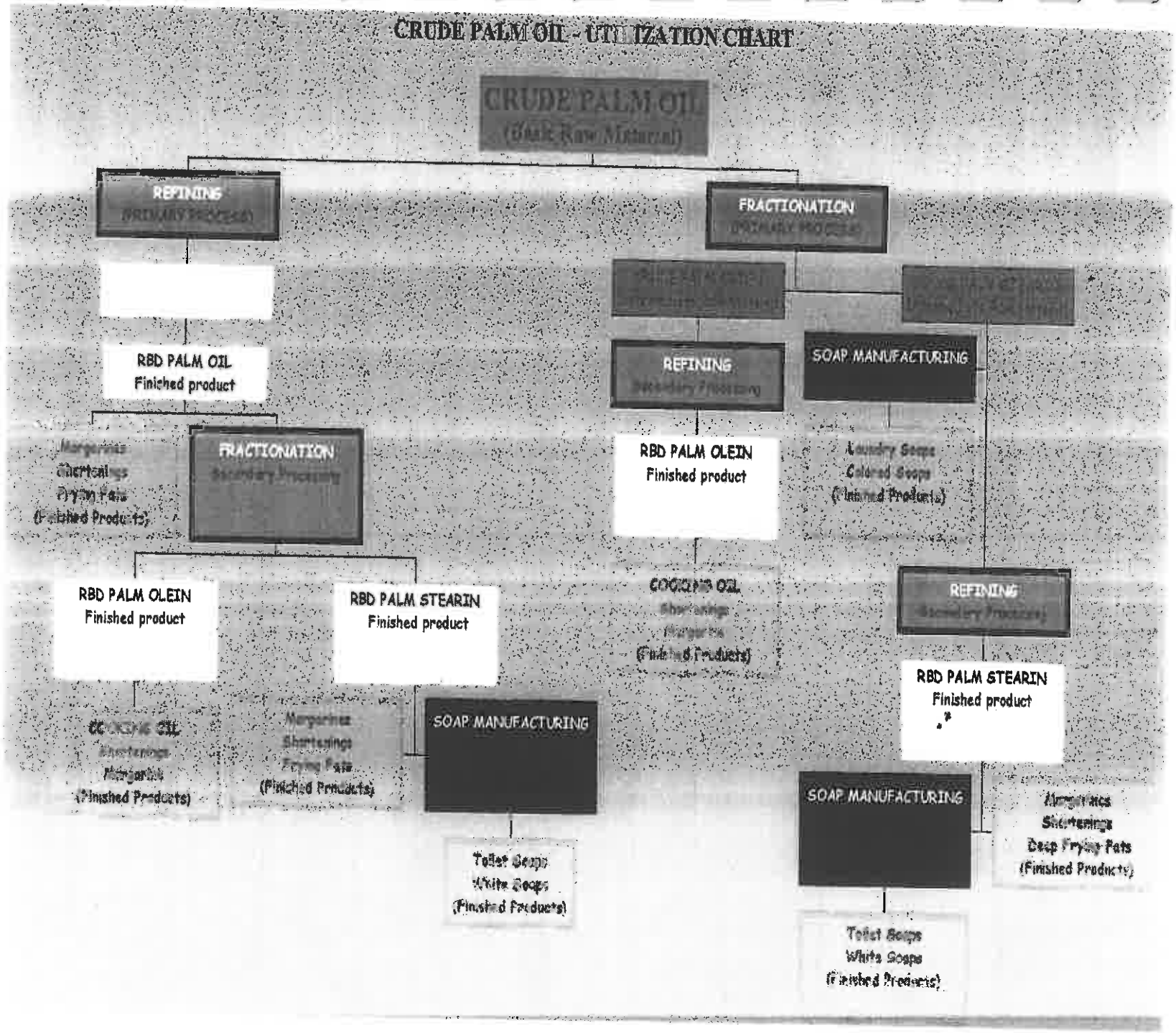
1. SECURITY
2. ADMINISTRATION
3. WEIGH BRIDGE
4. CPO LOADING POINT
5. CPO STORAGE
6. FFB OFFLOADING PLATFORM
7. FFB CAGE SYSTEM
8, STERILISER
9. EXCESS FIBRE COLLECTION
10. BOILER & CO-GENERATION
11. PALM OIL MILL
12. WATER TREATMENT
13. INCINERATORS
14. EFFLUENT TREATMENT PLANT

APPENDIX 6: OIL PALM PRODUCTS – THE COMPLETE VALUE CHAIN


wilmar
Evaporation 10 %
Solid 2 % (Animal feed/Fertilizer)
Water Evoration 17 %
Crude Oil 43 %
Pure Oil 21 %
PKO ± 1.6%
Kernel ±4 %
PK MILL ± 2.4%
Fruit 67%
Nuts 10 %
Moisture 1 %
Shell ±6 %
Empty Bunch 23%
Water Evaporation 2 %
Pericarp 13 %
Bunch ash 0.5 %
Dry Fibre Fuel 11 %

CRUDE PALM OIL - UTILIZATION CHART



APPENDIX 7: LIST OF PLANT SPECIES RECORDED IN SURVEYED FORESTS ON BUGALA ISLAND

Species name	Family	Herb	Liana	Shrub	Tree
Mimulops cicatricosa	Acanthaceae			√	
Whitifieldia elonganta	Acanthaceae			√	
Pteris burtonii	Adiantaceae	√			
Pteris dentata	Adiantaceae	√			
Pteris preusii	Adiantaceae	√			
Achyranthes aspera	Amaranthaceae	√			
Celosia globosa	Amaranthaceae	√			
Scadoxus cinnaborinus	Amaryllidaceae	√			
Pseudospondias microcarpa	Anacardiaceae				√
Artabotrys likimensis	Annonaceae		√		
Greenwaydendron suavelens	Annonaceae				√
Monodora myristica	Annonaceae				√
Uvaria angolense	Annonaceae		√		
Uvaria welwistchii	Annonaceae		√		
Xylopia parviflora	Annonaceae				√
Alafia sp	Apocynaceae		√		
Funtumia elastica	Apocynaceae				√
Landolphia buchananii	Apocynaceae		√		
Landolphia landolphiodes	Apocynaceae		√		
Landolphia microstalyis	Apocynaceae		√		
Landolphia owariense	Apocynaceae		√		
Oncinotis puntenoiroe	Apocynaceae		√		
Saba comorense	Apocynaceae		√		
Strophanthus sp.	Apocynaceae		√		
Tabernemontana holstii	Apocynaceae				√
Culcasia scandens	Araceae		√		
Schefflera barteri	Araliaceae			√	
Asplenium dregeanum	Aspleniaceae	√			
Asplenium holstii	Aspleniaceae	√			
Asplenium inaequilaterale	Aspleniaceae	√			
Asplenium sandersonii	Aspleniaceae	√			
Asplenium sp	Aspleniaceae	√			
Bolbitis gemifera	Aspleniaceae	√			
Dryopteris maniana	Aspleniaceae	√			
Lomariopsis sp	Aspleniaceae	√			
Tectaria gemifera	Aspleniaceae	√			
Impatiens niamniamensis	Balsaminaceae	√			
Begonia oxyloba	Begoniaceae	√			
Canarium schweinfurthii	Burseraceae				√
Prinistella plumbea	Celastraceae		√		
Salacia elegans	Celastraceae		√		
Commelina benghalensis	Commelinaceae	√			
Commelina capitata	Commelinaceae	√			
Floscopa sp	Commelinaceae	√			
Palisota manii	Commelinaceae	√			
Polia condensata	Commelinaceae	√			
Stanfieldiera imperforata	Commelinaceae	√			
Crassocephalum montuasum	Compositae	√			
Crassocephalum sp	Compositae	√			

Earlangia sp	Compositae			√	
Tridax sp	Compositae	√			
Aglaea pentagyna	Connaraceae		√		
Rourea thomsonii	Connaraceae		√		
Costus dubius	Costaceae	√			
Resparis sp	Cuctaceae	√			
Momordica foetida	Cucurbitaceae		√		
Cyathea sp	Cyatheceae				√
Bulbostylis ugandensis	Cyperaceae	√			
Cyperus cyperoides	Cyperaceae	√			
Cyperus renschii	Cyperaceae	√			
Scleria boivinii	Cyperaceae	√			
Scleria catophylla	Cyperaceae	√			
Blotiella natalensis	Dennstaedtaceae				√
Histiopteris sp	Dennstaedtaceae	√			
Pteridium aquilinium	Dennstaedtaceae	√			
Dioscorea abyssinica	Dioscoreaceae		√		
Dioscorea baya	Dioscoreaceae		√		
Dioscorea sp	Dioscoreaceae		√		
Dracaena fragrans	Dracaenaceae			√	
Alchornea cordifolia	Euphorbiaceae				√
Alchornea laxissima	Euphorbiaceae			√	
Antidesma venosum	Euphorbiaceae				√
Bridelia micrantha	Euphorbiaceae				√
Elaeophorbia drupifelii	Euphorbiaceae				√
Erythrococca stolsiana	Euphorbiaceae			√	
Macaranga kilimandscharica	Euphorbiaceae				√
Macaranga lancifolia	Euphorbiaceae				√
Macaranga monandra	Euphorbiaceae				√
Macaranga schweinfurthii	Euphorbiaceae				√
Margaritaria discoidea	Euphorbiaceae				√
Tetrorchidium dydmonstemon	Euphorbiaceae				√
Uapaca guineense	Euphorbiaceae				√
Casearia engleri	Flacourtiaceae				√
Harungana madagascariensis	Guttiferae				√
Symphonia globlifera	Guttiferae				√
Apodytes dimidiata	Icacinaceae				√
Iodes sp	Icacinaceae		√		
Leptaulus daphanoides	Icacinaceae				√
Plectranthus luteus	Labiatae			√	
Beileschmedia ugandensis	Lauraceae				√
Abrus precatorius	Leguminosae		√		
Acacia pentagona	Leguminosae		√		
Dalbergia capensis	Leguminosae		√		
Newtonia buchananii	Leguminosae				√
Piptadeniastrum africana	Leguminosae				√
Chlorophytum filipendula	Liliaceae	√			
Hugonia platysepala	Linaceae		√		
Marantachloa leucantha	Marantaceae	√			
Marantachloa purpurea	Marantaceae	√			
Marantachloa sp.	Marantaceae		√		
Trachophrynum braunianum	Marantaceae	√			
Marattia fraxinea	Marratiaceae	√			
Dissotis sp	Melastomataceae	√			

Memecylon jasminoides	Melastomataceae				√
Guarea cedrata	Meliaceae				√
Lovoa trichiloides	Meliaceae				√
Trichilia dregeana	Meliaceae				√
Trichilia preuriana	Meliaceae				√
Tiriacola funiliform	Menispermaceae		√		
Antiaris toxicaria	Moraceae				√
Ficus barteri	Moraceae				√
Ficus cyathistipula	Moraceae				√
Ficus densistipula	Moraceae				√
Ficus otteinofolia	Moraceae				√
Ficus polita	Moraceae				√
Ficus pseudomangifera	Moraceae				√
Myrianthus holstii	Moraceae				√
Trelipisium madagarscariensis	Moraceae				√
Pycnanthus angolensis	Myrsinaceae				√
Syzygium cordata	Myrtaceae				√
Syzygium guineense	Myrtaceae				√
Ochna bractiosa	Ochnaceae			√	
Ochna holstii	Ochnaceae				√
Ouretia parviflora	Ochnaceae				√
Aerangis sp	Orchidaceae	√			
Bulbophyllum sp	Orchidaceae	√			
Cynorkis sp	Orchidaceae	√			
Habenaria macrandra	Orchidaceae	√			
Biophytum petersianum	Oxalidaceae	√			
Raphia farinifera	Palmae				√
Adenia cissampeloides	Passifloraceae		√		
Ardisia racemosa	Passifloraceae				√
Paropsia guinensis	Passifloraceae				√
Passiflora edulis	Passifloraceae		√		
Hilleria latifolia	Phytollacaceae	√			
Piper guineense	Piperaceae		√		
Piper umbellatum	Piperaceae	√			
Brachiaria sp	Poaceae	√			
Hyparrhenia ruffa	Poaceae	√			
Leptaspis zeylanicum	Poaceae	√			
Loudetia kagerensis	Poaceae	√			
Oplismenus hirtelus	Poaceae	√			
Panicum hotchsteteri	Poaceae	√			
Panicum maximum	Poaceae	√			
Paspalum conjugatum	Poaceae	√			
Setaria megaphylla	Poaceae	√			
Maesopsis eminii	Rhamnaceae				√
Ventilago africana	Rhamnaceae		√		
Chassalia cristata	Rubiaceae		√		
Coffea canephora	Rubiaceae				√
Craterospermum laurinum	Rubiaceae				√
Dictyandra arborescens	Rubiaceae				√
Geophylla hirsuta	Rubiaceae	√			
Geophylla repens	Rubiaceae	√			
Keetia guinzui	Rubiaceae		√		
Oxyanthus speciosus	Rubiaceae				√
Oxyanthus unilocularis	Rubiaceae				√

APPENDIX 8: MAPPING AND LAND USE/COVER ANALYSIS

A reconnaissance visit was made to Bugala Island in order to collect data for mapping. This consisted of recording Universal Transverse Mercator (UTM) coordinates using a hand-held Global Positioning System (GPS) at various representative points on the island and a description of land use and land cover on the ground for map accuracy calculations and georeference. A total of 28 points were visited.

Spatial data on land use/cover and land tenure/ownership were analysed using Arcview and ILWIS map calculation functions. Input data is summarised in Table 7.

Land use/cover map was derived from interpretation of a 2000 Landsat satellite image by the National Biomass Study Programme. The FAO Land Cover Classification System was used.

Table 7: Spatial data used in developing spatial plan for oil palm development on Bugala Island

Spatial data	Source	Scale
Topographic maps of Bugala Island	Directorate of Overseas Surveys, 1950	1:50,000
Bugala Island land use/land cover spatial data	National Biomass Study Progamme	Digital
Map of land ownership type in Bugala Island, Kalangala District	Vegetable Oil Development Project, MAAIF	1:50,000

APPENDIX 9: BIRDS OBSERVED IN THE PROPOSED OIL PALM DEVELOPMENT PROJECT AREA

Britton No.	Common Name	STATUS
12	Pink-backed Pelican	
17	Long-tailed Cormorant	
36	Little Egret	
	Great White Egret	R-VU
42	Hamerkop	
43	Open-billed Stork	
61	Egyptian Goose	
96	Harrier Hawk	
116	Tawny Eagle	
130	Long-crested Eagle	
138	Black kite	
137	Fish Eagle	
143	Black-shouldered Kite	
252	Common Sandpiper	
213	White-spotted Pygmy Crake	
350	Red-eyed Dove	
355	Blue-spotted Wood Dove	
357	Tambourine Dove	
358	Green Pigeon	
371	Grey Parrot	NT
376	Eastern Grey plantain eater	
377	Ross's Turaco	
388	Diederik Cuckoo	
389	Emerald Cuckoo	
399	Red-chested Cuckoo	
401	Yellow bill	
406	White-browed Coucal	
436	Fiery-necked Nightjar	
465	Pied Kingfisher	
474	Blue-breasted Kingfisher	
475	Woodland Kingfisher	
477	Dwarf Pygmy Kingfisher	
479	White-throated Bee-eater	
488	Cinnamon-chested Bee-eater	RR
491	Little Bee-eater	
494	Blue-breasted Bee-eater	
513	Black & White Casqued Hornbill	
519	Pied Hornbill	
515	Crowned Hornbill	
627	Angola Swallow	
629	Lesser Striped Swallow	
643	Sand Martin	

647	Western Black-headed Oriole	
705	Little Greenbul	
709	Yellow-throated Leaflove	
732	Common Bulbul	
753	Snowy-headed RobinChat	
771	Sooty Chat	
818	Yellow-breasted Apalis	
860	Winding Cisticola	
837	Grey-backed Camaroptera	
843	African Yellow Warbler	
924	Green Crombec	
927	Grey Flycatcher	
960	Wattle Eye	
961	Black-throated Wattle-eye	
968	African Paradise Flycatcher	
988	Yellow-throated Long claw	
991	African Pied Wagtail	
1061	Splendid Glossy Starling	
1098	Red-chested Sunbird	RR
1112	Olive Sunbird	
1128	Variable Sunbird	
1130	Green-headed Sunbird	
1133	Yellow White Eye	
1172	Little Weaver	
1175	Vieillot's Black Weaver	
1179	Slender-billed Weaver	
1183	Large Golden Weaver	
	Northern Brown-throated Weaver	NT
1188	Weyn's Weaver	VU
1206	Grey-headed Sparrow	
1216	Pin-tailed Whydah	
1226	Waxbill	
1266	Bronze Mannikin	

R-CR: Critical in the region; R-EN: Endangered in the region; R-VU: Vulnerable in the region; R-NT: Near-threatened in the region, very close to vulnerable (Collar et al., 1994); R-RR: Regional Responsibility - Species with at least 90% of range or population within political boundaries and or confined to coastal or Albertine Rift forest or papyrus and or with population which depend on a very few significant sites for breeding or during migration

Pauridiantha calicarpoides	Rubiaceae				√
Pauridiantha sp	Rubiaceae				√
Randia longiflora	Rubiaceae				√
Rutidea sp	Rubiaceae		√		
Uragoga semlikiensis	Rubiaceae			√	
Zanthoxylum lepreulii	Rutaceae				√
Bersama abyssinica	Sapindaceae				√
Blighia unijugata	Sapindaceae				√
Blighia welwistchii	Sapindaceae				√
Lecaniodiscus ceraspermus	Sapindaceae				√
Zahna gorungensis	Sapindaceae				√
Chrysophyllum albidum	Sapotaceae				√
Englerophytum oblanceolata	Sapotaceae				√
Manilkara obvata	Sapotaceae				√
Pachystella brevipes	Sapotaceae				√
Drymaria cordata	Scrophulariaceae	√			
Smilax kraussiana	Smilacaeae		√		
Peddia fischeri	Thymeliaceae				√
Trema orientaris	Ulmaceae				√
Boehmeria macrophylla	Urticaceae				√
Urera trinervis	Urticaceae		√		
Clerodendrum fuscum	Verbenacaeae		√		
Clerodendrum johnstonii	Verbenacaeae		√		
Cissus velutina	Vitaceae		√		
Cyphostema bambusetica	Vitaceae	√			
Aframomum luteoalba	Zingiberaceae	√			
Aframomum mala	Zingiberaceae	√			
Aframomum zambezica	Zingiberaceae	√			
Renealmia congolana	Zingiberaceae	√			

APPENDIX 10: STAKEHOLDERS CONSULTATION

As part of the EIA process, different stakeholders were consulted on pertinent issues regarding the project.

ISSUES RAISED

ACODE

- Object to the use of taxpayer's money to donate land to investors who should be buying such land on the land market-a case of more than national treatment.
- Environmental and social management framework should contain adequate guarantees including the possibility of performance deposit bound.

Forest Department

- The investment Plan indicating the site where the factory is to be located, type of machinery to be used, road density and alignments and labour quarters
- Half of the land purchased is private forests
- Satisfaction of the land lords with the payments they received for the land
- Transfer of land from Uganda Land commission to BIDCO (is it permanent or temporary) and if the project doesn't take place what next?
- Look at the land act, NEMA regulations, Forest & tree planting Bill and marry them (because the laws governing gazetted and Natural forests are not the same)
- Look at the grazing land
- Mapping of the proposed oil palm plantation will not be possible without the site location of the factory.
- Migratory species e.g., kits (how will you deal with them) should be catered for
- Consider the economics of change of land use to palm oil given that it takes 8 years for the palm tree to mature
- Disjointed plantations as opposed to continuous plantations
- Mitigation plans for the various aspects i.e. nature reserves, fish, soil, land etc
- GIS specialist should map out the different natural resources in the area
- If they project is going to benefit the local man there is need for renegotiations
- What will happen to the government forests if natural forests are to be cleared for palm oil plantations?
- Since it takes 8 years to maturity of the palm oil tree what will people be feeding on?
- Since the population pressure is going to increase, what plans are in place to curb down the crime rate.
- The nucleus estate is bigger than the out growers so there is a likelihood that the out growers going to loose
- The amount of land allocated to the immigrants for food production is inadequate
- The plan for wind gusts after the destruction of the forests
- The agronomic practises such as the type of fertilizers to be used and there impact on the fish, birds etc.

MUIENR

- Will comment on the EIA report
- Get the land titles of the area under the project

NatureUganda

- Important Bird Areas on the Islands

The Uganda Wildlife Society (UWS)

- Look at the adequacy of the EIA.
- Commend the change in location to private land

- Look at the impact of the loss of forest cover, biodiversity and forest products from the private forests on the environment
- Provide alternative sources of fuel wood and related forest products for the local communities
- Emphasise and analyse of the impact of the oil mill on the environment
- The environmental impacts of the land use change as well as the factory and small-scale processing and production of the palm oil should be considered
- An assessment of the environmental impacts of mechanised and artisan methods for palm oil processing and production should be done.
- Look at the various legislations that mention the need for private landowners to manage their lands in accordance to the laws regulating forestry, wildlife and related natural resources. Who will harvest and benefit from the forest cover on former "public" and private land that will be removed to make way for the oil palm plantation? What will be the fate of wildlife that currently exists on the transformed land?

Wetlands Inspection Division (WID)

- Legal requirements pertaining wetland and environmental management should be taken into consideration
- The likely impacts of oil processing on wetlands and open waters should also be considered
- The former public lands that are wetlands should be excluded from the proposed developments

NEMA (Attached)

NEMA/4.5

22ND July 2003

The Permanent Secretary,
Ministry of Agriculture, Animal Industry and Fisheries,
P.O Box 102,
Entebbe.

Re: COMMENTS ON THE DRAFT TERMS OF REFERENCE FOR THE ENVIRONEMNTAL IMPACT ASSESSMENT FOR THE OIL PALM DEVELOPEMNT PROJECT IN BUGALA ISLAND, KALANGALA DISTRICT

Reference is made to the above subject. We have reviewed the Terms of Reference (TORs) and find that they address the major issues of concern. However, as stated in our letter of even reference dated 24th January 2003, you will in addition to the issues identified in the TORs, have to take care of environmental concerns associated with the proposed improvement in plantation road network which will involve extraction of road construction materials, hence require providing measures for restoration of any such sites that could be degraded during the process of extracting these materials. The assessment shall also address any other negative environmental impacts and issues that were not foreseen during the preparation of these TORs but may arise during the course of carrying out the Environmental impact Study should also be planned for mitigation.

Further more, since the TORs do not address the construction of the Oil Refinery, a separate EIA will have to be undertaken .for which Terms of Reference will have to be submitted, reviewed and approved.

Before commencement of the study, however, you are required, as provided for under Section 20(4) of the National Environment Statute 1995, to submit to this Authority for approval, the names and qualifications of the experts you are going to identify to carry out the study in line with the expert areas you have outlined under pages 9-16 of the Terms of Reference submitted.

Lastly but not least, I wish to clarify that, considering that the project location has since changed from the original location within the Forest Reserves to land purchased outside the Forest Reserves, this Authority expects that a full Environmental Impact Study shall be carried out other than an Environmental Impact Review as stated in your letter. This is particularly so because a number of baseline environmental factors and conditions applicable to the newly purchased land may not necessarily be similar to the baseline situation as was anticipated when the Forest Reserves were the targeted land for the project. You will, however, be free to make use of any information contained in the previous Assessment Reports that may still be applicable at this point in time.

I await receipt of the identified study team (and their qualifications to suit the identified study areas) for my approval once you have finalised their identification and thereafter the study can commence without any further delay.

Aryamanya- Mugisha, Henry
EXECUTIVE DIRECTOR

C.C The Hon. Minister,
Ministry of Finance, Planning and Economic Development,
Kampala.

C.C The Hon. Minister,
Ministry of Water , Lands and Environment,
Kampala.

- Finally , I should say that were a photo can back up a point, I find them very useful and informative in this kind of reports. Of-course remember to balance the number you select so as not to make the whole report a photo album.

LIST OF ORGANISATIONS

Organisation	Name	Title	Contact
	Peter Hickman	G.M	
1. ACODE	Godber Tumushabe	Executive Director	P. O. Box 29836 Kampala Tel: 256 41 530798 Email: acode@acode-u.org
2. Bujumba	John Kayondo	Subcounty Chief	Tel. 077641373
3. DWD WRMD			
4. Forest Department	Acaye.Charles	Forest Officer in Charge Natural Forests	P. O. Box 7124 Tel.231866/344297 Fax 236016/342607 Email: info@ecforest.org.ug
5. IFAD	Jim Semple	Ag. Econ.Consult	
6. Kalangala	Balironda, Mukasa David	DAO	Tel. 077641284
7. Kalangala District	Nakyanzi O.H	CAO	Tel. 077641158
8. Kalangala District	Kikoola Daniel	Chairman LC V	Tel. 077610440
9. Kalangala District	Mugisa Godfrey	Deputy RDC	Tel. 077463954
10. Kalangala District	Twikirize Ben	Deputy CAO/Sec, DLB	Tel. 077637230
11. Kalangala District	Nsubuga Costantino	V/Chairman LC V	
12. Kalangala District	Dr. Katamba	Focal Officer HIV/AIDS	077450478
13. KOMATSU	David Holley	M.D	
14. MAAIF	Omoding Joy	DCR	
15. MGLSD	Osinde Owor	Principal Community Dev. Officer	
16. MOWHC	Stephen Kitonsa	Road Engineer	
17. MUIENR	Dr. E. Kateyo	Sen. Lecturer	P. O. Box 7062
18. NatureUganda	Ambrose Mugisha	Conservation and projects officer	P. O. Box 27034 Kampala Tel: 256 41 540719 Fax 256 41 533528 E-mail: ambrose.mugisha@natureuganda.org
19. UWA			P. O. Box 3530 Kampala Email: uwa@uwa.or.ug
20. WID	Paul Mafabi	Ag. Assistant commissioner	
21. VODP	C.M Masaba	PC	
22. VODP	Muyaka Z	To	

cwpalmbidcolow		24-Nov	18:19										Appendix 11															
REPUBLIC OF UGANDA - IFAD/WB/BIDCO																												
VEGETABLE OIL DEVELOPMENT PROJECT - OIL PALM COMPONENT: REVIEW/REAPPRAISAL																												
Table 4 Indicative Farm and Household Models - Partial Budgets				New Palm Oil Enterprise for Outgrower of 1 Hectare -- Low Performance Scenario**																								
PRODUCTION AND VALUE		OPERATING CASH FLOW																										
				Years>>																								
Item	Notes	Unit	Unit Value UGSh	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
COSTS																												
Establishment, Maintenance, Operating																												
Labour - Land Preparation/Planting	1	workday	4000	85																								
- Weeding/Initial Fieldwork				22	20																							
- Field Management/Pest Control/Pruning					14	36	27	20	20	20	20	20	20	20	20	20	20	20	20	0	0	0	0	0	0	0	0	0
- Harvesting/Transport (see below)	2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Labour				107	34	36	27	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Field Labour Costs		UGSh		428000	136000	144000	108000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000
Inputs - Palm Plants	3	sum	640000	1	0																							
- Cover Crop Seed	3	sum	300000	1	0																							
- Fertilisers (rock phosphate)		kg	600	0	0																							
- Fertilisers (compound)		l	700000	0.07	0.20	0.39	0.59	0.40	0.20	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Herbicides		lit/gm	14500	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Rat Baits		kg	500	36	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Sundries/Pegs		unit	100	150	0																							
- Equipment/Tools	4	set	1	42800	13600	14400	10800	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
Field Services - Field Transport - Tractor		hour	15000	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Land Clearance	5	sum	245000	1																								
- Roads and Drains (50% of Bidco estimate)	5	sum	442000	1																								
- Other - Trucks	6	km	1000	10	5	5	0																					
Input and Field Services Costs		UGSh	na	1921800	336600	452400	438800	303000	163000	93000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000
Financing Costs	7	UGSh																										
Total Direct Costs	8	UGSh		2349800	472600	596400	546800	383000	243000	173000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000	103000
REVENUES																												
Outputs - Sales of Fruits	9	kg ffb	150	0	0	0	2000	4000	8000	10000	12000	12000	12000	12000	12000	12000	12000	12000	10000	10000	10000	10000	8000	8000	8000	8000	8000	8000
Gross Value of Sales	10	UGSh		0	0	0	300000	600000	1200000	1500000	1800000	1800000	1800000	1800000	1800000	1800000	1800000	1800000	1500000	1500000	1500000	1500000	1200000	1200000	1200000	1200000	1200000	1200000
less: Harvesting Labour - Workdays	11	day		0	0	0	5	10	20	25	30	30	30	30	30	30	30	30	25	25	25	25	20	20	20	20	20	20
- Costs	11	UGSh	4000	0	0	0	20000	40000	80000	100000	120000	120000	120000	120000	120000	120000	120000	120000	100000	100000	100000	100000	80000	80000	80000	80000	80000	80000
Harvesting Materials, Tools, Equipment	12	sum	80000	80000					80000						80000				80000				80000					80000	
Harvesting Transport Variable/Hire Costs	13	t	8000	0	0	0	16000	32000	64000	80000	96000	96000	96000	96000	96000	96000	96000	96000	80000	80000	80000	80000	64000	64000	64000	64000	64000	64000
Total Costs of Harvesting				80000	0	0	36000	72000	224000	180000	216000	216000	216000	296000	216000	216000	216000	296000	180000	180000	180000	260000	144000	144000	144000	144000	224000	144000
Administration Costs	14	sum	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000
Net Value of Sales				-180000	-100000	-100000	164000	428000	876000	1220000	1484000	1484000	1484000	1404000	1484000	1484000	1484000	1404000	1220000	1220000	1220000	1140000	956000	956000	956000	956000	876000	956000
Net Cash Flow (including labour) before financing	15	UGSh		-2529800	-572600	-696400	-382800	45000	633000	1047000	1381000	1381000	1381000	1301000	1381000	1381000	1381000	1301000	1117000	1117000	1117000	1037000	853000	853000	853000	853000	773000	853000
"direct cost of establishment to Year 1"	15						-4181600																					
Internal Rate of Return(enterprise)		%	16%																									
Net Family Cash Flow (add back HH labour)	16	UGSh		-2101800	-436600	-552400	-274800	125000	713000	1127000	1461000	1461000	1461000	1381000	1461000	1461000	1461000	1381000	1197000	1197000	1197000	1117000	933000	933000	933000	933000	853000	933000
(before financing)		*US$*		*-1051*	*-218*	*-276*	*-137*	*63*	*357*	*564*	*731*	*731*	*731*	*691*	*731*	*731*	*731*	*691*	*599*	*599*	*599*	*559*	*467*	*467*	*467*	*467*	*427*	*467*
Return per Labour Day	16	UGSh		-19643	-12841	-15344	-10178	6250	35650	56350	73050	73050	73050	69050	73050	73050	73050	69050	59850	59850	59850	55850	46650	46650	46650	46650	42650	46650
Internal Rate of Return(family)		%	20%																									
Credit Calculation/Financing Costs																												
Opening Balance				0	2210070	2928671	3888231	4976086	6070949	5522339	4891437	4165901	3331533	2372011	1268561													
Drawdown of Loan/Benefits over Years 1 to 5	17			1921800	336600	452400	438800	303000	0	0	0	0	0	0	0													
Repayment over 7 years				0	0	0	0	0	1268915	1268915	1268915	1268915	1268915	1268915	1268915													

Interest at 15% per Annum on Balance	18			288270	382000.5	507161	649055	791863	720305	638014	543378	434548	309393	165464	-53														
Total Outstanding	19			2210070	2928671	3888231	4976086	6070949	5522339	4891437	4165901	3331533	2372011	1268561	-407														
Total Outflow -- Repayments plus Interest	7								1989220	1906929	1812293	1703463	1578308	1434379	1268862														
Net Family Cash Flow after Financing		UGSh		-2101800	-436600	-552400	-274800	125000	-1276220	-779929	-351293	-242463	-117308	-53379	192138	1461000	1461000	1381000	1197000	1197000	1197000	1117000	933000	933000	933000	933000	853000	933000
		US$		*-1051*	*-218*	*-276*	*-137*	*63*	*-638*	*-390*	*-176*	*-121*	*-59*	*-27*	*96*	*731*	*731*	*691*	*599*	*599*	*599*	*559*	*467*	*467*	*467*	*467*	*427*	*467*
Internal Rate of Return to Family after Financing		%	7%	**Consistent Positive Cash Flow from Year 12**																									
Potential Estate Employment Earnings	20	workday		200	150	150	150	120	120	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
		UGSh		800000	600000	600000	600000	480000	480000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000
Family Cash Flow after Financing/Employment				-1301800	163400	47600	325200	605000	-796220	-379929	48706.68	157537.2	282692	346621	592138	1861000	1861000	1781000	1597000	1597000	1597000	1517000	1333000	1333000	1333000	1333000	1253000	1333000
IRR after Financing/Employment		%	21%																										

Notes:

** Figures based primarily on Bideo/Wilmar information, and/or Formulation and Appraisal Report data, updated with present cost/price values; and Consultants estimates

** The low performance scenario envisages a situation where the individual growers undertake own management with minimal input use after establishment and high costs of field and transport operations; probably typical of spontaneous growers

1 Land preparation and planting labour of 85 workdays per hectare assumed to be part family/part hired

2 Harvesting and transport labour costs included in category below, see note 11

3 Assumes final plant population of 148 palms/ha; and normal use of legume cover crop for early years of establishment

4 Estimated at 10% of field labour costs for field management tools only, excludes harvest tools, see below

5 Lump sums are overall estimates of costs by Bideo and/or Consultants, covering all operations of field mechanisation and infrastructure maintenance for the outgrower sector, but here reduced to half to reflect family labour use

6 Use of trucks for initial establishment operations only

7 Financing costs based on credit calculations as above for years 1 to 5 for disbursement; and years 6 to 12 for recovery

8 Excludes harvesting labour and transport variable costs and administration costs, treated as deductions from gross sales value below

9 Yield build-up -- in kilograms of fresh fruit bunch (ffb) -- based on poor performance of palm and only rudimentary field management

10 Price of UGSh 150 per kg ffb based on outgrower entitlement of USD 90A, using pricing formula where the constant J is 1.25 and fob price of crude palm oil is USD 428 per tonne, but with 17% reduction to reflect probale poorer quality

11 Harvesting labour use and costs assume poor efficiency of working and current/prospective semi-skilled labour rate based on USD 2 per workday

12 Harvesting materials, tools and equipment based on cost of tools and wheel barrow of US$ 40, replaced every five years

13 Assumes tractor hire rates for field transport of ffb

14 Based on half of Bideo estimate of USD 100/ha/year for Company management and technical services provision costs for outgrower operations

15 Net Cash Flow includes cost of labour; direct costs of establishment calculated on this basis amount to UGSh 4.18m, equivalent to USD 2090/ha

16 Family cash flow assumes that Field Labour provided by family and therefore household returns include the value of that labour input

17 Drawdown of "credit" will be entirely in the form of inputs and works for crop establishment derived from total inputs and field services costs for first five years

18 Interest due is calculated on the basis of simple interest on the cumulative debt balance from year to year at 15% per annum and interest due is capitalised until final repayment starts in year 6

19 Repayment of loan/benefits based on total amount outstanding plus subsequent interest to be recovered in seven equal instalments from year 6

20 Assumes new small farm taking up oil palm has from 200 to 100 days per year available for nucleus estate casual employment, taking account of family labour added back for oil palm work -- and other crop demands

Source: VODP Review/Re-Appraisal Report 2003