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Original English

ASSESSMENT OF CONTROL MEASURES FOR NYPA PALM INFESTATION IN NIGERIA

FINAL REPORT

Prepared for the United Nations Industrial Development Organization

Based on the work by

Bioresources Development and Conservation Programme (BDCP)

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United Nations Industrial Development Organization, Vienna.

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EXECUTIVE SUMMARY

A) BACKGROUND

A1) Global Distribution of Nypa

Nypa palm is one of the oldest angiosperm plants and probably the oldest palm species. Eocene and miocene fossil findings in Europe, North America and the Middle East and the Paleocene strata in Brazil suggest that Nypa palm had a pantropical distribution 13-63 million years ago. Today it is mainly found in the equatorial zone, 10°N-10°S, stretching from Sri Lanka through South-East Asia to North Australia. The largest natural Nypa stands are found in Indonesia (700 000 ha), Papua New Guinea (500 000 ha) and the Philippines (8000 ha). The northernmost natural occurrence is on the Ryukyu Islands of Japan and the southernmost in North Australia. In South-East Asia, Nypa palm is also cultivated.

A2) Introduction to Nigeria

The Nypa palm *(Nypa fruticans)* had been introduced by the British colonial government from Singapore Botanical Garden into the Cross River Estuary in the former Eastern Nigeria, to Calabar in 1906 as well as Oron and Opopo in 1912 (Key, 1953). Other oral sources relate that Nypa was introduced to check coastal erosion and that it enjoyed total protection by law. There are anecdotal accounts that people were prosecuted and imprisoned by the colonial administration for as much cutting a frond of the palm. It has now spread westwards along the coast down to latitude 40E. By the early 1990s Nypa had been recognised as a serious invasive "weed" (see King 1999).

The presence of Nypa palm seems to have first been reported in the public sector by NEDECO (1961) (quoted in Powell 1993). Powell (1993), in his personal estimation, in the intervening period between 1975 and 1990, did not consider Nypa a problem in the survey area (central axis of the Niger delta, principally Bayelsa state) nor indeed, anywhere in the Niger Delta.

Fig1 (a) and (b)- Topical example of an infested coastal environment with Nypa palm

A3) Biology, Life History and Spread

After maturing, the fruits of Nypa are usually pushed off from the infructescence by the developing plumule. They float on tidal water and start growing on suitable substrate. The radicle is probably aborted and the first root that appears is likely to be the first adventitious root. The seedling is prostrate first, but after being attached to the substrate, the plumule becomes erect and additional adventitious roots arise from the lower part of the stem. First flowering occurs 3-4 years after germination. Flies effect pollination. In a mature Nypa palm stand, normally about one quarter to one half of the palms produce flowers or fruits. The fruits mature in 5-9 months. In young fruits the endosperm is liquid, becoming solid in older ones. Frequently, more than one infructescence develops simultaneously per plant.

A4) Baseline Studies

Below are some of the efforts/studies made by the Nigerian Government along with Oil Companies and other international bodies:

I. The NNPC/RPI Study

A baseline study of the environmental condition was thought necessary and thus carried out by the lead government Agency in the petroleum industry, the Nigeria National Petroleum Company (NNPC) early in its operations (NNPC and RPI 1986). The environmental baseline studies were conducted for the purpose of establishment of control criteria and standards against related pollution in Nigeria. Vegetation components were part of the terms of reference. The incidence of Nypa was recorded in several river systems: the Egwa field of Chanomi creek in the Forcados/Warri River System; in the Warri field, the plant community was a combination of freshwater and mangrove species and included species such as *Cocos* and *Raphia*; all these reports seem to be associated with conditions in which

the original vegetation was subjected to some perturbation. Other river systems in which Nypa was found in the vegetation survey in the Niger delta included, Imo, Calabar and Sombreiro River.

II. The NARESCON Study

The Natural Resources Conservation Council (NARESCON) was created as a body to ensure the ecological well-being of Nigeria. The attitude of NARESCON to the *Nypa palm* problem was to facilitate an investigation into the matter and based on empirical data take necessary measures.

1.0 Findings of the NARESCON Study

The study was designed to capture data in the wet and dry seasons. This was meant to investigate issues of seasonal variations on the aquatic ecosystem and the study terms of reference. Eventually, only one season study was carried out. The major findings were as follows:

- Nypa palm is negatively associated with other plant species
- Nypa palm is associated with acid soil reaction
- *Fin-fish and shell fish* productivity is negatively correlated with the presence of Nypa palm
- Nypa palm provides no important monetary returns to the communities resident in the area of study
- Clearing of Nypa palm manually had no appreciable impact on Nypa palm

III. Federal Environmental Protection Agency

A thematic report, under the Large Marine Ecosystem Project for the Gulf of Guinea, Coastal Profile of Nigeria recognizes Nypa palm as an integral part of the mangrove ecosystem. It contends however, that in the Calabar and Cross River estuaries, the exotic Nypa palm has displaced the mangrove vegetation

IV. Federal Ministry of Agriculture Activities

The Federal Ministry of Agriculture and Rural Development (FMARD) was part of the national effort at resolving the Nypa palm dilemma. This was carried through the National Council on Agriculture (NCA). In its 29th session which held at the Sheraton

Hotel and Towers (27th-31st October, 1999), Council identified among its "Issues for Immediate Action" "**Control of Nypa palm in Mangrove**". It further directed the Federal Department of Fisheries to "contact Federal Ministry of Environment and NASENI". It however dispersed the activity among the following departments in the Ministry Fisheries Department and Planning Research Statistics Department.
Subsequently, a National Committee was established "to look into the problems and control of Nypa palm in the affected areas in Nigeria. The committee was made of Akwa Ibom, Rivers, Bayelsa, Delta states and National Institute of Freshwater Fisheries Research (NIFFR). A Nypa Palm Technical Committee was launched eventually and toured sites in the states.

B) ACTIVITIES:

B1. Project Step 3: Review of options for the control of Nypa Palm, including mechanical clearance and utilization

Activity 1: Carry out a literature/web research.

Activity 2: Hold a Stakeholders meeting/workshop:

This will be attended by representatives from government and non-governmental organizations, committee members and representatives of the local communities as well as an invited international expert. This workshop is a key component to assess and validate data on the various options for the control of Nypa Palm. The major objectives of the Workshop will include

- exploring the extent of infestation of the mangrove forests by Nypa Palm along the Nigerian coast
- sharing of some information resources and work done
- explore decision-making and research needs
- review the options on the appropriate actions to be taken- be it mechanical clearing or/and utilization
- elicit the willingness of the stakeholders in assisting with the next project phase

Activity 3: Compile options for the control and utilization of Nypa Palm.

The working groups formed during the meeting will be required to submit their report which will be compiled into a final document on the actions to be taken for Nypa Palm control and utilization.

B2. Project Step 4: Investigation of the Potential Diverse Uses of Nypa Palm

Activity 1. Research on the diverse uses of Nypa Palm through pilot projects. These pilot projects will be carried out practically and will attempt to overcome the present labour constraints e.g. through the use of climbing devices that enable the tapper to tap twice as many palm trees. However, long-term pilot projects such as ecological rehabilitation involving replanting of mangrove seedlings in originally Nypa invaded plots will also be suggested.

Activity 2. Determine practically the suitability of the uses learnt from the Expert to the Nigerian system.

Also to be determined practically are the uses learnt from the travel and through the International expert. Suggested Nypa Palm control methods will also be assessed to determine that most suited to the Nigerian ecosystems.

There will be an attempt to review in detail, all **indigenous knowledge** related to the use of Nypa for sugar and animal production. This would permit a major breakthrough for assessing the future potential of these trees and for sharing techniques and experiences between regions and countries. Many rural areas are likely to benefit from a new source of self-employment and sustainable income once the potential of tapping Nypa palm trees for sugar and animal production has received the full attention it deserves from decision makers through funding research, selection, technology improvement, training and extension and small credit for farmers.

Activity 3: Demonstration Projects/Hold workshops with the coastal communities to demonstrate such uses: During the workshops, practical demonstrations will be carried out on the above listed uses.

The workshop will feature training, skills development and capacity building of local community people to utilize Nypa in the production of domestic and commercial products- ear-rings, necklaces, roofing mats, key-holders, bags, caps etc.

Further more the workshop/seminar will act as a means of awareness creation and education on the threat of Nypa to the coastal ecosystem and measures to be taken such as to stop transplanting of Nypa along fishing camps in the coast, since the very Nypa seedling that is removed from these waters was an opportunity for mangroves to regenerate. Also the replanting of mangrove seedlings in originally Nypa invaded plots in rehabilitating the mangrove will be encouraged.
The best way of carrying out clearance of the Nypa palm will also be demonstrated such as- to clear/cut Nypa palm stands; pack debris and carry out prescribed burning; pick floating and trapped seeds and dispose; as well as control the resprouting of cut Nypa palm stumps.

Activity 4: Document the work in the form of a practical guide to the effective utilization and control of Nypa palm.

B3. Project Step 5: Proposal of a scheme of work for an indepth assessment to confirm the reported uses and to establish further transformation products from Nypa Palm

Activity 1: Hold steering committee workshop with government agencies, project steering/technical/scientific advisory committees. Out of the knowledge gathered from the sites so far and their expertise/experience the committee members are supposed to develop a draft scheme of work.

Activity 2: Develop an indepth assessment method to be used in confirming the uses and in establishing further transformation products from Nypa Palm.
Here the committee's suggestions will be used in producing an indepth assessment method for confirming the uses and in establishing further transformation products from Nypa Palm.

Activity 3: Propose/Develop a detailed scheme of work to be used for the above: A final scheme of work will then be developed for an indepth assessment to confirm the reported uses and to establish further transformation products from Nypa Palm.

This document summarises the work of four field teams working in different cultural and geographic settings. The teams surveyed the coastal States of Nigeria; Akwa

Ibom, Bayelsa, Cross River, Delta, Edo, Ondo and Rivers States. The teams determined the status of Nypa infestation in each State and delineated the extent of Nypa colonisation within the States.

A single species *Nypa fruticans*, the mangrove palm, a large, gregarious, creeping, unarmed, pleonanthic, monoecious palm was found to have a significant presence in all seven States surveyed with particularly heavy incidence in Cross River, Akwa Ibom, and Rivers States.

Observations:

Nypa was introduced into Nigeria in the early 19th century. However, characteristic Nypa pollen in the Senonian (upper Cretaceous) of tropical West Africa and Borneo represents some of the earliest records of palms. Nypa fossils are pan – tropical in distribution including southern Unites States of America suggesting a remarkably wider global distribution than its present distribution.

Nypa palm thrives best in brackish water environments. However, it has been observed in fresh water environments at Uya – Oron in Akwa Ibom State, Akpabuyo in Cross River State and in various fresh water swamps in Delta State. Optimum conditions are when the base and the rhizome of the palm are regularly inundated by brackish water.

The incidence of Nypa infestation in Akwa Ibom State is generally heavy particularly in Ikot Abasi, Mbo, Oron Oruk Anam, Udung Uko and Okobo local governments showing optimum growth in brackish water areas. On the marine coast at Ibeno, for example, Nypa stands are not very dense but there is an active colonisation of the area.

Nypa is widespread in the coastal areas of Cross River State. Nypa grows in almost pure stands in most locations including fresh water areas such as in Akpabuyo area. Some communities (Ine-Efik, Mkpasirike, and Edik Ekpu) in this State claim that Nypa is useful to them as food supplement, (as they eat the fruits like coconut), that Nypa stands are very good habitat for fish nursery and that Nypa stands provide protection for the community/settlement against storms. These communities will not

support complete eradication of Nypa however, they would be happy to find more economic uses for the palm.

In Port Harcourt and Kono (Rivers State), Nypa stands are extensive, dense and mature. Other locations around River's State have light patchy to medium infestation. In Bayelsa State, Nypa occurrence is widespread albeit in small patches. Patches of young Nypa were seen from Yenagoa to Akassa.

In Edo and Delta States, Nypa infestation is still in the early stages. However, where there is selective removal of mangroves or other disturbance, dense stands were observed while in Ogun and Ondo States Nypa infestation is recent and not yet extensive.

Generally, the palm has no uses apart from its use as thatch; though some communities in Ondo use its sap in concoctions for the treatment of malaria and its leaves as cattle feed. While communities in Cross River State value it for storm protection to their settlements.

There had been past efforts by certain organizations such as the Nigerian Conservation Foundation (NCF) to promote the use of Nypa palm for other uses. These uses include the experimental use of the hard shell (Endocarp) in the making of buttons necklaces and other fashion apparels as well as domestic materials. For this strategy to make a reasonable impact on the population of the palm, a market chain for sale of these products must be developed.

The palm, however, exerts a negative impact on the mangrove ecosystem through its ability to out compete and repress other mangrove species, leading to a loss of biodiversity and ecosystem function.

While the ecological need to control the spread of the plant was obvious to experts, some communities consulted during this study do not share this view.

Strategies for control, repression, or eradication in line with community perceptions are discussed.

The following are the Terms of Reference covered in this project:

The first step is to DELIMIT AND QUANTIFY THE EXTENT OF INFESTATION OF THE MANGROVE FORESTS BY NYPA PALM ALONG THE NIGERIAN COAST.

The second step is to DOCUMENT THE IMPACT OF NYPA PALM INFESTATION ON THE MANGROVE SUB-ECOSYSTEM OF COASTAL NIGERIA AND ON THE LIVELIHOODS OF COASTAL POPULATIONS.

The third step is the REVIEW OF OPTIONS FOR THE CONTROL OF NYPA PALM INCLUDING MECHANICAL CLEARANCE AND UTILIZATION.

The fourth step is the INVESTIGATION OF THE POTENTIAL DIVERSE USES OF NYPA PALM.

The fifth step is the PROPOSAL OF A SCHEME OF WORK FOR AN INDEPTH ASSESSMENT TO CONFIRM THE REPORTED USES AND TO ESTABLISH FURTHER TRANSFORMATION PRODUCTS FROM NYPA PALM.

The sixth step is to SUBMIT A COMPREHENSIVE REPORT TO UNIDO.

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LIST OF ACRONYMS AND ABBREVIATIONS

BDCP- Bioresources Development and Conservation Programme (BDCP)

CBO - Community Based Organization

DELSU- Delta State University

ENDA - The Eastern Nigeria Department of Agriculture

FMEHUD- Federal Ministry of Environment, Housing and Urban Development

FMST- Federal Ministry of science and Technology

GCLME- Guinea Current Large Marine Ecosystem

GEF- Global Environmental Facility

GIS - Geographic Information Systems

IOC- Institute of Oceanography

LGA - Local Government Area (LGA)

MFCSN- Mangrove Forest Conservation Society of Nigeria

NARESCON - Natural Resources Conservation Council

NASENI - National Agency for Science and Engineering Infrastructure

NCA - National Council on Agriculture (NCA)

NCF - Nigerian Conservation Foundation

NDHERO- Niger Delta Human and Environmental Rescue Organization

NIOMR - Nigerian Institute for Oceanography and Marine Research

NIFFR - National Institute of Freshwater Fisheries Research

NIFOR- Nigerian Institute for Oil Palm Research

NNMDA- Nigeria Natural Medicine Development Agency

NNPC - Nigeria National Petroleum Corporation

NGO - Non-Governmental Organization

pH - pondus de Hydronium

OSOPADEC- Ondo State Oil Producing Areas Development Commission

RPI - Research Planning Institute

SPDC- Shell Petroleum Development Coorporation

UNICAL- University of Calabar

UNEP- United Nations Environmental Programme

UNIDO - United Nations Industrial Development Organization

SECTION 1

Extent of Infestation of the Mangrove Forests by Nypa palm along the Nigerian Coast

Introduction

1.1 The mangrove ecosystem

Mangrove vegetation is almost entirely woody and varies in height from low shrubs to heights over 30m. Structurally, the mangrove forests, which occur in brackish conditions, are characterized by a closed stand of single layer of trees, with *sclerophyllous* leaves. The most prominent physiognomic features of the mangrove forest are the prop roots of *Rhizophora*, the pneumatophores of *Avicennia*, and other genera, all of which serve as breathing roots, while the prop roots of *Rhizophora* also serve as anchorage. The prop roots also allow the passage of water and nutrients into the plant while acting as filters against the usually high salt content of the brackish mangrove environment. The pneumatophores may assume either finger – like or looped forms. The straight, finger–like roots, which are negatively geotropic, are found in *Avicennia*. Looped roots are found in numerous species of the mangrove as well as in *Mitragyna* in the fresh water swamps. Another feature is the germination of the seeds of *Rhizophora* species while they are still attached to the parent tree (vivipary). Through this process, the young seedlings develop a massive hypocotyls and drop from the parent tree into the soft alluvium of the mangrove swamps where it anchors and grows. The growth of mangrove plants usually influences the ecosystem by contributing litter as well as trapping litter from tidal sources. Deposits of such and peaty clay may eventually develop into compacted, hard soil known as Chikoko. Chikoko is high in ferrous sulphides and is characterized by unpleasant gases (oxidized sulphur) that accumulate in anaerobic conditions. The combined effect of salinity and high acidity is the limitation of other vegetation not adapted to these conditions. Hence, fewer species are found in mangrove swamps compared to other tropical formations.

On both east and west coasts, palms play a significant role in the transition from mangrove to other terrestrial vegetation (Chapman, 1976). On the east coast, *Phoenix reclinata* is found, while *P. spinosa* is associated with the West coast.

Associated with the main mangrove formation is a group of halophytes that may grow at the edge of the mangrove swamp, mainly near the sea board (Keay, 1959)

or mixed with mangroves. This vegetation may have a complex flora dominated mainly by shrubs such as *Conocarpus erectus*, *Drepanocarpus lunatus*, *Dalbergia ecastophyllum* *Hibiscus tiliaceous*, *Phyllanthus muellerianus*, *Chrysobalanus orbicularis* and *Thespesia populnea* with the herbs *Ipomoea pescaprae* and *Telanthera maritime.*

The fresh water swamp forest replaces the mangrove forest landwards. Terrestrial swamp forest, close to water edge and/or adjoining the mangrove `forest may be dominated by species of *Raphia*, *Pandanus*, *Calamus*, *Alchornea*, *Alstonia*, *Carapa*, *Spondianthus*, *Mitragyna*, *Oxystigma*, *Cleistopholis*, *Uapaca*, and *Garcinia*.

The mangrove is regarded as a hydro – sere which succession leads to the stabilisation of coastal land formations. Exploitation patterns as well as species invasions that may lead to extensive removal or limitation in the growth of woody element may reverse this succession.

1.2 Biology of invasions

The dispersal of plants has been recognized as a natural corollary of the journey of discoveries of the 1500s (Castri, 1989). A breakdown of bio – geographic barriers has been on the increase with technological advances in transportation. An interchange of the world's biota has thus resulted as man moves around with goods. Biological invaders are either purposely carried by man or inadvertently accompany them (Mooney, et al 1989).

1.2.1 Characteristics of successful invaders

Invasive species have certain intrinsic attributes. These characteristics usually provide them with advantages compared to native species.

- Generally, successful invaders have a high population growth rate,
- Disturbed areas usually have more resources and are open niches for invasive species to occupy. More critical however, ecosystems with low native species diversity are thought to be more prone to invasions than more diverse ecosystems.
- A lack of natural enemies for a possible invader in an ecosystem predisposes such an ecosystem to invasion.

- A high spread rate is another quality of successful invaders. This is a natural corollary of the fact that if a species spreads quickly and in large numbers the chance to reach appropriate habitats increases. Under such circumstances, control measures will need to reach the species in all invaded areas at the same time, an often – difficult task.
- Vegetative reproduction is a favourable characteristic of invader plant species.
- A particularly troubling quality of plant invader species is the ability to maintain itself at low densities until conditions become favourable

1.2.2 Vulnerability of Ecosystems

Pre – disposing characteristics of ecosystems to invasion relate to the availability of resources such as light and moisture. Ecosystems that are in early stages of succession usually have high amounts of available resources and might be predisposed to invasion.

1.3 Nypa

1.3.1 Taxonomy and Nomenclature

Family: PALMEA

Genus/Species: *Nypa fruticans*

Common Names: Nypa palm; Nipa palm

Local names:

Efik: Nkaya mbakara

Ibibio: Ayang mbatang (Oron); Ayang mbakara, (more general Ibibio)

Yoruba: Ope-jaja

Synonyms: *Nipa fruticans* Thunb, *Nipa fruticosa* Lam., *Nipa litoralis* Blanco, *Cocos nypa* Lour.

1.3.2 Botanical Description

A large, creeping, unarmed, pleonanthic, monoecious palm. Stem prostrate or subterranean (rhizome), up to 45 cm in diameter, branching dichotomously at regular intervals, with curved leaf scars above, and roots along the underside. Leaves in tufts of 3-5 per plant, erect, 4.5-14.2 m long, simply pinnate; petiole very stout, up to 1.5 m long, channelled adaxially, terete distally, dilated towards the base into a short

sheath; leaflets up to 163 per leaf, linear, single – fold, 1.2-1.5 m x 6.5-8.6 cm, coriaceous, midrib bearing appressed brown scales on lower surface. Inflorescence solitary, interfoliar, erect, branched, multibracteate, protogynous, up to 2.1 m long with a stout, terete, up to 2.4 m long peduncle; rachis usually shorter than the peduncle, terete, terminating in a globose head of female flowers surrounded by numerous, short, catkin-like rachillas (spikes) terminating the lateral branches and bearing densely crowded, spirally arranged, solitary male flowers, most branches subtended by large, tubular, rubbery bracts protecting flowers and fruits; male spikes usually in pairs, cylindrical, often slightly curved, up to about 5 cm long; flowers extremely dimorphic but 6 perianth parts

Figure 2. Inflorescence (male "catkins" and female globose) head

similar for both sexes; male flowers with 3 stamens, filaments united into a column, without pistillodes; female flowers without staminodes; carpels (pistils) 3, distinct, much longer than perianth, irregularly polyhedric, curved and angled, with a funnel-shaped stylar opening. Fruiting head subglobose, up to 40 cm in diameter, fertile and partially developed fruits intermixed; fruit a drupe, developing from carpel, compressed and irregularly angled, pyramidal, 10-15 x 6-8 cm, brown to blackish, exocarp smooth, mesocarp fibrous, endocarp thick and composed of interwoven fibrous strands. Seed broadly ovoid, grooved adaxially, hilum basal, endosperm homogeneous. Germination is on the infructescence (viviparous), with the plumule exserted and pushing the fruit away. Eophyll bifid or with several leaflets.

1.3.3 Ecology

Nypa is strictly a mangrove palm, occurring in a variety of estuarine situations; it usually
grows in soft mud, often in vast natural stands.

1.3.4 Ecological threat significance:

Typically, Nypa palm forms pure stands, "crowding out" other "native" mangrove trees. In the understorey some *Acrostichum* and *Crinum* species may be found. Nypa palm swamp soils are muddy and rich in alluvial silt, clay and humus; they have a high content of various inorganic salts, calcium, and sulphides of iron and manganese, contributing to the typical odour and dark colour. The pH is around 5; oxygen content is low with the exception of, perhaps, the topmost layers. The displacement of the "native" mangrove by Nypa results in loss of species such as shellfish that normally encrust on mangrove aerial roots. The loss of biodiversity and the loss of resources by human communities build around these swamps, due to this phenomenon, have not been estimated but are undoubtedly enormous.

1.3.5 Global/Historical Distribution

A single species *Nypa fruticans*, the mangrove palm, its present distribution extends from Sri Lanka and the Ganges delta to Australia, the Solomon Islands, and Ryukyu Islands. It was introduced into Nigeria in the early 19th century. However, fossil record from Brazil, Europe India and Borneo suggest a wider distribution during the upper Cretaceous. Characteristic Nypa pollen in the Senonian (upper Cretaceous) of tropical West Africa and Borneo represents some of the earliest records of palms. Nypa fossils are pan tropical in distribution including southern U.S., South America and Europe, a remarkably expanded record compared with its present distribution

1.3.6 Biology, Life History and Spread

After maturing, the fruits are usually pushed off from the infructescence by the developing plumule. They float on tidal water and start growing on suitable substrate. The radicle is probably aborted and the first root that appears is likely to be the first adventitious root. The seedling is prostrate first, but after being attached to the

substrate, the plumule becomes erect and additional adventitious roots arise from the lower part of the stem. In very young seedlings the leaves are arranged distichously but later they become arranged spirally. At first, up to 8 bladeless sheaths develop per plant, followed by the first juvenile foliage leaves 3-6 months after germination. During early growth the stem grows obliquely downwards to form the "rhizome". About 1 year after germination the rhizome starts branching dichotomously and a new plant develops vegetatively on each branch. This branching pattern gives rise to the Nypa palm 'colony' structure of a mature stand, in which older rhizome parts decay simultaneously while dichotomous divisions produce new plants. There is also a constant decay of old leaves and formation of new ones throughout the life of a Nypa palm, which is estimated to be about 50 years. First flowering occurs 3-4 years after germination. Flies effect pollination. In a mature Nypa palm stand, normally about one quarter to one half of the palms produce flowers or fruits. The fruits mature in 5 – 9 months. In young fruits the endosperm is liquid, becoming solid as it grows older. Frequently, more than one infructescence develops simultaneously per plant.

Nypa palm thrives best in brackish water environments. However, it has been observed in fresh water environments at Uya – Oron in Akwa Ibom State, Akpabuyo in Cross River State and in various fresh water swamps in Delta State. Optimum conditions are when the base and the rhizome of the palm are regularly inundated by brackish water. For this reason, Nypa palm occupies estuarine tidal floodplains of rivers.

1.4 Advent of Nypa palm in Nigeria

Nypa was introduced into Nigeria in the early 1900, specifically, Oron 4.8^0N 8.2^0E in 1906 and Calabar in 1912 (Hutchinson and Dalziel, 1972). It has now spread westwards along the coast down to latitude 4^0E. By the early 1990s *Nypa* had been recognized as a serious invasive "weed".

Several reasons have been adduced for the introduction of Nypa palm into Nigeria. Oral sources relate that Nypa was introduced to check coastal erosion and that it enjoyed total protection by law. There are anecdotal accounts from Opobo that

people were prosecuted and imprisoned by the colonial administration for cutting a frond of the palm.

Coastal erosion and mangrove loss was associated with the wave action and destruction of the coastline when commercial shipping became prevalent in the colonial administration in the south eastern parts of Nigeria. The introduction of Nypa for coastal stabilization is thus plausible. This was probably done about 1906 and seeds were introduced from the Singapore Botanic Gardens (Hutchinson and Dalziel, 1972).

The other reason, often given to explain the introduction of Nypa to Nigeria is that it was introduced as a source of food. The Eastern Nigeria Department of Agriculture (ENDA) did a wave of introductions as recently as 1945 when seedlings of various species were imported. If Nypa was introduced as an agricultural crop for food it should be viewed along the other successful introductions such as, groundnut (*Arachis hypogea*), oranges (*Citrus sp*), plantain, banana (*Musa spp.*) etc. Rubber (*Hevea brasilensis*) a successful economic crop was introduced during this period. It should be recalled that by 1945, improved varieties of cassava were not yet available and subsistence farming was a difficult enterprise as cassava cultivars available at that time, took a few years to mature. A plant introduced as a potential food crop at that time would have been aimed to supplement cassava. Nypa hardy performed this function. This proposal of using Nypa as an additional source of food has not been realized.

Other suggested reasons for the introduction of Nypa include its use as an aesthetic/ornamental plant.

1.5 Previous studies/interventions for the control of Nypa palm in Nigeria

1.5.1 The NNPC Study

In 1985, the Nigeria National Petroleum Corporation (NNPC) carried out environmental baseline studies as part of its early baseline data gathering. These environmental baseline studies were conducted for the purpose of establishing control criteria and standards against possible pollution related to its operations.

Vegetation surveys were part of the terms of reference of these studies. The incidence of Nypa was recorded in several river systems in the country (see RPI 1985).

Nypa was reported as being present in Chanomi creek in the Forcados/Warri River System. In the same river system, Nypa presence was reported in Warri. Here, the plant community was a combination of freshwater and mangrove species and included species such as *Cocos* and *Raphia*. In these reports Nypa infestation seemed to be associated with conditions in which the original vegetation was subjected to some perturbation.

Other river systems in which Nypa were found in the vegetation survey in the Niger delta included, Imo, Calabar and Sombreiro Rivers.

In Imo River, Nypa was said to have out–competed native mangrove species in large areas, where it was in dominance 30 km inland from the shore as far as Kala Oko. At the Imo river mouth east, Nypa was found to be associated with *Avicennia africana* and *Rhizophora racemosa*.

The Calabar port complex was reported then to have "a few scattered trees" of Nypa. At the confluence of the Calabar and Uyama rivers, Nypa was found in association with species as varied as *Crudia klainea, Carapa procera and Ficus sp.* The presence of nipa in association with such freshwater swamp species was remarkably noteworthy. Similarly in Sombreiro River mouth east nipa was found growing in association with *Cocos nucifera, Raphia vinifera and Rhizohora racemosa.*

1.5.2 The NARESCON Study

The Natural Resources Conservation Council (NARESCON) was created as a body to ensure the ecological well – being of Nigeria. The attitude of NARESCON to the nipa problem was to facilitate an investigation into the matter based on empirical data, and to take necessary measures towards its control.

BOX 1.1: Terms of Reference, NRCC Nypa Palm Study, 1992	
i.	Study the distribution, regeneration and ecology of mangrove and nypa
ii.	Study soil ecology and chemistry in relation to nypa palm regeneration and establishment
iii.	Determine the impact of *Nypa fruticans* on the socio-economics of riverine communities
iv.	Determine the impact of nypa on fisheries productivity in mangrove ecosystems colonized by *Nypa fruticans*
v.	Suggest methods of control

A committee was set up under the supervision of the South–West Zonal Conservation Monitoring Centre, operating from Lagos. For ease of operations, the coast was divided into three portions, the Western Coast, Central Coast and the Eastern Coast. These approximated roughly to the following States:

a) Western Coast – Lagos, Ogun and Ondo,
b) Central Coast – Delta, Bayelsa and Rivers States and
c) Eastern Coast – Akwa Ibom, Cross River.

1.5.3 Findings of the NARESCON Study

The study was designed to capture data in the wet and dry seasons. This was meant to investigate issues of seasonal variations on the aquatic ecosystem and the study terms of reference. Eventually, only one season study was carried out. The major findings were as follows:

- Nypa is negatively associated with other plant species
- Nypa is associated with acid soil reaction
- Fin–fish and shell fish productivity is negatively correlated with the presence of Nypa
- Nypa provides no important monetary returns to the communities resident in the area of study
- Clearing of Nypa manually had no appreciable impact on Nypa.

1.6 Federal Environmental Protection Agency

A thematic report, under the Large Marine Ecosystem Project for the Gulf of Guinea, Coastal Profile of Nigeria recognizes nipa as an integral part of the mangrove ecosystem. It contends however, that in the Calabar and Cross River estuaries, the exotic nypa palm has displaced the mangrove vegetation

1.7 Activities of the Federal Ministry of Agriculture

The Federal Ministry of Agriculture and Rural Development (FMARD) was part of the national effort at resolving the nipa palm dilemma. This was carried through the National Council on Agriculture (NCA). In its 29th session which held at the Sheraton Hotel and Towers Abuja (27th-31st October, 1999), Council identified among its "Issues for Immediate Action" **"Control of Nypa palm in Mangrove"**. It further directed the Federal Department of Fisheries to "contact Federal Ministry of Environment and NASENI". It however, dispersed the activities among the Fisheries, Planning, Research and Statistics Departments of the Ministry.

Subsequently, a National Committee was established "to look into the problems and control of Nypa palm in the affected areas in Nigeria. The committee was made of representatives of Akwa Ibom, Rivers, Bayelsa, and Delta States and National Institute of Freshwater Fisheries Research (NIFFR). A Nypa Palm Technical Committee was launched eventually and toured sites in the states.

The following are the findings of the Committee's working groups:

- In Port Harcourt, Marine Beach and Abuloma Road (eastern bye-pass) were shown to be heavily impacted,
- Other impacted sites in Rivers State include Bonny River, Andoni River, Ngwo River, and Imo River,
- The committee also visited Akwa Ibom state and listed the following as heavily infested: Ikot Abasi, Ebughu, Ibaka and Utaewa.

SECTION 2

Impact of Nypa Palm Infestation on the Mangrove Sub-ecosystem of Coastal Nigeria

Preliminary Findings from the Current Study

2.1Akwa Ibom State

The survey was launched from the National Museum Oron mini-port, at Geographical Positioning System (GPS) reading - N 04^0 82.644 and E 008^0 23.168.

2.1.1 Nypa Palm Incidence

The incidence of Nypa infestation in Akwa Ibom State is generally heavy particularly in Ikot Abasi, Mbo, Oron Oruk Anam, Udung Uko and Okobo local governments (see Fg.2.2)

Fig 2.1a- Nypa palm found at the bridge along Ikot-Abasi market road

At Ikot-Abasi, large-size Nypa palm colonies were found growing at the newly constructed bridge along market road at N 04^0 57.281 and E 007^0 55.052. The trading post of the Royal Niger Company, where it first docked on arrival to Nigeria is located a few meters away. The Akwa-Ibom boat yard dock is also situated beside the trading post on the bank of the Opobo channel, which is the boundary area with Rivers State. It is also said to be the third place where Nypa palm was planted after Oron and Calabar.

2.1.2 Status of Nypa infestation in Akwa Ibom State

Nypa infestation in Akwa Ibom State is extensive. It thrives best and forms extensive stands in brackish water areas. In this study, young Nypa stands were observed in seasonally fresh water areas at Uya–Oron and fresh water areas along the Cross River and Imo River. Optimum conditions are when the base and the prostrate stem of the palm are regularly inundated by brackish water. On the marine coast at Ibeno, Nypa stands are not very dense but there is an active colonisation of the area (see Figures 2.1c and 2.3a).

Fig 2.1b-Nypa palm infestation as seen on both sides of Oron and Parrot Island coasts

Fig 2.1c-Totally infested Uta Ewa coastal environs

2.1.3 Impact of Nypa on the mangrove

Where the Nypa palm establishes a dense population, mangrove hardly grows. Figure 2.3b and figure below is a typical state of affairs in Oron and other heavily infested areas (see legend 9 – 10 of Figure 2.2) of the state.

Fig 2.1.d-Nypa palm infestation as seen on both sides of Oron and Parrot Island coasts

Exploration of Akwa Ibom east coast around Parrot Island, revealed equal quantity of Nypa palm infestation on both sides of the river.

Reduced level of infestation was observed as the survey team proceeded up north towards Atabong creek at N 04^0 48.719 and E 008^0 19.153. Here, mangrove is seen still struggling to survive infestation by Nypa palm.

Fig 2.1e-Surviving mangrove infested by Nypa palm at Atabong creek

Fig 2.1f-Reduced infestation and striving mangrove plants

2.1.4 Uses of Nypa in Akwa Ibom State

The people of Akwa Ibom State have not found a requirement for extensive use of *Nypa*. However, the fronds are used in thatching and in fencing. The Nigerian Conservation Foundation (NCF) has attempted experimental use of the hard shell (Endocarp) in the making of buttons necklaces and other fashion apparels as well as domestic materials (see Annex 1). For this strategy to make a reasonable impact on the population of the palm, a market chain for sale of these products must be developed.

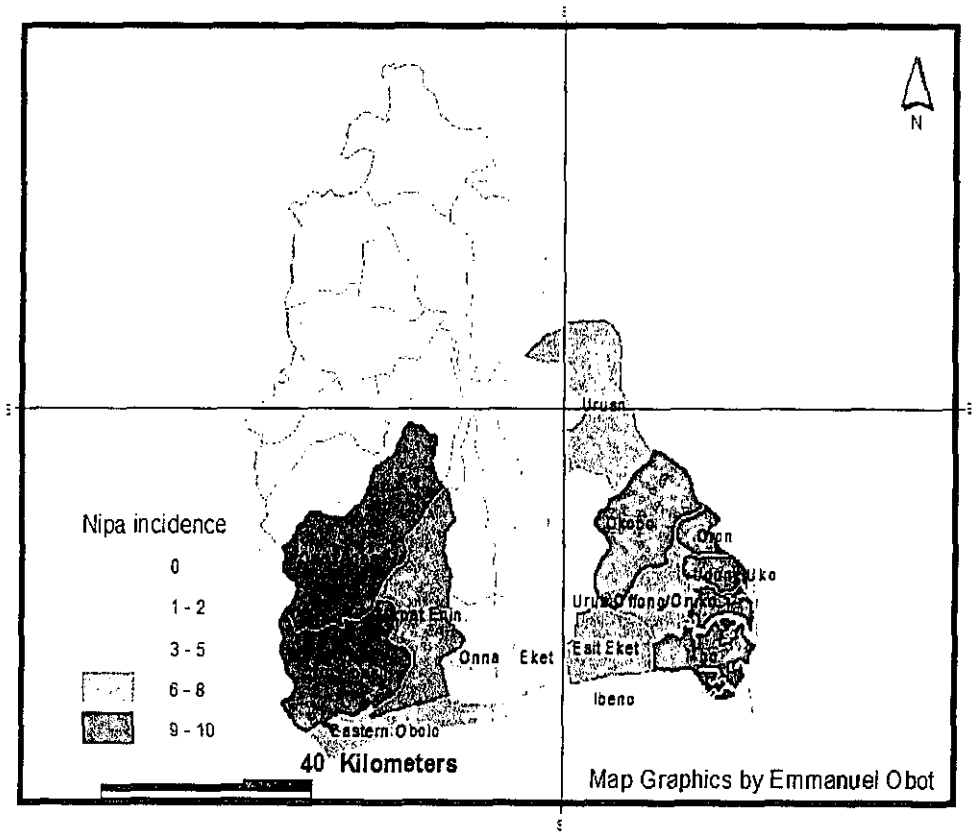

Fig 2.2 Incidence of Nipa in Akwa Ibom State

Fig 2.3a- Active Nypa colonisation at Inua Akpa, Ibeno

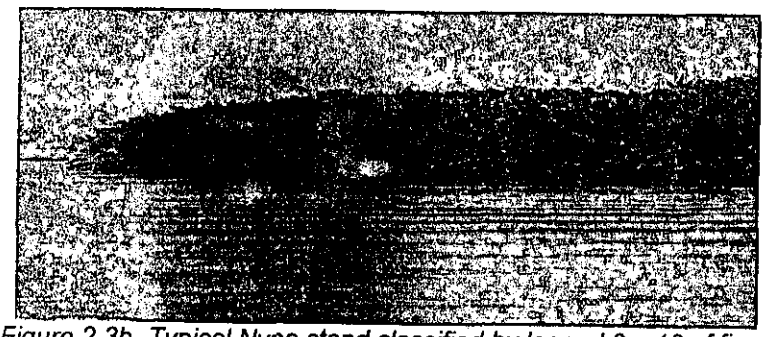

Figure 2.3b- Typical Nypa stand classified by legend 9 – 10 of figure 2.2 above. Notice the absence of other woody plants

2.1.5 Impact of Nypa on the livelihood of people

Community members interviewed on the usefulness of Nypa, preferred to discuss the uses of the mangrove in apparent display of a lack of useful information on Nypa. Mangrove, they claimed, could be used in building houses, processing fish, burnt as fuel wood and serve as habitat for fish, periwinkles, oysters and crabs.

At Iko where Nypa is referred to as 'Uwa-Joronjo', (meaning bad world), the only use for which Nypa is put is in roofing mats. However, the people expressed dismay at Nypa infestation of the coast and its perceived ability to repel fish, and other aquatic organisms from around it.

Figure 2.4 Fencing with Nypa palm fronds

2.2 Cross River state

2.2.1 Nypa Incidence

Nypa occurrence is widespread in the coastal areas of Cross River State. Nypa stands are almost pure stands in most locations including fresh water areas such as in Akpabuyo area.

The Villages/sites visited include

(i) **Akpabuyo/Bridge, Great Kwa River.**

Geographical position: Lat 04^0 56.969 N Long 008^0 23.736 E

Fig2.5 Vegetation at Akpabuyo

Fig 2.6 Harvested Nypa leaves

The pole of Nypa was not popular in construction because it is not as strong as Raphia. It was reported that Nypa displaced most other plant species, although the species was reported to play a protective role on the banks of the river.

(ii) **Anantigha Bridge** – Tidal beach with fishing activities

Geographical position-04^0 54.906 N Lat

008^0 19.363 E Long

Fig 2.7 Vegetation at Ananthiga

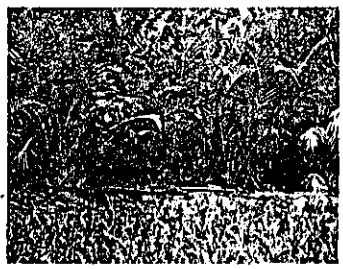

Fig 2.8 Nypa Colony

Fig 2.9 Nypa Seed.

(iii) **Aqua vistas Resort**

Geographical location- 04^0 54.896 N

008^0 19.469 E

Fig-3.0 (a-b) Nypa fruticans (forming a huge colony, almost pure)

(iv) **Ediba Beach (Timber market)**

Geographical position-$04^0$56.188 N

$008^0$18. 526 E

In the vicinity of the market, mangrove poles, native bathroom and fences constructed with Nypa were recorded.

Fig 3.1 Nypa colony at Edibe beach Cross river state.

(v) **Adiabo Bridge** (leading to Creek town) within Adiabo Community by Calabar River

Geographical position- 05^0 03.357 N

008^0 18.383 E

Vegetation listing included a pure stand of Nypa fruticans in places where the natural mangrove has been replaced by it.

Fig 3.2 Vegetation at Adiabo community

Fig 3.3 Trunkless tree Nypa with fruit

Fig 3.4 Nypa displacement of mangrove

Fig3.5 Nypa colony at Adiabo

2.2.2 Status of Nypa Infestation

All the areas visited; Akpabuyo, Anantigha, Aqua vista resorts, Edibe beach, Adiabo community, Ine-Efik, Mkpasirike, and Edik Ekpu have very high levels of Nypa palm infestation flourishing and fruiting.

A close interaction with the local communities showed that they know nothing about the plant or its uses apart from using it to thatch. Fruits are eaten like coconuts. The community claimed that Nypa stands are very good habitat for fishes to lay their eggs. No medicinal uses are known. The community also believes that Nypa stands protect them against the storm, the latter being a major problem for the communities devoid of Nypa. The community will not support complete eradication of Nypa, however, they would be happy to find more economic uses for the palm.

2.2.3 Impact of Nypa on the mangrove

The table below shows the estimated occurrence of the Nypa species with respect to the Mangrove species.

Table 1: Maximum upstream occurrence of mangrove and Nypa in the arms of the Cross River and the Calabar River

	West Arm of Cross River		East Arm of Cross River		Calabar River	
	Km from mouth of Estuary	Latitude (^{0}N)	Km from mouth of Estuary	Latitude (^{0}N)	Km from mouth of Estuary	Latitude (^{0}N)
Mangrove	52	04^{0}57'30	55	05^{0}00'50	81	05^{0}09'50
Nypa	42	04^{0}53'30	47	04^{0}59'00	48	04^{0}58'30

Table 1.Holzohner et al (2002)

In most of the sites visited, the Nypa palm had displaced the mangrove species.

2.2.4 Uses of Nypa in Cross River State

Thatching is the most popular use of Nypa. Field notes revealed that mat which was produced from leaflets of Nypa, was preferred to Raphia, being durable and stronger than Raphia, and being without thorns.

The evidence of the communities that Nypa contributes to the safety of the community from storms was noted. It is an indication of the community's ecological

consciousness that intact plant communities are important in the protection of coastal settlements from storms.

2.2.5 Impact of Nypa on the livelihood of people

Generally for Cross River State communities visited, the perception of the impact of Nypa palm with respect to their livelihood was positive, namely

- That Nypa was useful for thatch mat production, both for sale, and for local use in hut construction.
- That Nypa palm roots also provided bait for fishing.
- That Nypa stands provide protection against storms from the sea.

2.3 Edo and Delta States

2.3.1 Nypa incidence

2.3.2 Benin River

Nypa is present in the Benin River system. The infestation is at its primary stages. The mangrove vegetation here is in reasonably good condition and the stress of Nypa is not significant. Two levels of infestation are easily discernible: single stands and multiple clumps of mild to medium infestation.

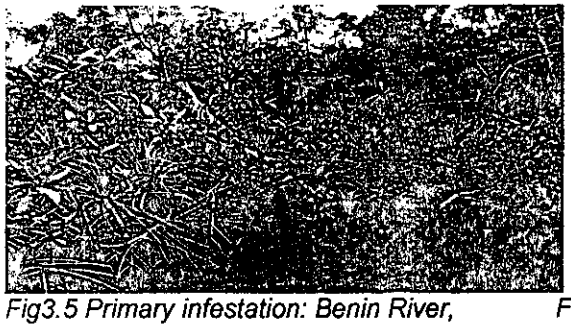

Fig3.5 Primary infestation: Benin River, Northern-most point of infestation

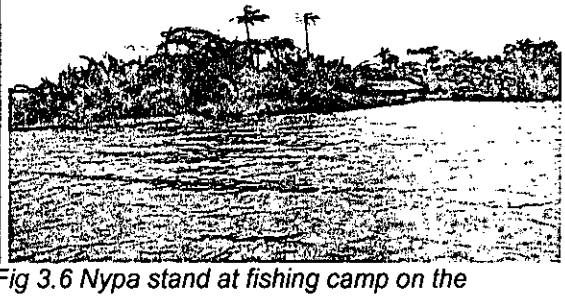

Fig 3.6 Nypa stand at fishing camp on the Benin River near Confluence with Ossiomo (GPS N0559092 and E00523174) flowing from Edo State (via Ajoki, Kolokolo and Ologbo)

2.3.3 Escravos River Basin

Some community settlements along this river system are heavily infested with Nypa. The communities/locations most heavily infested with Nypa include Ugbengogo, Ugbegogo creek, Canal settlement, Crayfish community, NNPC tank phase 3 and Chevron hangar.

Fig 3.7 Nypa palm fringing river bank between mangroves on the Forcados creek.

2.3.4 Warri/Forcados River system

Nypa is found throughout a large portion of this river system from the small creeks around Warri, along the main body of the river and up to the exit into the Atlantic. In Warri South LGA, nipa occurs as single stands or small clumps (between 1 – 5 plants) at the Ijala creek, the mangrove swamp along the expressway approach to the Port complex and behind the Federal Government College and several spots on the Warri River. Around some old dredge spoils, the nipa does not appear luxuriant. Medium stands occur around the landing beaches of Ugbwangue, the Orugbo-Ode Itsekiri creek as well as communities such as Kpisan, Aja-Eneshemi and on the coastline opposite the Nigerian Ports Authority.

The Kpisan community nipa stands are quit numerous though flowering specimens were not seen.

2.3.5 Status of Nypa infestation in Edo and Delta States

Nypa infestation in these states is still in the early stages. However, where there is selective removal of mangroves or other disturbance, dense stands were observed.

2.3.6 Impact of Nypa on the mangrove

Since these infestations were still in primary stages, no discernable effect to undisturbed mangrove sites could be determined.

2.3.7 Uses of Nypa in Edo and Delta States

There is extensive use of nypa fronds in construction of shelters and in fencing. Community members interviewed were ignorant of other uses and were not able to

relate to potential uses (such as tapping of the sap for sugar production) as they wondered how a prostrate palm without an erect stem and growing in muddy conditions could be tapped.

2.3.8 Impact of Nypa on the livelihood of people

Referred to as 'Calabar palm' or 'Calabar flower' in apparent reference to its source, Nypa has no positive impact on the livelihood of people apart from the occasional use of its fronds in construction of shelters and in fencing. The fact that Nypa presents a limitation to access, where it grows in large, difficult-to-clear clumps, may be responsible for its perceived negative impact by the local residents.

When potential uses (extraction of sugar, vinegar and alcohol) were suggested, community members indicated mild interest in learning these processes.

2.4 Ogun and Ondo States

2.4.1 Nypa incidence

Nypa palm was found in ten out of eighteen coastal communities visited. There were claims in some communities that the palms were actually planted as ornamentals. However, the Nypa is only found in small clusters.

Fig.3. 8 The Oronto cluster

Beside is a typical example as found at **Oronto.** The latter was the first sighting of Nypa during the survey. They were said to have been planted. GPS readings at about 7 metres were: Position: N = 06°.05065 E = 004° 48.174; Altitude = 8m. The soil in the area is predominantly the chikoko comprising very rich silt-clay material.

Fig 3.9 The Ikorigho stand (landscape and close-up)

At **Zion-Ikorigho** community, Position: 05°.57.390 E = 004° 55.390 altitude = 10m.

Figs 4.0 (a-c) Sighting of Nypa palm at and around Awoye community

Status of Nypa infestation

Nypa infestation in Ogun and Ondo States is recent and not yet extensive.

2.4.2 Impact of Nypa on the mangrove

Effect of Nypa on the mangrove of this zone is not significant. This is because the mangrove forests of the two states, particularly Ondo state, is very rich and vast, and as such the few Nypa clusters are of no significance.

2.4.3 Uses of Nypa in Ogun and Ondo States

- Referred to as *Ope jaja* (*Jaja's palm*), *Nypa fronds are used as thatch.*
- The people also claim use of Nypa sap in combination with other ingredients in a concoction for the treatment of malaria.
- Nypa sap is also drunk though the people said it is not a preferred drink.
- The leaves are fed to cows while pigs regular uproot Nypa to feed on the prostrate stem.

2.4.4 Impact of Nypa on the livelihood of people

Uses claimed above (section 2.4.4) are not extensive and as such it is doubtful if they contribute to family income. However, the long-term improvement of the livelihood of the people cannot be over-looked. The use of Nypa medicinally also contributes to the health of the community members.

2.5 Rivers and Bayelsa States

2.5.1 Nypa incidence

Nypa is wide spread in River's state especially around Port Harcourt and Kono. Outside these highly populated areas, patches of infestation are frequent especially in brackish water areas.

Results obtained show that Nypa palm has displaced the native mangroves around Port Harcourt and up to Opobo. Communities visited include:

Communities	Northings	Eastings
Marine base water side	No 4 ° 46.130'	E 007 ° 01.876'
Okirika water side.	N 04 ° 46.047'	E 007 ° 02.555
Enugu water side.	No 4 ° 46.042'	E 007 ° 02.553
Abuloma water side.	No 4 ° 45.786'	E 007 ° 02.307'
Ojimba waterside.	No 4 ° 47.141'	E 007 ° 03.865'
Okujagu – Ama.	No 4 ° 47.553'	E 007 ° 03.964'
Fimie/ Tere-Ama.	No 4 ° 46.490'	E 007 ° 01.674'
Amadi – Ama.	No 4 ° 47.404'	E 007 ° 01. 566'
Bori	No 04° 23.14	E 007 ° 31.67
Opobo	No 04 ° 31.044	No 007 ° 32.219

Tabla 2. (BDCP Field Source)

Fig 4.1 Nipa palm along the Opobo River

2.5.2 Status of Nypa infestation in Rivers and Bayelsa States

In Port Harcourt and Kono, Nypa stands are extensive, dense and mature. Other locations around Rivers State have light patchy to medium infestation.

In Bayelsa State, Nypa occurrence is widespread albeit in small patches. Patches of young Nypa has been seen from Yenagoa to Akassa.

2.5.3 Impact of Nypa on the mangrove

The dense Nypa stands have, in most locations, completely displaced other mangrove vegetation. Where other vegetation survives in Nypa stands, it was usually white mangrove (*Avicennia sp.*)

2.5.4 Uses of Nypa in Rivers and Bayelsa States

Apart from the use of Nypa fronds and leaves in thatching, the people of Rivers and Bayelsa States have not found other uses for nipa.

2.5.5 Impact of Nypa on the livelihood of people

All persons interviewed claimed negative impact of Nypa to fish stocks and fishing. It was also note in Kono that people do not collect shell fish encrusted on Nypa because, according to them, "those are bitter".

2.5.6 Pictures of Rivers, Bayelsa States Mangrove forests showing Nypa infestation

Figs 4 .2 (a – b) Nypa infestation

Fig 4.3 shows young mangrove Rhizophora

Fig 4.4 Nypa Infested area.

2.5.6.1 Pictures showing Nypa deforestation/destruction

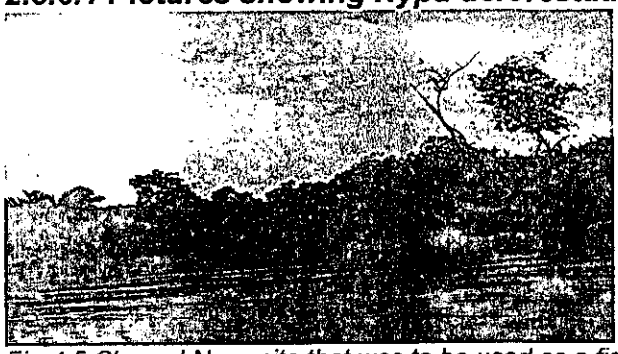

Fig-4.5 Cleared Nypa site that was to be used as a fish pond.

2.6 General discussions and recommendations

2.6.1 Pathways of spread

Holzlohner et al (2002) found a positive correlation between the size and age of the villages and occurrence of nipa. This is probably through the mechanism of selective harvesting of mangrove trees for domestic use. This correlation seems to hold true for Port Harcourt, Warri/Escravos River system and Benin River. In these locations mangrove vegetation has been removed for various reasons ranging from the expansion of settlement, road construction and the use of mangrove wood for various purposes. Dense Nypa stands are also associated with areas where domestic waste is discharged. These are areas of high nutrient (nitrogen and phosphorus) content. Oil and gas activities including seismic line cutting, transport lines and discharge points all seem to stress native mangrove and provide opportunity for Nypa to establish.

Once a suitable habitat is available, Nypa spreads mainly by the fruits arriving at the habitat through tidal floods. Nypa is attractive and different from other local plants. This allure attracts people to transplant it from camp to camp along fishing routes.

2.6.2 Ecological impact of Nypa

Nypa displaces other plant species. Whenever mangroves are disturbed and or eliminated Nypa rapidly colonizes the environment. It produces a dense cover with its fronds and inhibits light penetration. Re – establishment by the

light demanding mangrove seedlings, in these conditions is impeded. Moreover with its large leaves, Nypa palm prevents the viviparous seedlings of mangroves from gaining access to the soil. The mangrove seedlings may either fall in between Nypa fronds or are caused to fall in horizontal position to the soil and subsequently washed away by tidal currents. The formation of almost pure stands reduces the number of plant species and thus the ecological niches available for establishment and dynamics of other components of the mangrove ecosystem. That some communities are averse to collection of shell fish from Nypa due to the perceived poor quality of such shell fish is worthy of note. However, emperical data on species composition, growth rates and population structure of shell fish encrusting on mangrove roots against those encrusting on Nypa would be a worthwhile review.

2.6.3 Uses of Nypa

As thatch- The use of Nypa as thatch and in fencing is consistent throughout the region.

As fish breeding Sites-It was also claimed that Nypa stands serve as good fish breeding sites (evidence from most Cross River State Communities such as Ine-Efik, Mkpasirike, and Edik Ekpu). This claim however does not agree with neither oral evidence from other locations, such as Bonny creek where the people are averse to Nypa, nor scientific data from the NARESCON investigations (see section 1.5.2).

As fuel wood-This reaction is more noteworthy because this community has no source of fuel wood.However, it was noted that these were migrant settlers associated with marginal areas that mangrove has been overexploited.

As protection against storm-Nypa is also important to the communities in Cross River State as the only tangible protection from storms.

As Medicine- Communities in Ondo use Nypa sap in medicines used for the treatment of Malaria.

As animal fodder- It is used as cattle and pig fodder in communitie such as Ikorrgho, Ondo State.

2.6.4 Impact on people's livelihood

2.6.4.1 Importance of mangroves

The benefits of Nypa free mangrove vegetation in Nigeria can be inferred from the overall utilization potentials of pure mangroves as summarized below (see also RPI) 1985)

- They provide a wide variety of goods and services including wood (including merchantable timber), medicines, protection to fish stocks/breeding ground thereby, contributing to commercial and subsistence fishery and aquaculture, salt production and shoreline and coastal erosion control.
- tannin and dyes may be extracted from the bark of mangrove trees,
- The use of mangrove wood as domestic firewood, fencing materials, transmission poles, and pit prop timber in coal mines has proved satisfactory over the years.
- Mangrove swamp forests are also important sources of fish production, offering a rich and protected environment for fish and shellfish.

2.6.4.2 Impacts of Nypa

Nypa offers positive impacts in

- Providing a durable thatch material, as indicated by most communities visited in Cross River State.
- A potential source of sugar, vinegar and alcohol.
- provides edible jelly from unripe endosperm,

In all the uses discussed above, major contributions to family income through the use of Nypa and its parts could not be established. The recognition of Nypa for storm protection in small vulnerable communities is an ecological service that contributes to livelihood.

2.6.5 Control/utilisation or eradication

In tropical Asian countries, Nypa is tapped for production of sap as a beverage, production of sugar, alcohol and vinegar. In Indonesia, Nypa is given as an energy source to pigs. Other uses of Nypa are:

- Older leaves used for fabrication of panels (shingles) as thatch for roofs,
- Young leaves serve for cigarette wrappers,
- Leaves used for construction of household materials hats, baskets, brooms,
- Unripe endosperms of fruits used for jelly. In Thailand, this is the basis for the dessert/traditional sweet soup called *attap chee,*
- Shells of Nypa fruits mixed with coconut shells are used as fuel in barbecues,
- The horizontal trunk, usually buried in the mud is sold as firewood,
- Interior of trunk is used as source of edible starch (sago) albeit as a last resort in situations such as war and famine,
- Flowers are sold as aromatic tea and as vegetable

This survey reveals the extensive use of Nypa as thatch. Nypa is also used as an ingredient in medicinal concoction for malaria coastal communities in Ondo state. The recognition of Nypa as the only protection against storms by coastal communities in Cross River State is noteworthy. Equally worthy of note is that the communities in Rivers State, especially Port Harcourt and Bonny, are averse to the presence of Nypa.

With these various reactions and perceptions the question of control or eradication demands the recognition of the perceptions of all affected communities while the overall good of the long term ecology of the mangrove ecosystem is kept in focus.

The question of utilisation transcends putting the plant and its products to simple use. It demands a sustained market that would absorb the products so produced. The major mechanism of the spread of Nypa is its fruits. It is a

consistently large market that absorbs products made from these fruits that will reduce the number of fruits available for colonisation of new sites and therefore control spread. Thus far, while the attempts of the by governmental organizations like the Nigerian Conservation Foundation have produced marketable products, there is no consistent market chain to deliver the products. Secondly, putting Nypa and its products to simple use must be conscious of its biology as an invasive plant. The long term goal of this strategy must consider appropriate contingency control measures in the event of market failure.

The issue of utilisation of Nypa has, however, been a contentious one vis-à-vis its possible negative impact on the native mangrove vegetation. In its native Asia, Nypa is a very versatile crop that is intensely harvested from the mangrove. Its presence here, with several other palms in abundance presents a competition for attention. The successful utilisation strategy, in line with or based on the Asian experience, would depend on the following:

- Lifestyle and aspirations of community members where Nypa is found
- Amount of Nypa plants available in different locations for exploitation
- Availability of alternatives to Nypa palm
- Acceptance of use types by surrounding population where Nypa palm is abundant
- Convincing demonstration of sustainable uses of Nypa
- Demonstrated markets for Nypa products
- Acceptance of Asian type culinary traditions in Nigeria

Plants of the Niger Delta with which Nypa will complete for attention are listed in Table 3 below

Plants of the Niger Delta (and its uses) which Nypa will compete for attention

Serial Number	Plant species	Uses	Distribution	Remarks
1	*Pandanus candelabrum*	Caps, bags	Fresh water/ mangrove	Huge stocks abound. Largely un –

Serial Number	Plant species	Uses	Distribution	Remarks
				exploited. Trade in traditional products fading and being *displaced* by synthetic fibre bags etc
2	*Raphia hookeri,*	Fermented sap (palm wine), gin, broom, fish trap	Freshwater	An important economic crop. Palm wine is important in almost all cultural ceremonies in southern *Nigeria.* Plantations are beginning to be raised
3	*Raphia vinifera*	Palm wine, gin, thatch, hook sticks	Mangrove	An important and durable thatch material. Sold in large commercial quantities. Probably over-exploited
4	*Rhizophora mangle*	Firewood, railway sleepers	Mangrove	Important ecologically, craved by local baking industry
5	*Elaeis guineensis*	Palm oil, broom, soap making	Freshwater	The oil palm is a very important

Serial Number	Plant species	Uses	Distribution	Remarks
				economic crop
6	*Cyperus articulatus*	Mat-making		Mat making from this plant has been jeopardized by the advent of synthetic mats

Table 3 (BDCP Field Source)

Based on these rather complex scenarios, it is pertinent to present some recommendations towards the management of Nypa palm in coastal Nigeria.

2.6.6 Managing Nypa in Nigeria

Several authors have advocated the precautionary principle in dealing with invasive aliens. Ruesink et al (1995), for example, presents a detailed review of the concept. This calls for proactive mechanisms in managing the incidence of an invasive alien once it has gained entrance into a given territory. A robust management regime based on a thorough understanding of its biology, mechanism of spread, the role of anthropogenic factors in the dynamics and behaviour of the plant through its life and potential to wreak havoc is necessary.

Literature on managing plant invasions is very rich and contains a diversity of concepts including, Prevention, Eradication, Control and Early Detection (monitoring and early warning systems). A combination of methods may thus be necessary for managing Nypa. The choice, for Nigeria, of a mix of strategies would depend on the severity of infestation of the locations as well as the perceptions of associated human community settlements.

2.6.6.1 Prevention

Prevention represents the most effective management strategy in areas where Nypa is yet to establish but in which potentials for its establishment exists. Obot, (2006) had determined the areas of the Nigerian coastline in which the presence of Nypa was confirmed and conjectured on susceptible areas of the coastline (Figure 2.5) based on the habitat requirement and

biology of the plant (see section1.3 above).This should be a priority for Lagos and Ogun coast as well as the Central axis of the Niger Delta. It is thus possible to (at least theoretically) design prevention measures for these areas. This will be based on good science and continuous monitoring. Lagos, however, is more urgent. Nypa fruits have been seen in locations such as the Bar Beach. With its lagoons and estuaries Lagos will retain infestation once the plant has been established.

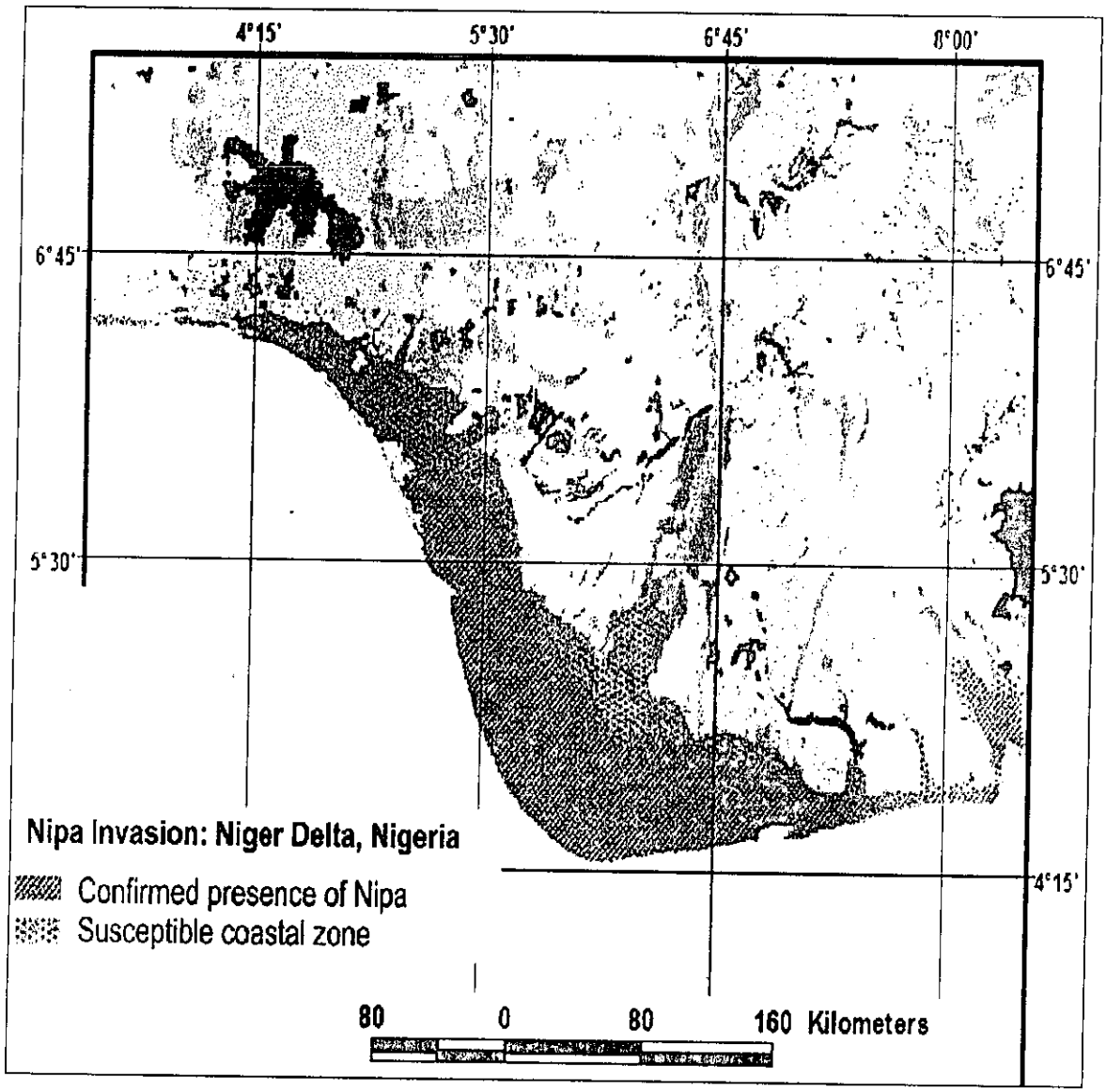

Fig 4.6 Nypa invasion in the Niger Delta Nigeria (source: Obot, 2006)

We recommend this as a major outcome of this project in collaboration with Federal, State and Local Governments as well as the Private sector.

The delineation of Nypa free zones may be considered on the basis of severity of infestation.

The three least infested states are, Ondo, Delta and Bayelsa. Of these, Bayelsa is probably the most infested. However, there are communities/locations within the infested states in which incidence is low and the community is conscious of the need for nipa control and sustainable mangrove management. A good example is the Iko community in Akwa Ibom State in which the Eastern Obolo Community Development Foundation is already engaged in community bases sustainable mangrove management including nipa control. Likelihood of success (in terms of costs and sustainability) is therefore highest in States with low incidence such as Ondo and communities that have community based structures such as CBOs to ensure sustainability

2.6.7 Institutional framework for managing Nypa in Nigeria

Institutional framework for the implementation of these strategies already exists. Several public institutions have been involved in Nypa control/eradication at different levels for example research, pilot control programmes and utilisation options. These include public institutions in the Federal and State levels of Government. Universities (University of Calabar, Rivers State University of Science and Technology, University of Uyo, the Nigerian Defence Academy), Research Institutes (NIOMR, NIFRR, NASENI) and NGOs (the Nigerian Conservation Foundation). The need here is coordination, harmonization of efforts. Synergy and continuity are necessary contributory factors to success. There is also need to build capacity at the State, Local Government and community levels for a coordinated response to monitoring and taking appropriate action against the spread of Nypa. During this study, rather depressing evidence of ignorance among key State functionaries as to the origin of Nypa and its presence in the state territories

2.6.6.2 Control

Control measures are most successful in the primary stages of invasion. Once established, control becomes dependent upon factors such as: dispersal ability of the invading species and the size of territory over which control is to be administered. For our circumstances, controlling Nypa ingress into new territory should therefore be a primary objective of management.

2.6.6.3 Eradication

Eradication implies the removal of every potentially reproducing individual of a species and the reduction of its population density below critical viable levels. Eradication is difficult. It is likely to be expensive because an eradication programme must include a long–term monitoring programme to forestall the threat of re – invasion.

In the Nigerian Nypa context, eradication is feasible for some locations with very low incidence of Nypa such as Ondo and parts of Bayelsa and Delta States.

2.6.6.4 Suppression

Suppression should aim at keeping the population below the critical nuisance level. An utilisation strategy with enough market chain support may achieve suppression.

2.6.6.5 Nypa free zone

As a national strategy, it is imperative that a declaration of "**Nypa free zones**" be established. These Nypa free zones as parts of the Nigerian coast should under no circumstances have Nypa stands. The Nypa free zones should become demonstration sites for the sustainable mangrove management. The aim should be to demonstrate best practices in mangrove management and utilisation including ecological services such as the protection of the coastline from storms. This should be centres for continuing education that should assist communities that are undecided about Nypa and or mangrove to draw lessons.

was found. State and Local Government Forestry Departments need to be strengthened to respond to mangrove management including Nypa control.

2.7 Extent of Nypa infestation

Resource persons and field workers in this survey attempted to georeference areas of Nypa infestation and also assigned subjective classification of the intensity of invasion with terms of patchy, low, high, very high and heavy. These classifications were assigned score points of 1 – 6 to allow the establishment of a GIS database and to display of this information in maps. Figure 3.1 is the approximate extent as well as classes of Nypa infestation based on the field data available. Cross River, Akwa Ibom and parts of Rivers State are heavily infested. Bayelsa, Edo, Delta, and Ondo States show a range from patchy to very high infestation,

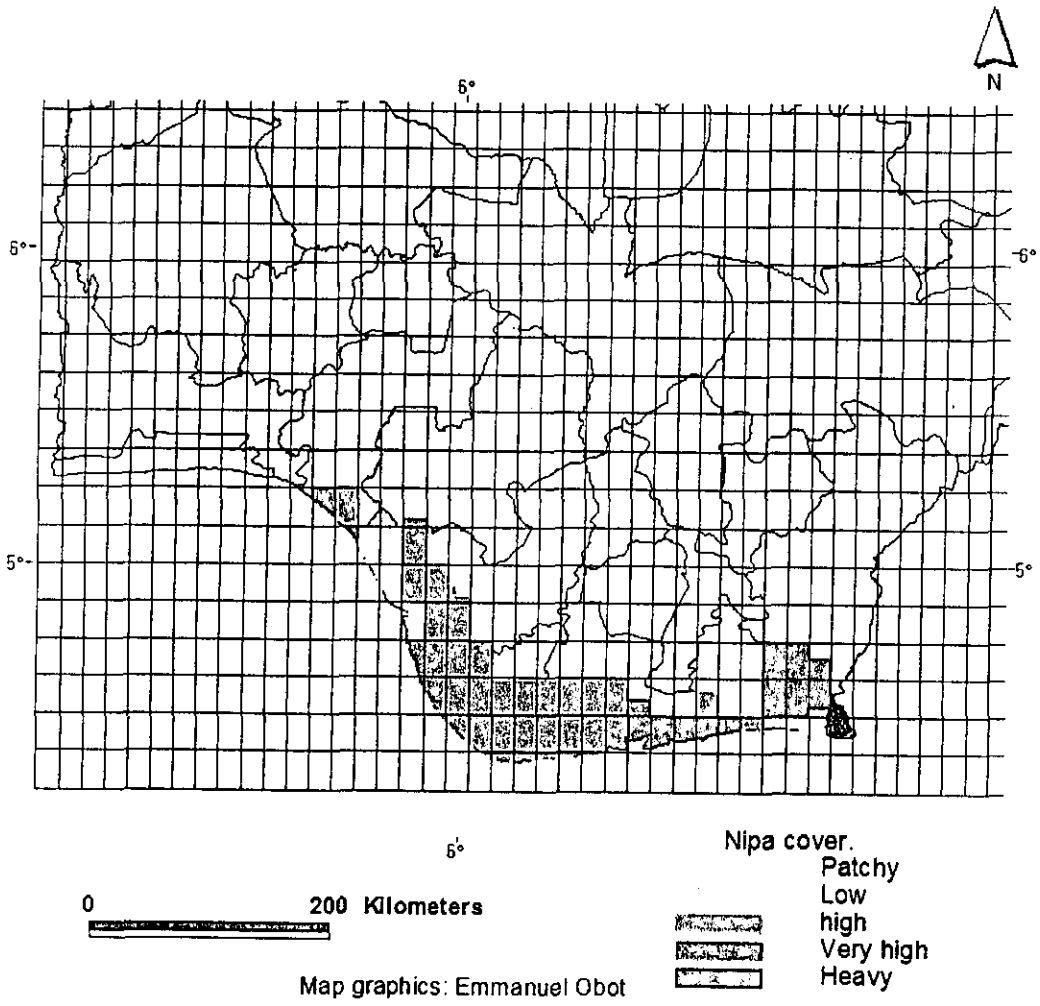

Fig 4.7 Approximate extent and status of Nypa infestation in coastal Nigeria

Concluding statements

From ecological perspective the displacement of mangrove vegetation by the alien Nypa is regarded as a serious threat to the existence of the Nigerian mangrove ecosystem, its biodiversity and its genetic pool. However consultations at community levels during the present study have not shared this view in some communities in Cross River State. Also in some communities where they are less abundant (Ondo State), they are being sustainably utilized. In elaborating strategies for the control of Nypa, therefore, the views of communities backed up with adequate public enlightenment must be considered.

SECTION 3:

Options For The Control Of Nypa Palm -Mechanical Clearance And Utilization

SUMMARY

3.1 Managing Nypa Palm in Nigeria

In the report of the field survey of Nypa infestation in Nigeria, we investigated concepts including, Prevention, Eradication, Control and Early Detection (monitoring and early warning systems). Prevention was suggested as the most effective management strategy in areas where Nypa is yet to establish but in which potentials for its establishment exists while control by utilization was generally agreed upon by all stakeholders especially the communities concerned, as the best management strategy.

Control measures on the other hand are most successful in the primary stages of invasion. Once established, control becomes dependent upon factors such as: dispersal ability of the invading species and the size of territory over which control is to be administered. For our circumstances, controlling Nypa ingress into new territory should therefore be a primary objective of management.

Eradication implies the removal of every potentially reproducing individual of a species and the reduction of its population density below critical viable levels. Eradication is difficult. It is likely to be expensive because an eradication programme must include a long – termed monitoring programme to forestall the threat of re – invasion. In the Nigerian Nypa context, eradication is feasible for some locations with very low incidence of nipa such as Ondo and parts of Bayelsa and Delta States.

Suppression should aim at keeping the population below the critical nuisance level. An utilisation strategy with enough market chain support may achieve suppression.

It should be noted that the villagers are opposed to any idea of Nypa eradication. Jokingly they said that if government wants to eradicate or evacuate Nypa palm, it should also consider evacuating the people as well! Asked if there are any adverse effects of Nypa, they said there are none, and that nothing is lost as a result of Nypa palm infestation except as recorded in some villages that greater distance is traversed on firewood collection of mangrove due to Nypa palm occupation of the shoreline.

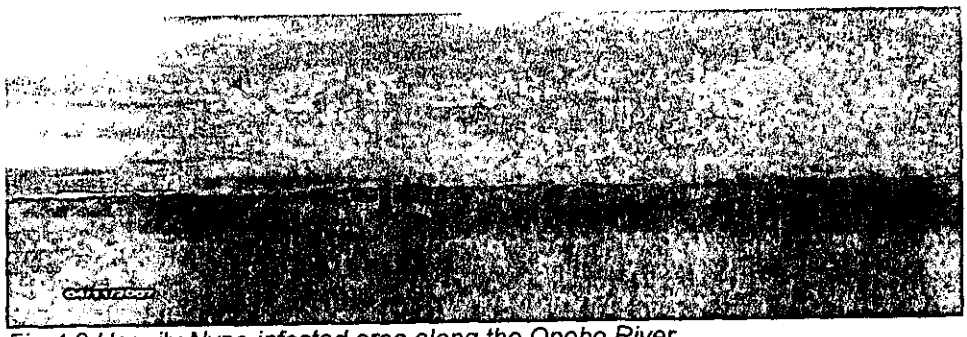

Fig-4.8 Heavily Nypa infested area along the Opobo River

The infestation of Nypa palm has the obvious adverse impact on the natural occurrence and distribution of mangrove species and consequently on the numerous benefits of mangroves. However, Nypa palm on its own has a range of useful products and beneficial roles as identified by the fishing establishments. Above all, the inhabitants of the fishing communities, where Nypa palm is dominating and has even displaced the original mangroves, are opposed to its eradication or evacuation. They do not seem to appreciate the presumed losses due to Nypa palm colonization. What options do we have in the consideration of Nypa palm eradication or control-by-utilization strategy?

3.2 Options for the Control of Nypa Palm /Nypa Control Measures

The options available for the control of nipa are mechanical control and control through utilisation.

3.2.1. *Mechanical control*

Mechanical control should only be practiced in the states where the Nypa palm infestation is still at a minimal, namely Edo and Ondo States.

Results obtained from the Nigerian Conservation Foundation's considerable experience in the control of nypa by cutting, indicate that cutting three times at intervals of 14 – 18 days accords effective control. This experience was developed as part of an intervention that started in 1996, when the Nigerian Conservation Foundation with the support of Ford Foundation had a 3 year demonstration project on the significance of the use of Nypa palm by the local populations as a potential measure to control the spread of the invasive plan along the Nigerian coast. The Federal Government of Nigeria, recognizing the negative impact of Nypa palm to Nigeria's coastal environment, had launched a Nypa palm control project in 2001 at Oron Akwa-Ibom State. Though the Nigerian Conservation Foundation (NCF) produced fashion apparels and household items from nipa parts, this approach requires massive collection of Nypa fruits. Such massive collection depends also on

massive sales of Nypa based products. The project did not develop market chains probably due lack of expertise. Conscious of this market failure, NCF found additional support from Mobil to investigate mechanical control options. The NCF/Mobil partnership on Nypa palm control from 2000 to 2003 suggests fighting the menace of Nypa palm in Nigerian mangrove ecosystem through community based Mangrove Habitat Rehabilitation action as follows:

i. Clearing of coastal areas of invasive Nypa Palm and the transplanting of mangrove seedlings and nurturing of new mangrove stands.
ii. Mangrove plantation maintenance
iii. Community-based education programme wherein the community people will be informed on the advantages of having mangrove belt restored by their shores as against the invasive Nipa Palm. Mangrove seedlings are supplied through the establishment of community mangrove nurseries. Also, Community Environmental and School Conservation Clubs are established to monitor and protect the project in their locality from human destruction and recolonisation of the planted area by Nipa Palm.
iv. Intensive water patrol to collect floating Nipa seeds and seedlings from the rivers and seas to stop its further spread.

3.2.2. Control by utilisation

3.2.2.1 Establishment of Craft Centres

As mentioned above, the use of the fruits in the production of crafts (to reduce propagules available to colonize new areas) would be effective where there is a market for the craft items. This is also a livelihood option. To improve on this strategy, the following steps should be taken:

i. Consolidate previous efforts focused on skills development in Nypa invaded areas and widen the scope of skill acquisition beyond a demonstrative level, focusing on youth, particularly the utilization of Nypa parts to produce a variety of commercial items which can be marketed.
ii. Set up a regional coordinating unit in Calabar, Cross-River State. The town was selected based on security and envisaged cooperation (office space, infrastructure) from the State Ministry; as Calabar is environmentally friendly.
iii. Set up 2 (two) fully equipped Nypa palm craft workshops within the Nypa infested areas (with one at Oron, Akwa-Ibom) with sub-stations in all the coastal states. Oron Local Government Area has been selected based on

previous experience and existent craft station as well as their level of awareness on the impact, uses and threats of Nypa.

iv. Run up of a 3-month introduction course on Craft Making for interested youths and school leavers pulled from across Nigeria. Thereafter the youths will be attached for 3 months at the two Crafts Centres/Workshops to blend their skills.

v. Set up entrepreneurship support scheme to motivate the participating youths.

vi. Support project participants in trade fairs and exhibitions as a way of promoting the product and market strategy.

vii. Support project participants with local advertisement and media promotion

viii. Develop new product in these centres, for example, vinegar and sugar production from Nypa.

3.2.2.2. *Benefits*- In this way

Rural economy will be improved because more mangroves will be available for communities to use in a sustainable manner in future. The level of breeding of fishes, crabs and other prawn will be raised and available in the seas, rivers and ocean and more fishes will be caught by the local fishermen.

Employment potentials will be derived from the project directly and indirectly.

Mangrove rehabilitation can be extended in most Nipa-invaded areas of Akwa Ibom coastal communities as a follow-up to this pilot.

Nigeria's costal communities will become more aware of the threats of Nypa to local economy and ecology of the coastal ecosystem.

3.2.3. *Anthropogenic factor*

As discussed earlier, the distribution and integrity of original mangrove vegetation is affected by human activities such as cutting of mangrove for firewood exploitation, as well as introduction of Nypa palm on gaps so created. Holzlohner *et al* (2002) found a positive correlation between the size and age of the villages and occurrence of Nypa.

(i) The first management initiative should be that of accepting the presence of Nypa Palm.

(ii) To mitigate this action, alternative source of fuel has to be found for the settlers. Production of biogas based on Nypa palm would also be a good option.

(iii) Development of strategies for planting of mangrove in habitats: Nypa has established deep in–shore, due to over exploitation of mangroves. Strip planting of mangroves for example would check the speed of Nypa reproduction. Judicious exploitation of Nypa belts for local uses should also serve to check the spread.

(iv) Development of mangrove nurseries, with the participation of local communities, is also a useful step towards mangrove regeneration.

(v) Capacity building and training aimed at establishing procedures and techniques for utilization of Nypa palm, borrowing the experiences of Asian countries, should be embarked upon. The local communities are keen to be trained accordingly. Products such as sugar, alcohol, edible jelly and salt among others should be implemented with the assistance of suitable consultants, whether foreign or local.

(vi) Ecotourism in the mangrove should be explored with introduction of white belly monkey and other wildlife, including fishery. The Marina Beach also known as Grace of God Resort is a noteworthy tourist outfit.

(vii) Creation of Forest Reserves: Management plan for the reserve should ensure sustainable development of all mangrove formations and the control of Nypa palm through its rational utilization potential strategies. The utilization potentials of Nypa palm as well as other mangrove formations should enhance the livelihood of the local communities including the fishing establishments. An action plan should be developed by a multidisciplinary team.

(viii) Enrichment planting with *Rhizophora racemosa*, *Laguncularia racemosa*, *Avicennia africana* and *Symphonia globulifera* among other species, is suggested. Stands of introduced extroduced extotics such as *Callophyllum inophyllum* and *Terminalia catappa* can be established on the sandy beach and dunes. This should form an integrated Nypa /mangrove mixed formation, on a pilot phase.

3.2.4. Other Options include:

(ix) Capacity building was is as an important tool in the control of Nypa Palm. The present level of understanding with respect to local people use is low.

It is anticipated that an increased knowledge of local people will enhance the use of Nypa Palm.

(x) Control should be practical especially in areas of low infestation by removal of Nypa Palm. In areas of high infestation, a control means that can lead to eradication in the long run should be adopted.

(xi) Creating a limit or a zone with respect to spread of Nypa Palm in Nigeria should be taken serious. However, the after mat of removing Nypa Palm should also be considered.

(xii) The establishment of cottage industries that use Nypa Palm as raw materials in areas where Nypa Palm infestation is high should be encouraged. Care should be taken to create unsustainable uses only. This is to discourage other local communities from planting and establishing Nypa Palm plantations. Creating unsustainable uses should also include a time limit on when to inform the people to stop using. The idea of creating unsustainable uses is to discourage local people from getting attached or addicted to the final products. Establishment of markets for Nypa Palm products should also be considered, if use by utilization is an option.

(xiii) Programmes should be designed to introduce Mangrove by enrichment planting, boundary planting, peripheral planting, inter-cropping, inter-planting etc. Any of the above intervention opted for should be monitored closely. The designed integrated intervention should be intended to gradually eradicate Nypa Palm on time or spatial arrangement.

(xiv) Each coastal State must decide on the quantity of Nypa Palm to be tolerated in its waters. They must also have Nypa Palm free zones. The Forestry/Environment departments in each State should monitor control and spread by:

(a) Collection of Nypa Palm flowers and petals

(b) Re-planting of Mangrove seedlings which are viviparous and capable of vegetative propagation

(c) Discouraging mechanical activities which might affect the ecosystem and ecology of the environment.

(d) Picking seeds on water or developing booms to prevent Nypa Palm seeds from floating freely.

Fig- 4.9 Dislodged Nypa plants and seeds beside Akwa-Ibom boat yard dock

3.2.5. Capacity Building:

NGOs working in the coastal states should be made to understand the potential of Nypa where the plant has invaded vast tracts of the Niger Delta. These NGOs should then come together to initiate and sponsor small scale projects. The aim of the small project is to alleviate the rampant poverty that plagues the mangrove communities, by building a 'cottage' ethanol industry around the palm and to link it up with larger production facilities.

3.2.6. Production of ethanol on a large scale by the State governments assisted by the Federal Government and Local/International donors:

Ethanol can be obtained from fermenting the sugar-rich sap that can be tapped continuously from the trees' inflorescence. Nypa has a very high sugar-rich sap yield. According to one study, the palm can produce 6,480-15,600 liters of ethanol per hectare, compared to 3,350-6,700 liters/hectare from sugarcane. Others go so far as to estimate potential ethanol yields to be as high as 20,000 liters once plantation management is optimised. However, the tapping technique is labor-intensive and it remains a question whether production can be scaled up that easily. Apparently, a malaysian company (Pioneer Bio Industries Corp Sdn Bhd (PBIC) thinks it is possible. The latter claims it will be able to produce a startling 6.48 billion litres (1.7 billion gallons) of nypa palm ethanol per year when its planned refineries in Malaysia's North-Western Perak State begin operations in 2009. This amount is roughly equal to 780,000 barrels of oil equivalent per day.

Section 4:

Documented Diverse Uses And Lessons Learnt

SUMMARY

Potential Diverse Uses of Nypa Palm

In South-East Asia, there is a long tradition (hundreds of years) of using palm sap obtained by tapping the inflorescence stalks (peduncle) as a source of treacle (molasses), amorphous sugar ('gula malacca'), alcohol or vinegar. The slightly fermented sap called 'toddy' ('nera' in Indonesia and Malaysia, 'tuba' in the Philippines) is sold and consumed as local beer. In Papua New Guinea, there is no tradition of using the sap. The long, pinnate leaves (fronds) provide material for thatching houses. In the Philippines, Malaysia, Indonesia and Thailand the fabrication of thatching panels, called locally 'shingles', 'pawid' or 'atap', is a significant local source of income. Leaflets and midribs are used for manufacturing of brooms, baskets, mats and sunhats. The white endosperm of immature seeds is sweet and jelly-like, and is consumed as a snack. The cuticle of young, unfurled leaves has locally been used as cigarette wrapping. Various parts of nypa palm are a source of traditional medicines (for example, juice from young shoots is used against herpes, ash of burned nypa material against toothache and headaches) and material for salt extraction.

In Nigeria the endocarp of mature fruits, called 'plant ivory', for the manufacture of buttons necklaces and other fashion apparels is successful in Nigeria and other fashion apparels as well as domestic materials. For this strategy to make a reasonable impact on the population of the palm, a market chain for sale of these products must be developed. Nipa fronds are commonly used as sail by local fishermen.

In Ondo and Ogun States Ope jaja (or Jaja's palm) as nipa is called, the people nipa fronds are used as thatch. The people also claim use of nipa sap in combination with other ingredients in a concoction for the treatment of malaria. Nipa sap is also drunk though the people said it is not a preferred drink. The leaves are fed to cows while pigs regular uproot nipa to feed on the prostrate stem.

Products of nipa palm are not yet internationally traded. The production of thatching material, sugar, vinegar, mats and baskets has only local significance. The sugar, produced in family enterprises in Malaysia and Thailand, is used for confectionery and for small-scale production of distilled spirits. Recently, a pilot scheme was established in West Kalimantan (Indonesia) to produce sugar from nipa palm on a larger scale. It is planned to exploit some 10 000 ha. The production of fuel alcohol

from nipa palm was seriously studied in the 1920s in the Philippines and Malaysia, and in the early 1980s in Papua New Guinea. Because of the high input of manual labour required to produce fuel alcohol, the process was not economically feasible in Papua New Guinea, whereas vinegar and treacle showed good potential for cottage-industry development in Papua New Guinea. The quality and price of vinegar produced with the method developed, compared favourably with commercially produced vinegars elsewhere.

A widely held opinion is that Nypa palm is displacing mangrove trees because of the dominance of Nypa palm in the biological competition. This opinion results from a superficial look at the combined biological and anthropogenic processes. The crucial factor is the man utilizing and over-utilizing nearly exclusively mangrove trees and so giving an expansion advantage to the extremely low used Nypa palm. Nypa palm being an aggressive colonizer, rapidly invades any areas cleared of mangrove. Interestingly, Nypa Palm also has a few uses which the local community members in the Niger delta areas put it to.

Fig 5.0 Nypa palm at Akpabuyo
Along the great kwa river

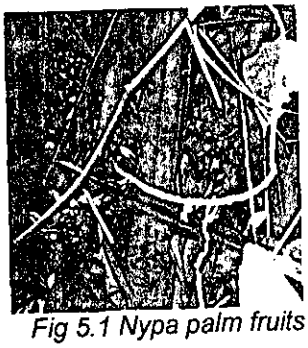

Fig 5.1 Nypa palm fruits

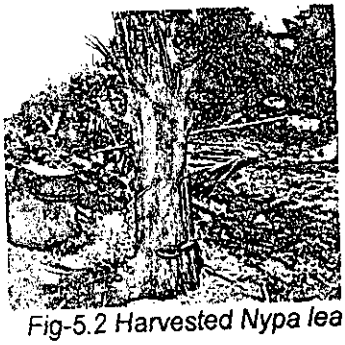

Fig-5.2 Harvested Nypa leaves

4.1 Local Uses

4.1.1. A white belly, black monkey was observed among Nypa palm. It was copiously photographed. According to Dr F. Nwosu (oral report) this was the first time that mangrove monkey was actually sighted in his more than ten years of surveys and mapping of mangrove vegetation. This indicates a tourist potential of Nypa mangrove environment, with this species of monkey.

4.1.2. The natives mostly make use of the Nypa palm to make thatch for their roofs. Further discussions with the local community members revealed other uses such as: house roofing, shade making on occasions, pig feed and cattle feed.

4.1.3. Other community members also admitted planting Nypa Palm as an Ornamental.

4.1.4. Nypa palm sap tapped from the stem is used for treating malaria in combination with other herb mixtures.

4.1.5. On its usefulness, Nypa palm is beneficial in providing and enhancing fish breeding habitat. Fish population is rather enhanced similarly shrimps and other marine products are increased by Nypa palm micro habitat features.

4.1.6. The pole of Nypa palm is not popular because it is not as strong as Raphia. The pole of Nypa is not durable and that has limited its use mainly for mat weaving. However some of the communities visited use Nypa palm in fence construction. Nypa poles though not so durable were also useful in hut construction work.

Fig 5.3 (a-b) Nypa colony at Ine Efik Cross River State.

Fig 5.4 (a-b Nypa used for hut construction at Ine-Efik

4.1.7. The perception of the impact of Nypa palm with respect to livelihood was positive namely: that Nypa was useful for mat production; fencing and for local use in hut construction.

Fig- 5.5 Nypa palm used as fencing material and thatching house

4.1.8. The Nypa Palm roots also provided bait for fishing.

4.1.9. It was reported that Nypa palm plays a protective role on the banks of the river. Provision of protection against storms from sea waves into the village was rated highly.

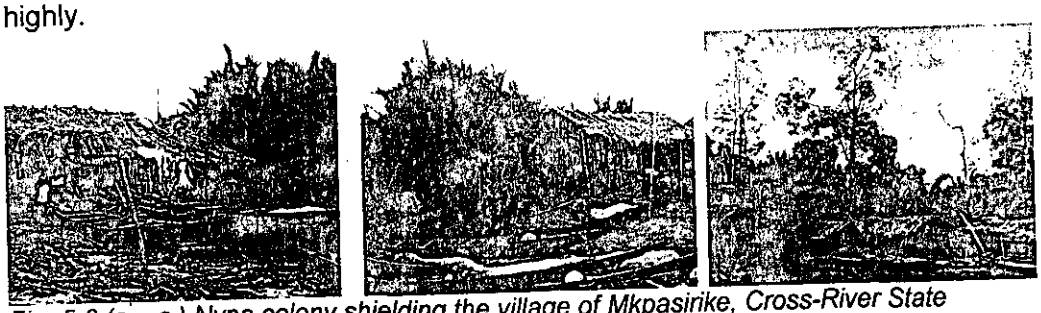

Fig- 5.6 (a – c) Nypa colony shielding the village of Mkpasirike, Cross-River State

4.1.10. Nypa seeds are used in filling up water-logged ground to act as a means of erosion control.

Fig- 5.7 Nypa palm seeds used to fill the ground and control erosion at Ibaka, Akwa-Ibom State

4.1.11. The following tables summarize the different uses to which the coastal communities put Nypa palm into, based on the questionnaires completed.

Plant Part Used and Rate of Use

S/No.	Plant Part Used	Direct Use	Indirect Use
1.	Sap	XX	
2.	Young Leaves	XXXXX	
3.	Trunk	X	
4.	Whole Plant	XXXX	
5.	Seeds	XXX	
6.	Mature Fruit	XX	

Key: XXXXX=Very High; XXXX=High; XXX=Moderate; XX=Low; X=Very Low

Table 4 (BDCP Field Sources)

Characteristics of Use Values of Nypa Palm

S/No.	Functions/Services	Direct Use	Indirect Use
1.	Erosion Control		XXXX
2.	Flood Control		XXXX
3.	Nutrient Retention/Breeding		XX
4.	Aesthetic Function		X
5.	Medicinal		XX
6.	Roofing, Fencing, Mat-making		XXXXX
7.	Ornamentals		X
8.	Food		X
9.	Habitat/Nursery		-------
10.	Tourism		-------
11.	Sugar/Ethanol		-------

Key: XXXXX=Very High; XXXX=High; XXX=Moderate; XX=Low; X=Very Low

Table 5 (BDCP Field Source)

As seen above, the young leaves of Nypa palm are the most used parts and are mostly used in roofing, fencing as well as mat-making. There is yet to be tourist developments and the Nypa palm is yet to be planted by the community members. Also important to note is the fact that Nigeria is yet to harness the use of Nypa palm as a source of sugar and ethanol.

4.2 Practical Uses Learnt from Experts

Although Nypa Palm has been present since about hundred years and increasingly abundant in Nigeria, no utilization has been developed, apart from provision of building materials for huts. However in tropical Asian countries from where Nypa Palm was introduced, the palm had been utilized for multiple purposes. Nypa palm is

even grown there in plantations; it is the first choice species for farming in new mud flats. Below are the reported uses of Nypa palm in other countries.

4.2.1 Food and non-food products from Nypa Palm

The information on food and non-food products are derived from Thailand experience, Cameroon, Nypa literature (Dalibard, 1999, Hamilton & Murphey, 1988); while some non-food products originate from the Ford and Mobil sponsored Nypa projects of NCF in Oron between 1996 and 2003.

- The tapping of sap and the conversion to an amorphous sugar stands on top within the range of multiple Nypa products. Common is also the marketing of fresh sap. Nypa farmers use small pieces of mangrove wood to avoid the fermentation to alcohol, for sap destined for selling as fresh beverage or production of sugar. Three litres of sap are needed to produce one litre of sugar. The market price in Thailand for one litre of sap is 4-5 baht (about 12 US cent/N15) and for one litre of sugar 25-30 baht (about 73 US cent/N90).
- A part of the tapped sap is fermented to wine, and also the distillation of wine to a liqueur is known.
- Important is also the production of vinegar from Nypa wine, with help of bacteria species of the genus *Acetobacter*.
- In South East Asia, honey production is known from Nypa flowers but probably 'lost' sap during tapping plays also an important role.
- In parts of Indonesia, on the islands of Roti and Savu, the tapped sap is given as energy food to pigs and dogs (Cook, cited by Fox 1977).
- In South East Asia, there are also considerations to utilize Nypa alcohol as fuel. Compared with other crops, the annual alcohol fuel yield (litres/ha) is on the upper level - tapped Nypa 6,480, tapped coconut 5,000, cassava 3,240-8,640, sugarcane 3,350-6,700 and sweet potato 6,750 -18,000 (Hamilton & Murphey, 1988). A newer comparison from Malaysia (Internet information by Leanan, May 2007) showed results (litres/ha/year) of 15,000-20,000 for Nypa, 5,000-8,000 for sugar-can and 2,000 for corn. In Malaysia is a factory in the planning stage where from 10,000 ha Nypa plantation will be produced 140 Mill gallons alcohol fuel (bio fuel) per annum. (Internet information by Parodes, July 2007).
- The flowers of Nypa palm are sold on local markets of Thailand and other South East Asian countries as vegetable.
- Young Nypa shoots are also used as vegetable.
- The petals of the flowers make an aromatic tea.

- Also the utilization of the edible jelly from unripe endosperms (seeds) is common. In Thailand, this jelly is the basis for desserts or traditional sweet soup - attap chee. A colour change of the seeds from light-brown to dark-brown indicates maturity (Siddiqi, 2000).
- The interior of the horizontal rhizome hidden in the mud (in Asian literature named trunk) can be used for provision of edible starch (sago) similar to the sago palm. In parts of Indonesia, this starch was considered as last food source in times of war. Therefore the palms around the settlements were reserved for such events.
- Known is also the production of a special salt and the utilization as traditional medicine, e.g. juice from young shoots against herpes.
- The ripe seedlings or the peels from processed ones can be used as firewood for drying of fish and shrimps. In Cameroon (Bakassi) where Nypa has penetrated from Nigeria, Nypa seedlings are already an important firewood source for smoke-drying of fish and shrimps, and customers very well accept the products because of the gold-brown colour (Personal information by Njifonjo, 2005). Recently, the use of Nypa seeds as fuel for smoke-drying of fish also in Ibeno, Akwa Ibom State, Nigeria; the consulted dealers and fish-processors mentioned also the customer-attractive gold-brown colour of the product.
- There are preliminary results to utilize mangrove species *Avicennia officinalis* from India as component for antifouling paints (Mantrie *et al*, 2004). Most effective were aqueous solutions of the leaves against diatoms. In the University of Calabar, there are on-going investigations to use also *Nipa fruticans* for this purpose.
- In Thailand, it is common to convert the shells from Nypa seedlings mixed with coconut shells if available, to high-quality charcoal, mainly sold for barbecue in 200g polyethylene bags - 15 baht = about 41 US cent/bag.
- The rhizomes ('trunks') which are hidden in the mud are freely used by rural inhabitants as fire wood but are also sold on local markets in South East Asia.
- The fronds of Nypa palm rank in South East Asia on the second place after sap, in economic terms. The older leaves are mainly used for fabrication of panels (shingles) as thatch for roofs. The large shoots - Nypa 'bamboo' is used as building materials. Utilization of leaves and Nypa 'bamboo' is the only traditional use of Nypa palm in Nigeria.
- In Cameroon, Nypa 'bamboo' is used in combination with ropes, as packing materials for local and regional shipping of goods.

- The cuticle of young, unfurled leaves serve in Thailand and other South East Asian countries as wraps for cigarettes.
- The midribs and leaflets are construction materials for baskets, mats and brooms, etc. The long brooms constructed during the Nypa project of Nigerian Conservation Foundation (NCF) from midribs, were ideal for removal of spider webs on the ceilings.
- The midribs of young leaves, in Thailand are converted to durable threads preferred against synthetic ones, for the Nypa products.
- During the Nypa project of NCF, from the hard shell of mature fruits were developed buttons, key-holders, necklaces, ear rings and other decorations. A handicap was the infestation by fungi which should be avoided by special preparation/treatment.

Fig: 5.8 Jewelries produced from Nypa palm fruits at NCF craft centre

4.2.2. The following tables 3&4 summarize the different use values (direct, indirect) based on questionnaires completed by Thai Nypa farmers (Li Thi Thu Ha, 2006)

Table 1: Characteristics of use values of Nypa palm

Economic values	Direct use	Indirect use
1. Sap	XXXXX	
2. Roofing	XXXX	
3. Young leaves	XXXX	
4. Trunk	XXX	

Key: XXXXX = very high, XXXX = high, XXX = moderate,

Functions/Services	Direct use	Indirect use
1. Habitat/nursery		XXXX
2. Erosion control		XXX
3. Flood control		XXX
4. Nutrient retention		XXX
5.Aesthetic function		XX

Key: XXXXX = very high, XXXX = high, XXX = moderate, XX = low,

Table 6 (a –b) (BDCP Field Source)

Table 2 Direct use values of nipa palm per household

Benefits	%House.h.	Prod./yr.	$
Dir. benefits			624
Sap (kg / yr)	90	2,147	248
Old leaves (set of leaves/yr)	60	3,208	244
Young leaves (set of leaves/yr)	50	190	93
Trunk	8		39

Proc. benefit			682
Sugar (kg)	90	1,130	423
Wine (ltr)	8	665	216
Vinegar (ltr)	7	650	43
Total benefits			1,306

Table 7 (a- b)(BDCP Field Source)

NOTE: *In Thailand, there are either Nypa farmers or mixed farmers (Nypa-agriculture, Nypa-shrimp or shrimp-Nypa). The combination of Nypa and other cultivation helped local people to reduce risks while improve their income. Mixed farming becomes more significant because of decreasing earnings from shrimp farming, acidified soil and saltwater intrusion in land formerly used as paddy (rice) fields. Typical is that people use land around their house to cultivate agricultural crops such as rice, beans and vegetable while farther lands are used to plant and exploit Nypa palm.*

4.3 Retention Of Pb (Ii) Ion From Aqueous Solution By Nipah Palm (Nypa Fruticans Wurmb) Petiole Biomass

After an experiment carried out by scientists in a Nigerian University (University of Port-Harcourt, River State), the following conclusion was drawn:

The sorption of Pb(II) onto Nipah palm (Nypa fruticans Wurmb) petiole biomass is favoured by low metal ion concentration. The kinetics of the sorption process was found to follow a pseudo-second order rate law and the equilibrium data agrees well with the Langmuir isotherm. Small differences in Pb(II) retention after treatment with TGA were obtained. For both pure - metal or modified - metal biomass systems, chemical reactions are important and significant in the rate-controlling step. This investigation has revealed that Nipah palm (Nypa fruticans Wurmb) petiole, which is hitherto an environmental nuisance in the Niger Delta area of Nigeria could be converted to low-cost adsorbent for remediation of metal contaminated effluents (Donbebe Wankasi, Michael Horsfall Jnr And Ayebaemi I. Spiff; 2005).

4.4 Use of Nypa palm as Green Charcoal

Pro-Natura International (a Non-Governmental Organization) has developed a continuous process of pyrolysis of vegetable waste (agricultural residues, renewable wild-grown biomass) transforming them into green charcoal. This domestic fuel performs the same as charcoal made from wood, at half the cost. It represents a freeing up from the constraints of scarcity, distance and cost of available fuels in Africa. The machinery required for the process is of relatively modest scale and functions on practically no outside energy and no emission of toxic fumes, it only

takes 8 kW of electric power. When run by two persons, it can produce more than 4 tonnes of green charcoal a day.

The green charcoal project precisely meets the recommendations of the international Convention against desertification, paragraph 19/1 (f.) "...utilisation... in particular of renewable energy sources, supply of appropriate technologies to reduce dependence on fire wood.

Section 5:

Proposed Final Scheme of Work

SUMMARY

The option of utilization as a control measure was generally ariven at during the site visits, awareness campaigns and workshops held. The villagers who up until now do not consider Nypa palm a threat as they do other plants such as the water hyacinth, refused to understand why the Nypa plam should be cut down when there were so many demonstrated uses. Those who attended the training workshop were also awed at the production of jewelleries from Nypa and the women in the communities were all interested in learning how this could be done. Due explanation to them have however made them understand that other mangrove serves more purposes to the environment and the fact that Nypa displaces the cut down trees thus exposes the coast to many environmental threats such as erosion. This was generally agreed to by the communities visited and an agreement was reached that the growing of Nypa should only be done by those ready to enclose an area for their breeding and this must be someone who has sufficient funds to utilize the Nypa palm in the production of finished products on a large scale. For the rest of the community members including the farmers and fisher men/women, the Nypa should be cut down and used for the production of any of the products on a smaller scale, for the improvement of their livelihood.

The following resolutions on a proposed scheme of work for an indepth assessment/further transformation products were reached by stakeholders:

(a) Develop low technology adaptable to local circumstances.

(b) Build capacity of local people to engage in cottage industries.

(c) Develop marketing strategies that are sustainable and establish South-South cooperation between Nigeria and other countries where Nypa Palm is found.

(d) Adopt a Bottom-Top policy formation to increase active local participation and choice of cottage industries by local people.

5.1. For the first year, the Project suggests the implementation of these five programmes of community mobilization in order to help achieve the control of Nypa by utilization:

1. Awareness programme: to raise awareness about the various uses to which Nypa can be put into, and the necessity of using them (i.e. utilization) as a means of control.

2. Lobbying programme: to lobby key agricultural decision makers in government and the farmers unions, to include the continuous utilization of Nypa as an integral part of their work.
3. Training programme: to train agriculture extension officers and farmers how to use the Nypa in the production of the above mentioned uses (especially those already demonstrated in Nigeria) while maintaining their natural functions.
4. Mentoring programme: to guide and help the extension officers and farmers once they have begun to use these Nypa found within their area or on their farm.
5. Partnerships programme: promote co-operation between NGOs, government departments, land owners on how to use Nypa industrially in the production of ethanol.
6. Provision of Funds/Loan facilities: to help the farmers establish small scale industries where Nypa can be made into finished products, thereby creating employment and improving the livelihood of the farmers and communities as a whole.

Benefits

When the farmers/stakeholders are made to form Unions, the direct result of their activities includes healthy coastal and the inland ecosystems and the income resulting from the enhanced livelihoods of the people will also increase accordingly.

When the people have proven that they are capable of managing their resources in a sustainable manner, the next step will be to request the government to recognize their achievements by granting them the right to manage these mangrove resources independently, or through a co-management arrangement.

By providing support for the farmers and the fisherfolks' conservation activities, instead of leaving the Nypa control decision-making in the hands of government officials and the business sector, the government will be able to control the spread of Nypa palm which till now is considered a threat to the Nigerian mangrove. The more these Nypa palms are cut down for use, the more space is available for the mangrove to thrive. Since an awareness programme on mangrove reforestation has already been carried out successfully, this most certainly ensures that the mangrove will be planted in the place of the cut down Nypa or atleast allowed to regenerate. This utilization of Nypa whilst still conserving the mangrove will only ensure sustainable livelihoods for the poor families living along the coast.

5.2. Sustainable Management

- The sustainable management should concentrate on Nypa palm utilization and restoration of mangrove. The Asian experience, e.g. in Thailand, are to be used. The following proposal should be considered as a frame for a pilot project.

- A part (e.g. 1 ha) of the Nypa jungle should be identified for uprooting and test planting of mangrove trees (*Rhizophora racemosa*). The uprooted Nypa rhizomes should be tested as firewood and the leaves used for the different products mentioned earlier.

- In a neighbouring part (e.g. 1 ha) of the Nypa jungle should be only cut off the Nypa fronds and planted mangrove. The cut Nypa leaves should be used as mentioned earlier.

- Apart from utilizing the Nypa jungle for mentioned products, converting a part (e.g. 1 ha) into an experimental tendentious Nypa plantation neighbouring to the both mangrove plantations, by selective cutting of the leaves, described in earlier. An important aim should also be the comparison of quantity and quality of Nypa products in a Nypa jungle (natural forest) and in this tendentious Nypa plantation.

- A fourth version should be considered, a real Nypa plantation on a neighbouring plot (e.g. 1 ha) in accordance with the Asian examples by harvesting all rhizomes and leaves from the older plants of the Nypa jungle. It should be arranged that only younger plants of the same size remain. Also later compared should be the quantity and quality of Nypa products with the results of the previous version and Nypa jungle.

- There should be found out whether a belt of Nypa jungle should seawards remain for erosion protection of the plantations or not
- Apart from tapping of sap for test production of sugar, alcohol and vinegar, also the unripe endosperms (fruits) should be sampled for creating food products. All the other possibilities of utilization of the Thailand experiences should be tested.

- By tapping of sap and sampling of the immature seedlings, the reproduction power of Nypa through floating seedlings would be reduced.

- Harvesting of the seedlings directly from the Nypa palm and sampling during floating is necessary to avoid Nypa seeds to penetrate into the experimental plantations and germinate there. The ripe seedlings can be used as high-quality firewood (high-quality because of the gold-brown colour of the smoke-dried products).

- All fishers along the entire Nigerian coast should be inspired to sample the floating Nypa seedlings for fire wood as it has started already in Bakassi (Cameroon). The increasing deficiency of mangrove firewood will contribute to this also from ecological point of view extremely urgent activity.

5.3. Proposed Field Station in the Nigerian Mangrove States

Below is a proposed Nypa field station by BDCP

- *Responsibility:* UNIDO will anchor the initiative under the auspices of GCLME. The overall coordination will be handled by the Regional Coordinating Unit (BDCP) and the latter will see to the proper running and ensure continuity of the station; with the help of the sub-stations in each state.

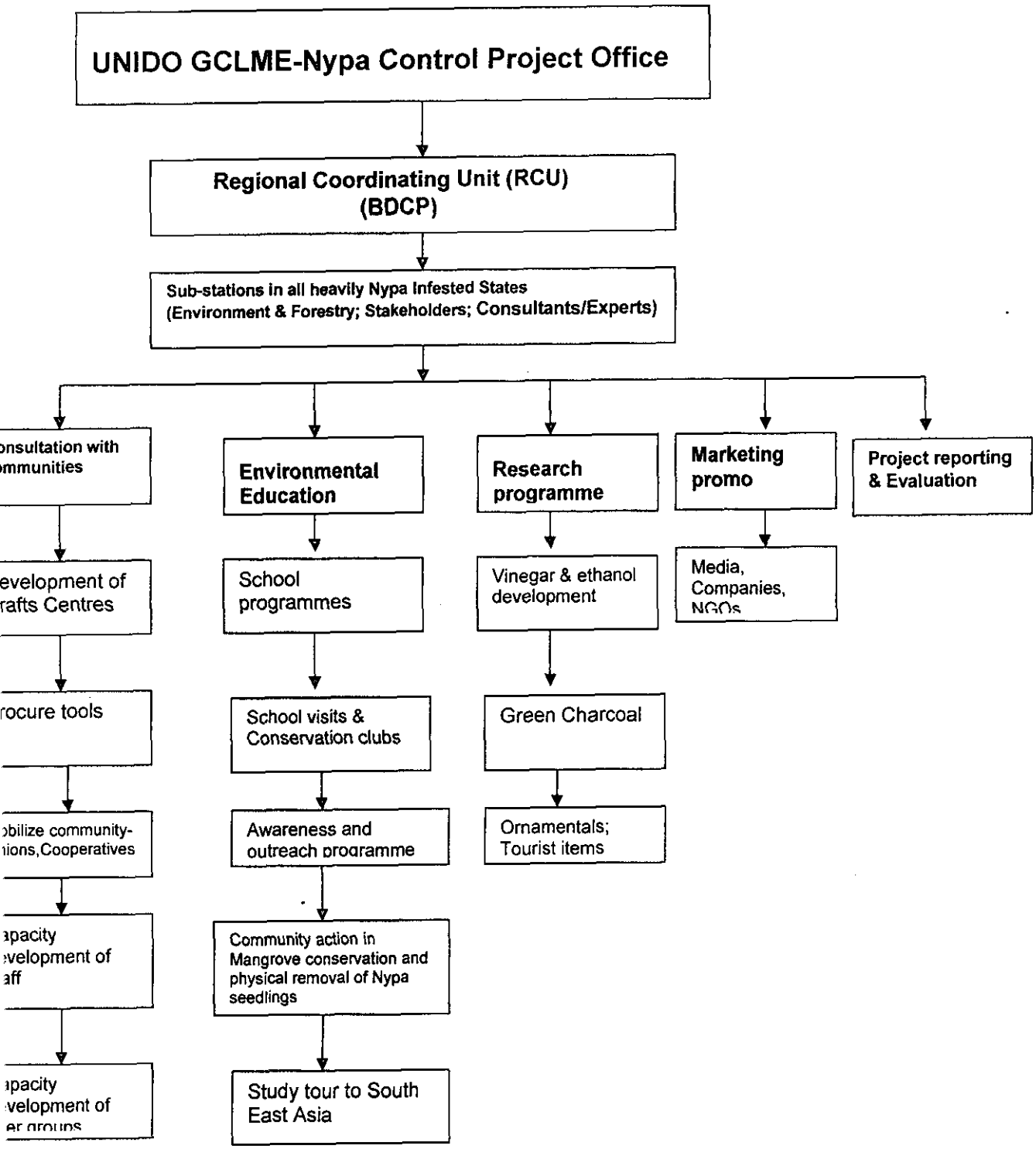

Chart 1 Organizational Structure for Proposed Nypa Field Station_BDCP 2007

The Regional Coordinating Unit (RCU) will have the following sections:

5.3. 1. Environmental Education Section

- An **Information Centre** should be established within the RCU and the latter should be made to occupy a central position. There should be a permanent exhibition part with fundamental graphs, photographs and models relating to the mangrove ecosystem and interrelations between natural and socio-economic factors. Another part of the exhibition should be variable containing

actual topics such as anniversaries, international and national relevant conferences or documentations from travels to other mangrove ecosystems. Both parts should be enriched with audio-visual and interactive systems. Target groups are school classes, student groups, environmental societies, policy makers and the general public.

- Periodically (monthly/weekly) should be organized **Public Presentations** with general and actual topics relating to Coastal Area Management, especially Nypa-mangrove. Modern presentation techniques should be available, especially multi-media presentation facility (Power Point). Target groups are school classes, students, environmental societies and other relevant groups.

- **Brochures** on coastal area aspects, especially Nypa-mangrove, should be added for environmental enlightenment and education.

- Regular **Schooling of Multipliers** for environment-friendly and sustainable management of the mangrove ecosystem should be integrated. Topics could be e.g. establishing of mangrove nurseries, planting of mangrove trees, sustainable utilization of mangroves or multiple utilization of Nypa Palm as food source. Target groups are representatives from mangrove villages in the concerned State Mangrove Reserve, from other mangrove villages along the Nigerian coast as well as other West African countries, especially the neighbouring Cameroon.

- The available rooms and facilities should also be used for **Practical Studies of Students** e.g. from forestry, fisheries, marine science and coastal zone management.

- **Guided Excursions** in the Mangrove Reserve by boat should be an important component. Target groups are students, members of environmental societies, policy makers, as well as national and international eco-tourists.

- The media such as **Radio, Television and Newspapers** should be intensively utilized for enlightenment and education of the public in environmental and sustainable utilization issues.

- The **Maintenance of Electronic Techniques** for presentations should be given a high priority. The storing should be generally in dust-proof cupboards equipped with bulbs for reducing the relative air humidity.

5.3.2 Mangrove Reserve Management Section:

This section should be responsible for all activities of forest and wildlife management. It should keep also the contacts with the villages inside the Mangrove Reserve. The rangers/guides should belong to this section of the RCU. Relating to the guide function, the section should collaborate with the Environmental Education Section.

- Priority should be given to a complex **Inventory Survey** in the mangrove reserve with three components: **Mangroves, Wildlife** (animals) and **Human Settlements.**

- During the **Mangroves** component of the survey is to find out the species composition, under special consideration of the relation between mangrove trees and Nypa Palm, size class distribution and regeneration potential in terms of wildlings and flowers/fruits. The mangroves survey is to be accompanied by taking soil samples. It should also be surveyed the forestry practices and utilization level. The mangrove component of the survey should be repeated in intervals of five years.

- From the mangrove inventory survey are to be derived measures for harmonization of species composition, e.g. by decreased utilization of mangrove trees and increased use of Nypa palm, fixing of minimum stem diameter for harvesting of the different mangrove species or planting of mangrove species in areas with relevant soil composition.
- The component **Wildlife** of the inventory survey should include mammals, birds, amphibians, reptiles, fish, crustaceans, molluscs and insects. Of interest is distribution of species and stock size estimations. From the survey results are to derive endangered species, regulations for utilization by humans and measures for ensuring an optimum species proportion. The wildlife component of the survey should be repeated in intervals of five years, parallel to the mangroves component.
- In the component **Human Settlements** of the inventory survey are to be found out socio-economic factors such as number and size of settlements and their geographic positions, demographic data, occupations of the settlers,

income, fisheries practice and production, fuel wood and timber exploitation, Nypa palm utilization, income, infrastructural facilities such as provision of drinking water, school, medical service. The Human Settlements component of the survey should be repeated in intervals of five years, parallel to the mangroves and wildlife components.

5.3.3. Research Coordination Section:

- This Section should find out the relevant research topics in collaboration with the Management Unit/RCU, coordinate the performance of the research of national and international guests, especially MSc- and PhD students and supervise the activities, parallel to the university professors. While the Management Unit concentrates on mangroves, wildlife and socio-economic surveys and its management conclusion, the Research Coordination Unit handles basic and applied special research topics. The results should fuel the tasks of the Management Unit. From the endless chain of research opportunities with bio-chemo-physical and socio-economic content here will be mentioned only a selection of practice-relevant topics.
- Influence on the productivity of the estuarine environment, of Nypa palm forest in comparison with a mangrove forest, considering micro-organisms, plankton, benthos and fish. There is obviously a continuous dying of the down leaves of Nypa Palm; is this comparable with the leaf fall of mangrove trees?
- Development of rational methods for harvesting the rhizomes, which can be used as fire wood to smoke-dry fish and shrimps or sugar production, additionally to the mature Nypa seedlings.
- Despite the intensive literature studies as well as visits to and email contacts with Asian specialists, there was not found any example where Nypa palm was removed and mangrove trees planted. In this connection, important questions remain:
- Will Nypa palm die after three times cutting the leaves or will the vegetative reproduction still continue from the rhizomes in the soil (mud)? Is it sufficient to remove the leaves several times or is it necessary to dig out the rhizomes in order to kill Nypa palms?
- If the preliminary result of NCF could be confirmed that Nypa can be killed by three times cutting of the leaves, which time is needed for decomposition of the dead rhizomes?
- Can the nutrient deficiency which probably exists by accumulating and blocking nutrients in the rhizomes be compensated by fertilization?

- Which method of fertilization could be applied in a tidal environment?
- Is it needed to establish nurseries for mangrove planting? Which criteria could be used? Density of fiddler crabs? How many crabs per area unit, a mangrove plantation can tolerate without using nurseries? If nurseries are needed, which is the minimal size of mangrove saplings for planting without being killed by fiddler crabs?
- Investigations for development of a method for age determination of Nypa palm.

5.4. Further activities towards technological/indigenous knowledge transfer from Southeast Asia (Thailand) –Nigeria

In the frame of follow-up activities of the ministerial/pilot study visit to Thailand in 2006, there should be prepared another study visit of a delegation composed mainly of members of potential demonstration sites/villages and experts. This second study visit to Thailand should help to convince the potential mangrove planters/Nypa users, after physically witnessing the processing methods and products at the Nypa Processing Institute.

5.5. Proposed Workplan For An Indepth Assessment To Confirm The Reported Uses And To Establish Further Transformation Products From Nypa Palm, With Detailed Costing

Indications of use of Nypa in Nigeria are in the production of craft and house hold items, medicine and fodder (Ogun and Ondo States) and production of fashion apparels. The production of food and snacks, vinegar, and sugar as reported from South East Asia requires in-depth investigation including the creation of awareness toward acceptance of the products by Nigerians. Preliminary studies in sap collection produced very discouragingly poor results. The work plan proposed here will, therefore, seek to understand the importance of the various use strategies towards improving and making them economically viable. As seen above (see Section 1.2.2.1), the activities will be coordinated by the RCU and carried out at the Nypa palm craft workshops as well as the state sub-stations. A four-year period has been proposed although the monitoring and evaluation is expected to last for atleast five (5) years.

Monitoring and Evaluation (M&E): An M&E Plan will be developed with project level indicators (including process and environmental status indicators) to provide a

framework to monitor the performance and impacts of project activities on the global environment. The project will generate baseline information based on the impact indicators by the end of the first year of implementation. **It is expected that monitoring of these indicators will continue during and beyond project implementation.** Best practices and lessons learned from the monitoring and evaluation activities would be widely disseminated for use by other community development and environmental conservation projects. This monitoring and evaluation plan and indicators of success would be related to major outcomes.

Proposed scheme

1. Establish a project unit in South South region of Nigeria called UNIDO-GCLME Nypa Control Project (provide detailed costing of establishment e.g. office spaces, project staff, activities budget etc) possibly in Calabar. The project office will be responsible for the execution of the following sub-projects.

2. Capacity building of local people to be carried out by the project – demonstration project in selected communities.

3. The projects will have market assessment and development aspects for Nypa products

    a. **Phase 1: Assess the existing situation.** Understand the issues as regards the local community members; define the problems and opportunities, and shortlist a range of products.

    b. **Phase 2: Identify/specifying products, markets and means of marketing.** Decide on the best products and gather information for their further development.

    c. **Phase 3: Plan enterprises for sustainable development.** Formulate a business plan and prepare for implementation.

4. Consult the Institutions (government and non-government) in Thailand and other Asian countries that have products and works on Nypa and build collaboration – exchange visits etc

5. Monitoring and Evaluation aspect

6. Institutional aspect e.g. proposing of regulations especially on Nypa free zones etc

7. Regular meeting of stakeholders to evaluate options and access progress
8. Conduct further research on socioeconomics aspects and on further product development
9. Mangrove enrichment planting

Costing for the Proposed Scheme

Establishment of GCLME-Nypa Control Project Office
Detailed Costs for the First Year

S/No	Item	Price/unit (₦)	Quantity /No.	Amount (₦)
1	Hiring of Office space per annum	400,000	4	1,600,000
2	File cabinets	15,000	3	45,000
3	Office Tables/Chairs	40,000	6	240,000
4	Desktop Computers	120,000	5	600,000
5	Wireless Internet access	500,000	1	500,000
6	Monthly Subscription	20,000	12	240,000
7	Stationeries and consumables	10,000	12	120,000
8	Salary for Programme Officer	250,000	12	3,000,000
9	Salary for monitoring and evaluation officer	100,000	12	1,200,000
10	Salary for market assessment and development officer	100,000	12	1,200,000
11	Salary for research assistants	150,000	12 x 2 assistants	3,600,000
12	Other support staff	80,000	12 x 3	2,880,000
13	Project vehicle	5,000,000	1	5,000,000
14	Impress	20,000	12	240,000
15	Boat (preferably fiber boat)	750,000	1	750,000
	Total			**21,215,000**

Table 8: (BDCP Field Source)

Note: The Programme officer will serve as the coordinator and will over-see the running of the RCU. The research assistants will be persons who have distinguished themselves in the field

of Mangrove and Nypa research. In order to cut costs, the Control Office will also serve as the RCU.

Capacity Building of Local People – Demonstration Sub-Project
Detailed costing (4 sensitization workshops)

S/No	Item	Price/unit (₦)	Quantity/No.	Amount (₦)
1	Organizational costs (local transport, ICT facilities, printing of invitation cards and hand bills)	200,000	4	800,000
2	Per diem for resource persons	200,000	4 x 4 demonstrations	1,600,000
3	Printing of leaflets and pamphlets to be distributed to participants	100	2000	200,000
4	Hiring of Venue	50,000	4	200,000
5	Refreshment during workshop	500	500 x 4	1,000,000
	Total			**3,800,000**

Table 9 (BDCP Field Source)

Note: The workshops will be organized at intervals with the aim of capacity building and data collection as well as assessment. The participants will be drawn from each concerned State and will serve as trainers in the sub-stations upon their return.

Detailed Costing of Market Assessment and Development

S/No	Item	Price/unit (₦)	Quantity	Amount (₦)
1	Rapid rural appraisal in 3 locations (transport, per diem and for 6 researchers for one week, and logistics)	500,000	3	1,500,000
2	Marketing research in 3 locations	500,000	3	1,500,000
3	Business plan development	500,000	1	500,000
4	Organization of trade fairs and exhibition of products	2,000,000	1	2,000,000
	Total			**5,500,000**

Table10 (BDCP Field Source)

Note: This stage is aimed at market promotion of the products/uses of Nypa and local, national as well as international companies (including Oil Companies) will be invited. The oil companies will be encouraged to invest in the venture as part of their community development efforts in the Niger-Delta states where their activities are carried out.

Detailed Cost of Collaboration with Thailand (visits) for one year

S/No	Item	Price/unit (₦)	Quantity	Amount (₦)
1	Budget for Travel cost and per diem for the Visit to and Development of collaboration with Thailand	600,000	4	2,400,000
2	Ancillary costs for the development of the collaboration and training of manpower	1,000,000	2	2,000,000
	Total			**4,400,000**

Table 11 (BDCP Field Source)

Note: The trip to Thailand will involve an intensive training of the persons and open possibilities for further collaboration and/or investment.

Detailed Cost of Monitoring and Evaluation for five years

S/N	ITEMS	COST PER UNIT	TOTAL FOR 5 YEARS
1.	Baseline Survey (non-recurrent)	N5,000,000.00	N5,000,000.00
2	Mid-term evaluation (non-recurrent)	N3,000,000.00	N3,000,000.00
3	Data Collection/Collation (per annum)	N1,000,000.00	N5,000,000.00
4	End of programme evaluation (non-recurrent)	N3,000,000.00	N3,000,000.00
5	**Total**	**N14,000,000.00**	**N16,000,000.00**

Table 12 (BDCP Field Source)

Note: Cost per unit above, implies the cost for each phase of the activity (in this case running for a year). Besides the data collation, the rest will be carried out once for a one-year period.

Detailed Cost of Enrichment Planting

S/No	Item	Price/unit (₦)	Quantity	Amount (₦)
1	Labour cost of planting	1000/man/day	1,460 man days	1,460,000
2	Allowance for logistics			5,000,000
	Total			**6,460,000**

Table 13 (BDCP Field Source)

Note: The enrichment planting with mangrove seedlings will be done in the places where the Nypa has been cut and a total of five workers (villagers drawn from each community visited) will be employed to work for the four year duration (i.e. 1,460 days). The other staff will be drawn from the State Forestry Departments.

Development of Craft Centres

S/No	Item	Price/unit (₦)	Quantity	Amount (₦)
1	Procure tools and equipment for the craft centres	30,000,000	2	60,000,000
2	Costs for the development and running of the substations	5,000,000	5	25,000,000
	Total			**85,000,000**

Table 14 (BDCP Field Source)

Note: The craft centres will be two while the sub-stations will be five in number to represent the Nypa-prevalent states (there might not be a need to still have sub-stations in the states where the centres exist). The tools and the running of the centres will follow the same pattern as the RCU above on a smaller scale. Having in mind that the state and local governments will assist in the setting up and running of the sub-stations with help from the local CBOs and unions. The equipments to be bought will also be determinant of the actual amount to be used under procurement (the above are estimates).

WORK PLAN

PROJECT STEP	OBJECTIVE	SPECIFIC ACTIVITY	RESPONSIBLE PARTIES	TIME DURATION	EXPECTED OUTPUT
The first step is the **Consultation with communities**	Adopt a Bottom-Top policy formation to increase active local participation and choice of cottage industries by local people.	Identify/Establish links with all Stakeholders in the costal areas and others concerned with Nypa Palm. Initiate linkages and communication network with the concerned communities through the traditional rulers.	**GCLME-Nypa Control Project Office**, Coastal Communities	6 months (1st and 2nd quarter of year 1)	Report on extent of local people participation and choice of cottage industry.
The second step is the **Development of Crafts Centres**	(1) procure tools (2) mobilize community (3) capacity development of staff	To identify and purchase tools suitable for the establishment of craft centre in the substations. Based on the documented choice of local people, organize training parties.	**GCLME-Nypa Control Project Office**, Coastal communities.	3 months (1st quarter) 21 months (3rd quarter in 1st year to 1st quarter in 3rd year)	Report on the purchase of tools, response of local people and capacity development of staff and user groups identified.

	(4) capacity development of user groups	Training, skill development and capacity building of staff and user groups to utilize Nypa for production of domestic and commercial products. Local advertisement and media promotion.		12 months (3rd quarter of 1st year to 2nd quarter of 2nd year) 2nd year and 1st quarter of 3rd year	
The third step is the **Environmental Education:**	1) School programmes 2) School visits & conservation clubs 3) Awareness and outreach programme	Carry out public presentations on documented uses and lessons learnt. Schooling of Multipliers for environment-friendly and sustainable management should be integrated. **Guided Excursions** in the Mangrove Reserve by boat should be an important component.	**GCLME-Nypa Control Project Office**, Stakeholders, NGOs, Government Agencies, International Expert and Schools.	45 months 45 months 48 months	Report on school programmes initiatives; schools visits and follow up activities with respect to conservation clubs formed.
The fourth step is the **Community action in Natural Mangrove stand maintenance and physical removal of Nypa seedlings**	Creating a limit or a Nypa free zone with respect to spread of Nypa Palm in Nigeria. Ensure sustainable development of all mangrove formations and the control of Nypa through its rational utilization potential strategies	Discouraging mechanical activities which might affect the ecosystem and ecology and carry out enrichment planting of mangroves Picking seeds on water or developing booms to prevent Nypa Palm seeds from floating freely.	**GCLME-Nypa Control Project Office**, and Coastal Communities	42 months	Report on the No Nypa free zones created and utilization potentials of Nypa Palm used to actualize mangrove stand maintenance.
The fifth step is the **Study tour to South East Asia**	Technological/indigenous knowledge transfer Southeast Asia (Thailand) – West Africa (Nigeria) collaboration Representatives of all	Initiate pilot study visit to Thailand. A visit to the special Nypa Processing Institute in Thailand to	**GCLME-Nypa Control Project Office**, Scientific Committee including Institutions/NGOs that have worked	12 months (1ST visit in the 3rd and 4th quarters of 1st year and second visit in the	Scheme of Assessment Work proposed

	potential Nigerian demonstration villages should join in the establishment and demonstration site/village in order to participate in technical seminars for detailed knowledge transfer. With this activity a larger set of multipliers for Nypa utilization will be created.	convince the potential mangrove planters/Nypa users, after seeing with their own eyes the processing methods and products.	extensively on Nypa palm, Coastal Communities	3rd and 4th quarters of the 4th year)	
The sixth step is **Research programme** Vinegar & ethanol development	Develop an assessment method to be used in confirming the uses and in establishing further transformation products from Nypa Palm.	Development of rational methods for harvesting the rhizomes and sap which can be used as fire wood to smoke-dry fish and shrimps or sugar production, vinegar and ethanol production	**GCLME-Nypa Control Project Office,** Scientific Committee including Institutions/NGOs that have worked extensively on Nypa palm.	33months (4th quarter of 1st year to 2nd quarter of 4th year).	Report on confirmed uses and suitability of such uses/products to Nigeria.
The seventh step is **Marketing promo**	Increase local and international awareness of Nypa Palm products, especially its availability in Nigeria.	Setting up entrepreneurship support scheme to motivate the participating youths Support participants in trade fairs and exhibitions as a way of promoting the product and market strategy	**GCLME-Nypa Control Project Office,** Institutions/NGOs that have worked extensively on Nypa palm.	36 months (3rd quarter of 1st year to 2nd quarter of 4th year).	The public is expected to be knowledgeable about Nypa Palm products and the need to sustainably use mangroves
The eight step is **Project reporting**	To prepare and submit reports to UNIDO once in every two quarters.	Prepare concise reports intermittently. Submit prepared reports to UNIDO.	**GCLME-Nypa Control Project Office**	Once every 6 (six) months	Concise reports submitted to UNIDO.
The ninth step is **Project evaluation**	Ascertain economic, social and environmental impact of project.	Monitoring and evaluation will be carried out at the start of the project, while the project is on-going, at the end of the project and after the completion of project activities.	**GCLME-Nypa Control Project Office; State Governments (Forestry)**	Beyond 4 years	Submit a concise report to UNIDO.

Table 15 (BDCP Field Source)

Section 6

Conclusions and Recommendations

6.1. Activities required to contain Nypa threat.

From ecological perspective the displacement of mangrove vegetation by alien Nypa is regarded as a serious threat to the existence of the original mangrove. However, the Focus Group Discussion (FGD) conducted during the present study has not shared this view. Therefore, in order to contain this perceived threat, it is necessary to take the following steps.

a) control of Nypa by utilization such as using the seed as earrings, fronds as mat and regular harvest of fronds; it is noted that 3 cuttings of Nypa killed them
b) up rooting of Nypa plants in states where the Nypa is not yet a threat; which is however difficult
c) instituting a coastal management system/Nypa work station involving regeneration of mangrove with local participation, enrichment planting, adoption of agroforestry interventions and practices, and establishment of forest reserves or strict forest reserves (SNRs), to regulate the management of mangrove/Nypa formations.
d) Training and capacity building on the procedures and techniques of Nypa products utilization as enumerated in this report. The willingness of the communities to engage in such training should be utilized with appropriate infrastructural development and incentives structure.

6.2. Policy Frame work

Conservation of genetic resources such as mangrove vegetation implies the development, sustainable and rational use of the resources. It must therefore involve not only the government sector but also the local people and local institution. It must also adopt a multidisciplinary and multi-locational research and development strategy.

In the case of mangrove formations, inhabitants of fishing settlements and other stake holders should be actively involved in the management and sustainable exploitation of the mangroves including nypa palms. The potential of the species for provision of various useful products should be explored and harnessed. Similarly, their protective roles should also be exploited. The local people should also be engaged in maintaining a critical balance between the invasive Nypa palm and the original mangrove components. As already stated, regular harvesting of Nypa palm and regeneration of mangrove species are some of the steps to be undertaken. Government policy should be enacted to facilitate such steps as the provision of incentives as well as training and capacity building. Government should also assist

communities which have the Nypa palm in abundance in creating local industries separate from those to be funded by International bodies.

6.3. Suggested Action Plan

6.3.1. Individual and community level

At the individual and community levels, training and information sharing are crucial to achieve the goals itemized under policy frame work. The sharing of information on the value of Nypa has already been started by BDCP and may further be achieved through state workshops involving community leaders, other villagers, Forestry and Ministry of Environment personnel.

6.3.2. Government Level

One of the most important ways that government (at local and state levels) can contribute to the conservation and sustainable utilization of mangrove species is by allocating funds to campaigns that will encourage interest in the use of mangroves and that will also generate awareness of the economic and ecological importance of the species and ecosystem. Funds are required for local initiatives such as preservation of wildlife sanctuaries and the formation of protected areas. Control of oil exploration activities must also be legislated upon.

6.3.3. International Level

The assistance of international organizations such as UNIDO, WWF, MAB, IUCN working with local institutions and NGOs such as BDCP and NCF should be sought in order to conserve critical habitats, and to establish ecotourism centres based, for instance, on mangrove monkeys and other wildlife.

6.3.4. Collective

Everyone must join hands in establishing a Nypa Management System which will be in form of Work Stations and Craft Centres.

Recommendations:

(1) The suggested action plan and policy framework set out above should be considered and implemented in order to develop as well as use sustainably the species and sites of conservation interest in the mangrove ecosystem.

(2) The issue of wholesale Nypa eradication should be given a second thought since the local inhabitants of fishing settlements are convinced that its usefulness far outweighs its perceived adverse impacts

(3) It is expedient therefore to control Nypa distribution by its judicious regular exploitation

(4) Any approach adopted should be seen to involve the communities and the latter should be fully involved in the management process.

(5) The Nypa Management Team, Work Station and Project Offices should be established as shown in Annex B below and activities as well as monitoring of the projects should far exceed the recommended period of 4years.

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LIST OF ANNEXES

ANNEX A – PROJECT WORK PLAN

JECT STEP	OBJECTIVE	SPECIFIC ACTIVITY	RESPONSIBLE PARTIES	TIME DURATION	EXPECTED OUTPUT
first step is the MITATION AND NTIFICATION THE EXTENT INFESTATION THE GROVE ESTS BY NYPA M ALONG THE ERIAN COAST	To delimit and quantify the extent of infestation of the Nigerian Mangrove forests by Nypa Palm.	Identify/Establish links with all Stakeholders in the costal areas and others concerned with Nypa Palm. Constitute Project Committees (Steering, Advisory and Scientific/Technical). Carry out training sessions of ad-hoc staff to be involved in site survey. Identify/map out Nypa infested areas. Initiate linkages and communication network with the concerned communities through the traditional rulers. Undergo site survey. Assess the effect of Nypa Palm on Mangrove biodiversity.	BDCP, Adhoc Staff, Coastal Communities	1 month	Report on extent of Nypa palm infestation determined
he second step is ie OCUMENTATION F THE IMPACT OF YPA PALM NFESTATION ON HE MANGROVE UB-ECOSYSTEM F COASTAL IGERIA AND ON HE LIVELIHOODS F COASTAL OPULATIONS.	To document the impact of Nypa Palm infestation on the Mangrove sub-ecosystems of coastal Nigeria. To document their effect on the livelihoods of coastal populations in	Produce initial survey reports. Hold meetings with/ distribute questionnaires to the communities to assess the impact of Nypa Palm on their livelihoods. Analyze the data obtained and document such	BDCP, Coastal communities.	1 month	Report on the extent of impact on mangrove sub-ecosystem and on livelihoods identified.

	Nigeria.	impacts. Compare the sites visited in Project step 1 with other mangrove sites devoid of Nypa Palm. Assess the impacts of Nypa Palm on Nypa infested mangrove sub-ecosystems. Document such impacts.			
third step is the IEW OF IONS FOR THE ITROL OF 'A PALM LUDING CHANICAL EARANCE AND LIZATION.	To review the available options for the control and utilization of Nypa Palm.	Carry out a literature research and compile a draft on documented uses and lessons learnt. Hold a Stakeholders meeting. Compile options for the control and utilization of Nypa Palm.	BDCP, Stakeholders, NGOs, Government Agencies, International Expert	0.5 months	Report on "Methods of Nypa Palm Control" documented.
e fourth step is VESTIGATION OF IE POTENTIAL VERSE USES OF YPA PALM.	To investigate the diverse uses (edible, medicinal, aromatic, pesticidal, ornamental etc.) to which Nypa Palm can be put.	Research on the diverse uses of Nypa Palm through pilot projects. Determine practically the suitability of the uses learnt from the expert to the Nigerian system. Hold workshops with the coastal communities to demonstrate such uses. Document the work in the form of a practical guide to the effective utilization of Nypa palm.	BDCP, Scientific Committee including Institutions/NGOs that have worked extensively on Nypa palm, Coastal Communities	0.5 months	Report on the uses of Nypa Palm
The fifth step is the PROPOSAL OF A SCHEME OF WORK FOR AN INDEPTH ASSESSMENT TO	To propose a scheme of work (with detailed costing) for an	Hold a steering committee meeting where a scheme of work will be developed.	BDCP, Project Steering Committee	0.5 month	Scheme of Assessment Work proposed

FIRM THE ORTED USES TO ABLISH THER NSFORMATION DUCTS FROM A PALM	indepth assessment to confirm the reported uses and to establish further transformation products from Nypa Palm	Develop an assessment method to be used in confirming the uses and in establishing further transformation products from Nypa Palm. Propose a final scheme of work to be used for the above.			
sixth step is to MIT A MPREHENSIVE ORT TO UNIDO	To prepare and submit a final report to UNIDO.	Prepare a final report. Submit the report.	BDCP	0.5 months	Final report submitted to UNIDO.

Table 16 (BDCP Field Source)

ANNEX B1 & B2: WORKPLAN -PROPOSED SCHEME OF WORK

ANNEX B1: WORKPLAN

	ACTIVITIES	Year 1				Year 2				Year 3				Year 4			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	**Consultation with communities**																
2	**Development of Crafts Centres (2):** (1) procure tools																
	(2) mobilize community																
	(3) capacity development of staff																
	(4) capacity development of user groups																
3	**Environmental Education:** 1) School programmes																
	2) *School* visits & conservation clubs																
	3) Awareness and outreach programme																
4	**Community action in *Natura* Mangrove stand maintenance and physical removal of nipa seedlings**																
5	**Study tour to South East Asia**																
6	***Research* programme** Vinegar & ethanol development																
7	**Marketing promo**																
8	**Project reporting**																
9	**Project evaluation**																

Table 17 (BDCP Field Source)

ANNEX B2- WORK PLAN

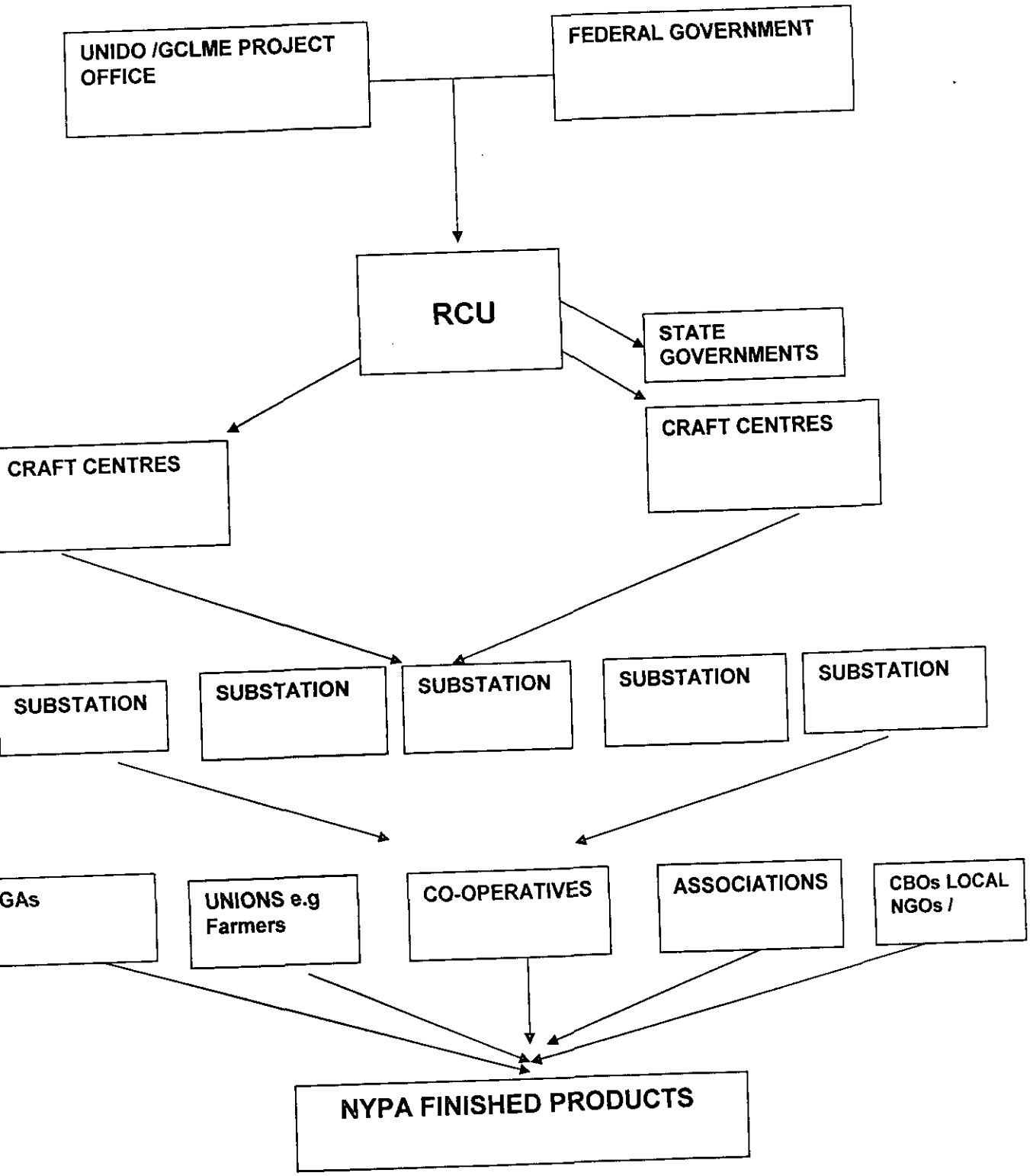
PROJECT STEP	OBJECTIVE	SPECIFIC ACTIVITY	RESPONSIBLE PARTIES	TIME DURATION	EXPECTED OUTPUT
The first step is the **Consultation with communities**	Adopt a Bottom-Top policy formation to increase active local participation and choice of cottage industries by local people.	Identify/Establish links with all Stakeholders in the costal areas and others concerned with Nypa Palm. Initiate linkages and communication network with the concerned communities through the traditional rulers.	**GCLME-Nypa Control Project Office**, Coastal Communities	6 months (1st and 2nd quarter of year 1)	Report on extent of local people participation and choice of cottage industry.
The second step is the **Development of Crafts Centres**	(1) procure tools (2) mobilize community (3) capacity development of staff (4) capacity development of user groups	To identify and purchase tools suitable for the establishment of craft centre in the substations. Based on the documented choice of local people, organize training parties. Training, skill development and capacity building of staff and user groups to utilize Nypa for production of domestic and commercial products. Local advertisement and media promotion.	**GCLME-Nypa Control Project Office**, Coastal communities.	3 months (1st quarter) 21 months (3rd quarter in 1st year to 1st quarter in 3rd year) 12 months (3rd quarter of 1st year to 2nd quarter of 2nd year) 2nd year and 1st quarter of 3rd year	Report on the purchase of tools, response of local people and capacity development of staff and user groups identified.
The third step is the **Environmental Education:**	1) School programmes 2) School visits & conservation clubs 3) Awareness and outreach programme	Carry out public presentations on documented uses and lessons learnt. Schooling of Multipliers for environment-friendly and sustainable management	**GCLME-Nypa Control Project Office**, Stakeholders, NGOs, Government Agencies, International Expert and Schools.	45 months 45 months 48 months	Report on school programmes initiatives; schools visits and follow up activities with respect to conservation clubs formed.

		integrated. **Guided Excursions** in the Mangrove Reserve by boat should be an important component.			
The fourth step s the **Community action in Natural Mangrove stand maintenance and physical removal of Nypa seedlings**	Creating a limit or a Nypa free zone with respect to spread of Nypa Palm in Nigeria. Ensure sustainable development of all mangrove formations and the control of Nypa through its rational utilization potential strategies	Discouraging mechanical activities which might affect the ecosystem and ecology and carry out enrichment planting of mangroves Picking seeds on water or developing booms to prevent Nypa Palm seeds from floating freely.	**GCLME-Nypa Control Project Office**, and Coastal Communities	42 months	Report on the No Nypa free zones created and utilization potentials of Nypa Palm used to actualize mangrove stand maintenance.
The fifth step is the **Study tour to South East Asia**	Technological/indigenous knowledge transfer Southeast Asia (Thailand) – West Africa (Nigeria) collaboration Representatives of all potential Nigerian demonstration villages should join in the establishment and demonstration site/village in order to participate in technical seminars for detailed knowledge transfer. With this activity a larger set of multipliers for Nypa utilization will be created.	Initiate pilot study visit to Thailand. A visit to the special Nypa Processing Institute in Thailand to convince the potential mangrove planters/Nypa users, after seeing with their own eyes the processing methods and products.	**GCLME-Nypa Control Project Office**, Scientific Committee including Institutions/NGOs that have worked extensively on Nypa palm, Coastal Communities	12 months (1ST visit in the 3rd and 4th quarters of 1st year and second visit in the 3rd and 4th quarters of the 4th year)	Scheme of Assessment Work proposed
The sixth step is **Research programme** Vinegar & ethanol development	Develop an assessment method to be used in confirming the uses and in establishing further transformation products from Nypa Palm.	Development of rational methods for harvesting the rhizomes and sap which can be used as fire wood to smoke-dry fish and shrimps or sugar production, vinegar and ethanol production	**GCLME-Nypa Control Project Office,** Scientific Committee including Institutions/NGOs that have worked extensively on Nypa palm.	33months (4th quarter of 1st year to 2nd quarter of 4th year).	Report on confirmed uses and suitability of such uses/products to Nigeria.

seventh is **ting o**	Increase local and international awareness of Nypa Palm products, especially its availability in Nigeria.	Setting up entrepreneurship support scheme to motivate the participating youths Support participants in trade fairs and exhibitions as a way of promoting the product and market strategy	**GCLME-Nypa Control Project Office,** Institutions/NGOs that have worked extensively on Nypa palm.	36 months (3rd quarter of 1st year to 2nd quarter of 4th year).	The public is expected to be knowledgeable about Nypa Palm products and the need to sustainably use mangroves
eight step **Project rting**	To prepare and submit reports to UNIDO once in every two quarters.	Prepare concise reports intermittently. Submit prepared reports to UNIDO.	**GCLME-Nypa Control Project Office**	Once every 6 (six) months	Concise reports submitted to UNIDO.
ninth step **Project luation**	Ascertain economic, social and environmental impact of project.	Monitoring and evaluation will be carried out at the start of the project, while the project is on-going, at the end of the project and after the completion of project activities.	**GCLME-Nypa Control Project Office; State Governments (Forestry)**	Beyond 4 years	Submit a concise report to UNIDO.

Table 18 (BDCP Field Source)

ANNEX C1: ORGANIZATIONAL STRUCTURE SHOWING THE FUNCTIONS /ACTIVITIES TO BE CARRIED OUT BY ALL ROLE PLAYERS OF THE PROPOSED NYPA PALM MANAGEMENT SYSTEM



Annex C2:
Functions of the different arms of the Nypa Management Units and Craft Centres

S/No.	Section	Components	Functions
1.	UNIDO Project Office		i. Over-see the entire running of the project ii. Funding iii. Liaise between Local and International Organizations/Governments
2.	Regional Coordinating Unit (RCU)	BDCP (assisted by recruited Experts & Resource Persons)	i. Liaise between UNIDO and State Governments, Communities ii. Assessment iii. Survey iv. Documentation v. Supervision vi. Training of Trainers vii. Research viii. Data Accumulation and Circulation ix. Liaise between and Identify all stakeholders x. Monitoring and Evaluation
3.	Craft Centres		i. Liaise between the RCU and Communities ii. Training iii. Industrial production iv. Collaborate with local NGOs and CBOs v. Monitoring and Evaluation vi. Supervision of Sub-stations vii. Exhibitions,Fairs viii. Technology transfer ix. Organize Workshops
4.	Sub-Stations	Nypa-infested States	i. Enrichment planting ii. Community assistance and training iii. Collaboration with stakeholders iv. Assist in formation of local Unions v. Assist in the obtaining and management of funds disbursed to unions vi. Identifying of suitable locations for planting vii. Identifying persons suitable for training
5.	Institutions	a) Local Government b) Unions e.g. Farmers c) Cooperatives d) Associations e) NGOs/ CBOs	i. Marketing ii. Obtaining of Laon Facilities iii. Public Awareness iv. Experience sharing v. Technical Assistance vi. Mobilization vii.

Table 19 (BDCP Field Source)

Location of proposed offices

Office	Locations (State)
UNIDO Project Office	Abuja/ Cross-River
Regional Coordinating Unit (RCU)	Cross-River
Craft Centres	Akwa-Ibom and Bayelsa or Rivers
Sub-stations	Akwa-Ibom, Bayelsa, Cross-River, Delta, Rivers

Table 20 (BDCP Field Source)

Note:
(1) The prevalence of Nypa palm in Edo and Ondo States is not yet at an alarming rate and as such it has been proposed that mechanical clearance be used in such states, followed immediately by enrichment planting of mangrove seedlings to prevent the Nypa from re-emerging.
(2) For the two states where the craft centres exist, there might not be a need to establish sub-stations. These two sub-stations can then be established in Edo and Ondo if the states insist on control by utilization.

ANNEX D- REPORT ON THE TECHNICAL SCIENTIFIC WORKING GROUP AND PROJECT STEERING COMMITTEE MEETING

Minutes of the working group on the assessment of control measures for Nypa palm infestation in Nigeria

The group comprises of:

Prof. Obot (Chairman and Consultant on the project)

Mr. M. P. O. Dore

Dr. Omorefe Asemota

Prof J. C. Okafor

Prof. E. Sokomba

Dr. Ahmed R. Kasim (Rep. National Coordinator GCLME).

Mr. Sunny U. (Rapporteur).

Ms. Ngozi Aligwekwe

Mr. N. Adimorah

Mr. Thomas Taangahar

Absent: Dr. Ohimain

Step 1.

Delimitation and quantification of the extent of infestation of the mangrove forests by Nypa Palm along the Nigeria coast.

Outcome: Survey and inventory will be carried out to ascertain the level of Nypa Plam in the mangrove forests of the Nigeria coast.

- Movement (car, boat and any other means of transportation in the coastal region)
- Local participation
- Local Taxonomist
- Factors that can militate against the survey and inventory of the Nypa Palm infested areas.
- Inadequate information to the community
- Community resistant
- Youth militants

Survey equipments includes the use of handheld GPS, Maps, Satellite imagery to ascertain the locatiom, area and demarcation. Prof Obot, Dore and Sunny will be responsible for the training.

Step 2.

Documentation of the impact of Nypa Palm infestation on the mangrove sub-ecosystem of coastal Nigeria and on the livelihood of coastal populations

Outcome: a questionnaire will be design by a social economist on the socio economic benefits to the coastal community.

Step 3.

Review of options for the control of Nypa Palm including mechanic clearance and utilization.

Outcome: At the inflorescence stage i.e. cut off the flowers when they start to come out.

Cutting off the fronds then cut again after fourteen (14) days. This is done in all seasons.

Step 4.

Investigation of the diverse uses of Nypa Palm.

Anatomy of the plant

Questionnaire for the diverse uses of Nypa Palm from the coastal community

Ministers visit to Thailand

Internet base research on the uses of Nypa Palm.

Step 5.

Proposal of a scheme of work for an indepth assessment to confirm the reported uses and to establish further transformation products from Nypa Palm.

Outcome: make a comprehensive report on the ethnobotanical uses of Nypa Plam.

Step 6

Submit a comprehensive report to UNIDO.

Outcome: All reports should be ready at this time. UNIDO as an industrial organization will be interested in the industrial outputs of the project.

Modality for take off.

The first three states are heavily infested namely.

Cross River State

Akwa Ibom State

Rivers State

Delta State is Extensive

Bayelsa State is beginning to come up.

ANNEX E: NYPA PALM WORKING GROUP RECOMMENDATIONS

Attendance

S/No	NAMES	ORGANISATION	ADDRESS	E-MAIL	PHONE NO.
1	Gal Sieghard Holzloehner	10C, UNICAL	UNICAL	Sholzoez@yahoo.com	08052119304
2	Okoro K.O.	Ministry of Environment	Asaba Delta	khalilokoro@yahoo.com	08033725100
3	Prof. J.C.Okafor	Tree Crops and tropical Ecology	No. 7 Dona Drive Indep. Layout Enugu	Jonathan okafor_f@yahoo.com	08035982712
4	Imo Umanah	NCF	NIPA Control by Utilization Project-Eket, Aks	umanahnipa@yahoo.com	08029938062
5	Emmanuel Obot (Prof.)	NCF	Lekki Conservation Cetre Lagos	eaobot@yahoo.com	08023312420
6	O .Asemota	NIFOR	NIFOR P..M.B 1030, Benin City	omorefeasemota@yahoo.com	08037188605
7	Ibrahim Inahoro	NCF Regional Office	10GA Marian street Road Calabar	ibrahiminuloro@yahoo.com	08023595217
8	Ihemejeh Ugochokwu	GCLME	25 Luguard ST.Ikoyi Lagos	Ernest_ihemejeh@yahoo.co.uk	08036754932
9	Ubi Sam	NCF	109 Marian Road Calabar	Ubisam @yahoo.com	08035875769
10	C.O Oshunsanya (mrs)	FME.HUD, Abuja	S.H.E Calabar	Cooshusanya @yahoo.com	08033063512
11	Dore MPO	Wild life Preservation Trust	8,u/uuAdiae Street B/C, Edo State	Mpodore @yahoo.com	08023667704
12	Ernest Chinwo	Thisday Newspaper	Calabar	ernestchinwo@yahoo.com	08033412429
13	Chiefe E.N. Ekeng	Communiy Chief	49 Mustak Way Oron	edyekeng@yahoo.com	08033799275
14	Bette Otu	Min. of Environment	Opposite cultural center Calabar	Esbee2010@yahoo.com	08057605552
15	Joseph E. Asuquo	Min. of Environment Uyo	State Secretariat min. of Environment, Uyo Akwa Ibom	joemilesenior@yahoo.com	08023288936
16	Ngozi Aligwekwe	BDCP	13 Sudan Street, Zone 6, Wuse, Abuja	Ngozi@bioresources.org	08036310802
17	Nnaemeka Chukwuone	BDCP	110 Aku Road Nsukka	nnachuwuone@yahoo.com	08036310802
18	Sunny U.	BDCP	13 Sudan Street, Zone 6, Wuse, Abuja	Sunny@bioresources.org	08033462579

Table 21(BDCP Source)

Expected outputs:

Expected results of the Nypa working group discussions include:

1. The extent of infestation of the Mangrove forests by Nypa palm along the Nigerian Coast delimited and quantified.
2. The impact of Nypa palm infestation on Mangrove sub-ecosystem of coastal Nigeria and on the livelihoods of the coastal populations documented.
3. Options for the control of Nypa Palm including mechanical clearance and utilization reviewed.
4. Diverse uses (edible, medicinal, aromatic, pesticidal, ornamental etc.) to which Nypa palm can be put investigated; the case for Capacity Building.

5. A scheme of work for an indepth assessment proposed to confirm the reported uses and to establish further transformation products from Nypa palm.

Prof. Obot E. of NCF being present but not fit, requested Mr. Dore M. P. O. of the FMEHUD to Chair the group discussions on **Assessment of Control Measures for Nypa palm Infestation in Nigeria**. An inquiry was made, as to if all present have seen a copy of the States report, or if the discussions should be based on Workshop presentations. Finally, a brief rundown of the Sates visits was summarised by resource persons.

1. The extent of infestation of the Mangrove forests by Nypa palm along the Nigerian Coast delimited and quantified.

Discussions on the first issue were to centre on: the availability of seeds in the area, the vegetation in the area, the quantity of Nypa Palm in the area, the level of fishing activities and the villages/settlements found in the area. States and Local Government Areas were discussed taking into consideration River systems, oil facilities and the use of qualitative data and not quantitative data (not minding the scale of infestation).

Further discussions revealed that some States have River water networks which allow Nypa Palm seeds to go about 8 km inland. The possibility of future infestation in mildly infested areas was also considered during the group discussions. The possibility of Nypa palm displacing economic trees was also considered, as in the past Nypa Palm has been found growing beside Oil palm tree. Another vital issue raise is that of Nypa doing better in polluted water. Other invasive species such as Hyacinth plants have also been found to do better in polluted water.

Speculation remains that all ports except Sapele port would be overtaken by Nypa Palm in the near future. The question "Does infestation affect biodiversity and productivity of ecology?" remained unanswered. The claim that infested water increased fisheries availability in Cross Rivers Sate was challenged by the theory of nutrients from the Cameroon Mountains increasing the presence of fish.

RESOLUTIONS

The infestation of the coastal States is summarized briefly into three stages from the initial 10 classifications:

(1) Heavy infestation
(2) Medium infestation
(3) Low infestation

Infestation ratings among coastal States in Nigeria

State visited	Infestation rating
Akwa Ibom	High
Bayelsa	Medium
Cross Rivers	High
Edo	Very Low
Delta	Medium
Rivers	High
Ogun	Non (Susceptible)
Ondo	Low
Lagos	Non (Susceptible)

Table 22 (BDCP Field Source)

The group also resolved that qualitative rather than quantitative indices be considered. This would take into consideration peculiarities such as:

(a) States and LGAs
(b) The presence of fishery settlements
(c) River systems found in the area
(d) Activities of oil companies in the area

2. The impact of Nypa Palm infestation on Mangrove sub-ecosystem of coastal Nigeria and on the livelihoods of the coastal populations documented.

It was generally accepted that Nypa Palm cannot protect better than Mangrove, although Nypa Palm provide protection against sea storm. Extensive human activities also affect Mangroves. There was a high correlation between human settlements and Mangrove loss. Other observations made during the working group discussions include: Nypa being used in the production of household utilities such as mat, cap, hand bag, hand fan, etc; Nypa's inability to serve as firewood and community members going further than necessary to get firewood; fishing

communities responsible for the destruction of Mangrove as a preference to Nypa Palm; and community members should be encouraged to use saw dust as a means of energy generation.

The impact of Nypa palm infestation on Mangrove sub-ecosystem and on the livelihood of coastal populations was considered under the following;

(a) Productivity impact,
(b) Ecological impact, and
(c) Socio-economic impact

Observations made during the discussions include: Nypa Palm stands dislodged can create a big space where it once stood, leading to erosion; if Nypa Palm or Mangrove is completely eradicated, generation gap will make it difficult for people to actually choose between Nypa Palm and Mangrove; distance is responsible for the absence of Nypa Palm in the West coast of Nigeria; Nypa Palm inhibits the natural establishment of Mangrove; the impact of Nypa Palm on the productivity is not conclusive due to a lack of empirical data to back any claims; and leaf falls of both Mangrove and Nypa Palm contribute to water nutrient cycle.

RESOLUTIONS

The resolutions were made based on the following impacts:

(a) Productivity
(b) Ecology
(c) Socio-economic

Diverse opinions were made with respect to productivity, and it was suggested that there would be need for further studies. Empirical facts and results will be necessary to make conclusions with respect to the impact of Nypa Palm on Mangrove sub-ecosystem and livelihoods of coastal populations. However, some communities reported an increase in fisheries, while others reported otherwise.

3. Options for the control of Nypa Palm including mechanical clearance and utilization reviewed.

The first management initiative should be that of accepting the presence of Nypa Palm.

Capacity building was seen as an important tool in the control of Nypa Palm. The present level of understanding with respect to local people use is low. It was anticipated that an increased knowledge of local people will enhance the use of Nypa Palm.

The group discussants also felt that control should be practical especially in areas of low infestation by removal Nypa Palm. In areas of high infestation, a control means that can lead to eradication in the long run should be adopted.

Creating a limit or a zone with respect to spread of Nypa Palm in Nigeria should be taken serious. The after mat of removing Nypa Palm should also be considered.

Practical reforestation of the Mangrove is another possible action that would yield positively.

The establishment of cottage industries that use Nypa Palm as raw materials in areas where Nypa Palm infestation is high should be encouraged. Care should be taken while creating unsustainable uses. This is to discourage other local communities from planting and establishing Nypa Palm plantations. Creating unsustainable uses should also include a time limit on when to inform the people to stop using. The targeted uses should be such that people will not get attached to.

Programmes should be designed to introduce Mangrove by enrichment planting, boundary planting, peripheral planting, inter-cropping, inter-planting etc. Any of the intervention opted for should be monitored closely. The designed integrated intervention should be designed to gradually eradicate Nypa Palm on time or spatial arrangement.

Each coastal State must decide on the quantity of Nypa Palm to be tolerated in our waters. They must also have Nypa Palm free zones. The Forestry/Environment departments in each State should monitor control and spread by:
Collection of Nypa Palm flowers and petals

e-planting of Mangrove seedlings which are viviparous and capable of vegetative opagation

iscourage mechanical activities which might affect the ecosystem and ecology of e environment.

ick seeds on water or develop booms to prevent Nypa Palm seeds from floating eely.

RESOLUTIONS

The following resolutions were reached on the options for control:

(a) Accept Nypa Palm as a problem in the Nigerian coast.

(b) Control should be practical

(c) Create a limit of acceptable spread of Nypa in the Nigerian coast

(d) Adopt an integrated method of control including utilization, enrichment planting, boundary planting, peripheral planting etc

(e) Monitor any intervention method adopted

(f) Florescence removal

(g) Use boom to remove and reduce Nypa seeds movement

4. Diverse uses (edible, medicinal, aromatic, pesticidal, ornamental etc.) to which Nypa palm can be put investigated; the case for Capacity Building.

RESOLUTIONS

The following resolutions were reached on diverse uses:

(a) Capacity building on the stressed uses

(b) Develop markets for the various uses/products of Nypa Palm

(c) Communities should be taught to use Nypa seeds instead of Mangrove wood

(d) Burn seeds/suppress seed dispersal

5. A scheme of work for an indepth assessment proposed to confirm the reported uses and to establish further transformation products from Nypa palm.

RESOLUTIONS

The following resolutions were reached on a proposed scheme of work for an indepth assessment/further transformation products:

(a) Develop low technology adaptable to local circumstances

(b) Build capacity of local people to engage in cottage industries

(c) Develop marketing strategies that are sustainable and establish South-South cooperation between Nigeria and other countries where Nypa Palm is found

Adopt a Bottom-Top policy formation to increase active local participation and choice of cottage industries by local people