NATIONAL MANGROVE MANAGEMENT ACTION PLAN

2010-2012

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GLOSSARY OF ACRONYMS

EMR	Ecological Mangrove Restoration
EPA	Environmental Protection Agency
EC	European Commission
EU	European Union
FAO	Food and Agriculture Organisation
GBEDF	Guyana Biological Education and Education Foundation
GDF	Guyana Defence Force
GFC	Guyana Forestry Commission
GIS	Geographic Information System
GPF	Guyana Police Force
GSA	Guyana School of Agriculture
MAC	Mangrove Action Committee
MoE	Ministry of Education
MOU	Memorandum of Understanding
MPO	Mangrove Project Office
NARI	National Agricultural Research Institute
NDC	Neighbourhood Democratic Council
NDIA	National Drainage & Irrigation Authority
NMMAP	National Mangrove Management Plan
RDC	Regional Democratic Council
SPSP	Sector Policy Support Programme
S&RDD	Sea and River Defence Division
UG	University of Guyana

1.0 INTRODUCTION

The essential role that mangroves could play in the defence of the coastal zone, their role in carbon sequestration, and the increased risks posed by the predicted rise in sea level and the rising cost of maintenance of the sea defense structure, have prompted a commitment on the part of the government of Guyana to the conservation, restoration and protection of the mangrove forest.

Guyana has an area of 214,970 km ^{2}, and is situated on the north-eastern coast of the South American continent. The country is divided into five main biophysical divisions: the Coastal Plain, the Savannahs, the Pre-cambrian Lowland Region, the Southern Upland Region and the Pakaraima Highlands (**Appendix 1**).

The coastal zone of Guyana lies between 0.5 to 1.0 m below high spring tide level of the Atlantic Ocean, making it particularly vulnerable to flooding, erosion and salinization. Moreover, global sea level rise is expected to increase from 20 cm to 100 cm by the year 2100. The coastal zone is 430 km long and 26-77 km wide.

Approximately 90 percent of the nation's population of 750,000 reside within the coastal zone; even though it constitutes less than seven percent of the country's total land area, has the most fertile soils. As a result, it is important for Guyana to place significant emphasis on the Atlantic Ocean and sea defense structures.

An Overseas Development Assistance project conducted within the vicinity of Essequibo River on wall defence between 1979 and 1984 indicated that "the best coastal protection you can have in Guyana is a long sloping foreshore, leading to mangroves and a small earthen dam behind that" (FAO, 1994).

In recent decades, the mangrove belt has been severely depleted and the natural cycle of erosion and recovery is apparently at disequilibrium. Although the cycle mechanisms are poorly understood, it is generally assumed that heavy damage by humans, the loss of old groynes (constructed during colonial times but largely left to disintegrate since then), and increases in sea level and wave energy are the principle factors explaining the depletion. Whatever the cause, the protection of mangroves is a major concern.

The current widespread institutional interest in mangrove ecosystems and the recent surge in mangrove literature, clearly indicate that these ecosystems have increasingly received much attention during the last decades. This essentially implies that the economic roles of mangroves in tropical coastal environments, their efficiency in coastal protection, their biological and cultural diversity and their links with coastal fisheries, are currently better recognised and understood. Nevertheless, the incessant degradation, transformation and conversion to other uses of these vital ecosystems due to ignorance, mismanagement and poor law enforcement are a great source of worry globally.

In Guyana, while mangroves contribute substantially to sea defence by damping wave action and protecting coastal banks, they have also been a source of raw materials and this has lead to degradation of mangrove fields despite the important ecological services they perform. Guyana Government's recent inclusion of climate change considerations in public policy has been enshrined in the Low-Carbon Development Strategy (2009) wherein there is a central focus on forest conservation, including the protection of the substantial mangrove belts along the coasts and estuaries. More specifically, Guyana has developed a Sea and River Defence Policy, which calls for alternative solutions to traditional hard structures including the re-establishment of *mangroves for effective flood defence and to protect environmental resources.*

This document presents a concise overview of the key issues related to the sustainable management of the national mangrove forest. The associated guidelines presented have been identified as national imperatives for the protection and sustainable management of mangroves.

1.1 OBJECTIVES OF THE PLAN

The overall objective is to respond to climate change and to mitigate its effects through the protection, rehabilitation and wise use of Guyana's mangrove ecosystems through processes that maintain their protective function, values and biodiversity while meeting the socio-economic development and environmental protection needs in estuarine and coastal areas.

The specific objectives of this plan are:

- To establish the administrative capacity for the management of mangroves in Guyana
- To promote sustainable management of mangrove forest.
- To establish and complete a legal framework for mangrove ecosystem management which encourages community-based participation.
- To support research and development of Guyana's mangrove forest
- To develop effective protection and/or rehabilitation of mangrove ecosystems
- To increase public awareness and education on the benefits of the mangrove forests

1.2 RATIONALE

Under the EC's Global Climate Alliance Budget line, a programme linked to sustainable Coastal Zone Management is being developed for funding. Of the 4.165 million euros provided, 3,685,000 euros will be committed for budget support and 480,000 euros for project support.

The operational duration of the project is 48 months from the signature of the Financing Agreement (n^0 9732/GUA) in mid 2010. The overall objective of the programme is to abate climate (carbon sequestration through reforestation and forest preservation) change and to mitigate its effects via enhanced sea defence biodiversity etc. A new and updated National Mangrove Management Action Plan (NMMAP) will be developed under the Sector Policy Support Programme (SPSP).

1.3 PERIOD OF THE PLAN

The Mangrove Management Plan covers a three–year period from 2010 to 2012.Alternative funding will be sought to continue the plan when the EU funds expires. The long-term sustainability of the project will depend on the alternative funding sources, and revision and modification of the mangrove action project. The momentum built through successful implementation of the projects of this action plan will contribute to long term sustainability. To this end, a well-conducted campaign of visibility and education is a vital part of the programme.

2.0 BACKGROUND INFORMATION

2.1 DEFINITION OF MANGROVES FOREST

Mangrove forests are one of the primary natural features of coastlines throughout the tropical and sub-tropical regions of the world. Mangrove forests refer to an ecological group of evergreen plant species belonging to several families, but possessing marked similarity in their physiological characteristics and structural adaptations to similar habitats (Aksornkoae, 1993).

Mangroves are highly adapted to the unstable, oxygen-depleted, saline environment in which they live. They are shrubby, fast-growing evergreen trees that form dense stands reaching up to 25 m at maturity. In Guyana, as is typical in the mangrove belts of the Americas, three species dominate.

2.2 SPECIES OF MANGROVE TREES

The three main mangrove species occurring in Guyana are ***Avicennia germinans***, ***Rhizophora mangle*** and ***Laguncularia racemosa*** (Hussein, 1995) (***Figure 1***). The environmental conditions favouring the growth of the individual species vary. Throughout the Caribbean, the typical pattern is to find *Rhizophora* as the pioneer species, establishing the seaward edge of the mangrove forest.

Avicennia germinans is locally known as courida or black mangrove. It is the most important and dominant mangrove species in the open mud flats of Guyana. It is tolerant of high saline conditions and the trees grow in isolated groups or woodland formations. Individual trees are fairly large and may grow up to 20-25 meters in height and 40 centimeters in diameter at breast height. The wood can be used as fuel-wood, poles etc, and the seeds can be eaten when cooked. The flower produces a high quality honey. The trees flower and fruit all year round and the seeds are viviparous in nature. This species regenerates and coppices well and can be managed under a coppice system.

Rhizophora mangle is known as the red mangrove. It is an evergreen tree, which grows to about 25 meters in height and 40 centimeters in diameter at breast height. A single seed germinates inside the conical fruit forming a long narrow first root (radicle), which is green except for the brown enlarged and pointed end up to 1.25 centimeters in diameter. It can grow up to 30 centimeters in length before it detaches from the mother tree and falls. The elaborate prop and aerial roots systems stabilize the trees and act as a first line of defence against wave action; in line with its position on the seaward edge of the system. The species normally grows in soft muddy soils along sheltered river banks and estuarine margins. Flowering and fruiting occurs throughout the year.

The timber of *Rhizophora mangle* can be used as posts, poles and firewood. It can also be converted into good quality charcoal. The bark produces high quality tannin of the phlobaphene-

yielding catechol group, which is not broken down by ferments and is thus suitable for leatherwork.

Laguncularia racemosa is known as white mangrove. It is an evergreen tree with un-buttressed roots. The tree can grow to height of 5.6 m and a diameter of 30 centimeters. The bark is light brown to reddish dark brown, and the leaves are ovate.

Germination is epigeous and un-opened seeds are carried up to 4 - 8 centimeters on a slender green stalk. Further, the roots are fibrous, and this species coppices reasonably well. It normally grows in the back portion of mangrove swamps, which remains unaffected by tidal inundation, except during spring tide. The soil is generally clayey to silty clay.

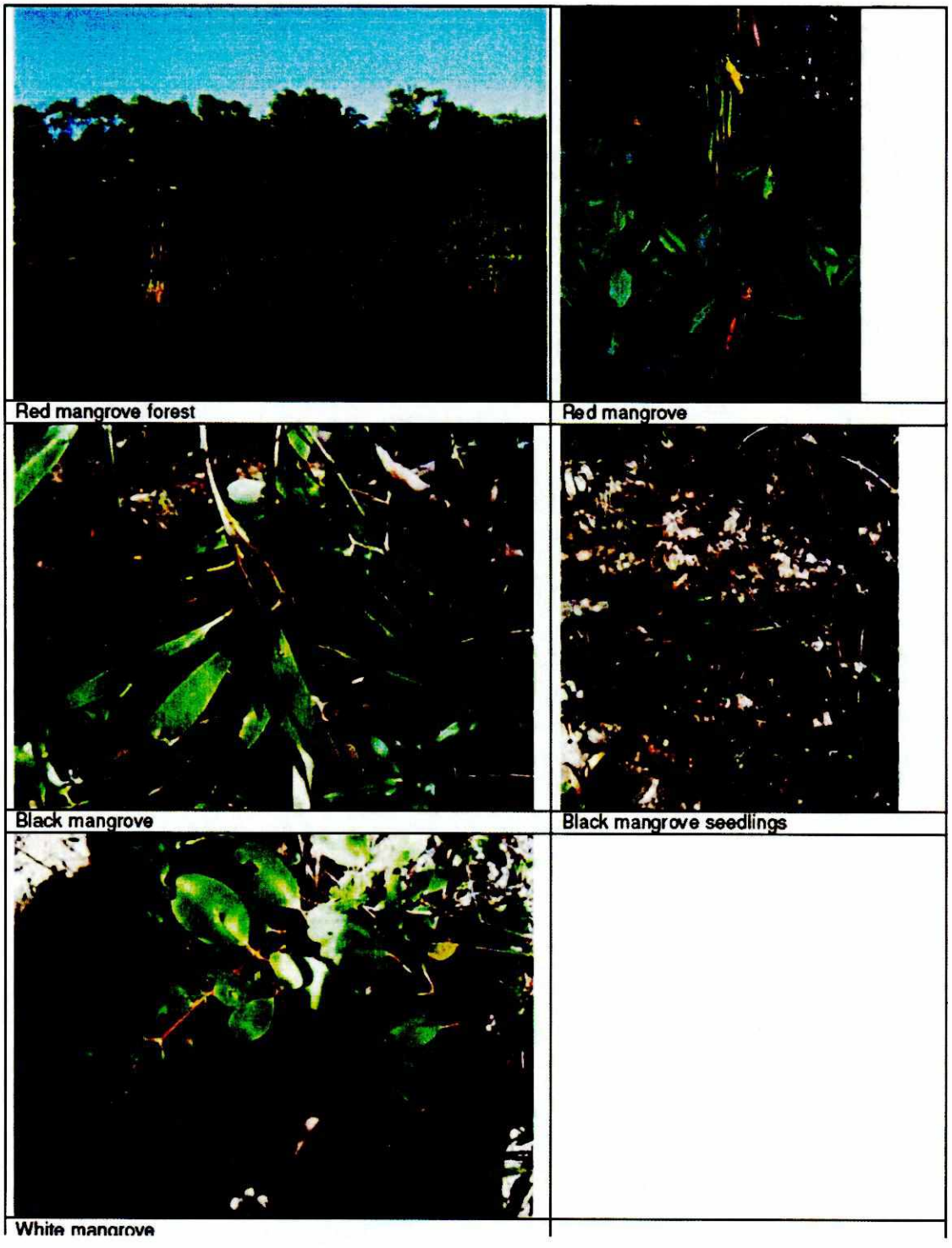


Figure 1: Mangrove Species

Rhizophora exhibits a lower saline tolerance and a higher tolerance for high-energy waves and longer inundation periods. Mature *Rhizophora* stands develop tangles of ropey prop roots supporting a tall, somewhat open forest. The trees respond poorly to cutting as their regenerative capacity is limited. Fifty percent (50%) leaf removal causes death (GFC, 2001). The propagules – large pre-germinated 'seedlings' known locally as 'monkey whistles' are generated throughout the year in relatively low numbers compared to the other species, and require longer (18-30 months from emergence of flower bud to drop of mature seedlings) to mature.

Avicennia and *Laguncularia* typically form the bulk of the forest between the *Rhizophora* fringe and the high tide line. Both species can tolerate higher salinity levels and longer periods of drought. *Avicennia* propagules can be found in large numbers along the high tide line down current from mature stands, and regeneration of these species has been observed from seed sources that are several miles away.

These three species comprise the major components of the mangrove forests of the Americas. They grow best in fine-particle mud deposits, *Avicennia* in particular having developed the specialized respiratory roots (pneumatophores), which extend like tubular bristles from the oxygen starved root systems.

In addition to the mangrove trees, the in-land edge of the mangrove zone is populated by a number of salt-tolerant, opportunistic species of forbs, vines, shrubs and trees that include mangrove fern, black sage, monkey apple, sea almond, thatch screw pine and a number of grasses and sedges which can collectively be referred to as a mangrove-associate community. It contributes to the diversity of the coastal zone biome and to the stability of the sea defences. More information on the role they play in the ecology of the whole coastal system is needed.

In some circumstances, significant wetlands, usually of fresh or slightly brackish water, can be found behind the sea wall. This inland plant community has been named the 'back mangal' by Tomlinson. It is likely to support black and white mangrove populations, and offers additional opportunities for mangrove reforestation, which, while making no significant contribution to the sea defences, adds considerable acreage to the potential overall mangrove forest.

2.3 IMPORTANCE OF MANGROVES

Mangrove forests are the major coastal ecosystem found in Guyana, and are among the richest and most productive ecosystems. One calculation estimates that a minimum of 200m of standing forest is needed to provide an appreciable effect on wave energy (*Action Fiche*) can play on protecting a vulnerable coast is only one aspect of their importance. The mangrove forest supplies a number of economically significant products including; timber, firewood, tannin, and honey. They provide an environment for many species of flora and fauna, including crabs, shrimp, and many species of fish. Although their role as nurseries for economic fish species is recognized worldwide, there is no empirical evidence of the contribution they make to Guyana's fisheries. Therefore in Guyana, there is limited information on the economic significance of

mangroves to the fishing industry.

A mature mangrove forest also acts as a sediment trap, thereby assisting in the accretion of coastal sediments and further, adding to the protection of the low-lying inland areas. Mangrove forests also have a role in carbon sequestration with a capability of fixing an estimated 17 metric tonnes of carbon/hectare/year.

Further, economic benefits could be derived from mangroves through eco-tourism. There can be bird watching trips to observe rufous crab, hawk, and other uncommon birds of the coast, and intact stands of mangroves undoubtedly offer many opportunities for such activity. Due to an increase in the demand for tannin the production of mangrove bark increased dramatically during the period 1996 – 1999. The Guyana Forestry Commission (1996 and 1999) reported 10,886.4 kg and 90,956.8 kg of mangrove bark was extracted in Regions One and Two for tannin by the local leather industry, however this has since reduced with only a production of 12,619 Kg and 27,697kg in 2008 and 2009 respectively.

2.4 THE GUYANA ANOMALY

Literature on the composition of the mangrove forest in Guyana indicates that the typical pattern of *Rhizophora* forming the seaward fringe, with *Avicennia* and *Laguncularia* established inside this, does not prevail here. *Avicennia* is almost always found as the outermost species, with *Rhizophora* restricted to riverside and estuarine environments (***Figure 2***). There is no fully satisfactory explanation for this situation. However, several possible explanations have been offered.

Hyper salinity, which develops on open mud flats between tidal inundations where evaporation from trapped pools of water gives rise to very high salt concentrations is often proposed as an explanation, given the lower tolerance of *Rhizophora* to high salinity levels. However, this does not explain its absence at the seaward edge, where these conditions are less likely to occur. In addition, salinity levels along the Guyana coast (with its huge inputs of fresh water from the Amazon and the Guyanese rivers) are normally well below the accepted tolerance levels for mangroves. Data on actual salt tolerance of individual species under conditions found in Guyana is limited, but all species are considered able to tolerate levels of up to 90 ppt for short periods. The acceptable levels are around 30 ppt.

Excessive wave action is also offered as a reason for the absence of *Rhizophora* but here again, the species most adapted to higher wave energy is the one that is missing.The possibility exists that, historically, *Rhizophora* was present, in the typical pattern. Its removal through cutting for human use, coupled with its relatively low regenerative capacity, through vegetative means or seed production, and the fact that, once the mangrove forest is destroyed, it rebuilds from the shore out into the tidal zone as stands of *Avicennia* and *Laguncularia*, but never reaches the point where *Rhizophora* would naturally occur, could account for its absence.

Equally, a set of conditions could exist that dictate an atypical arrangement of mangrove species.

These are questions that merit further study, as most mangrove restoration projects world-wide focus on *Rhizophora* as the genus most adapted to the colonization of depleted environments on high-energy coastlines.

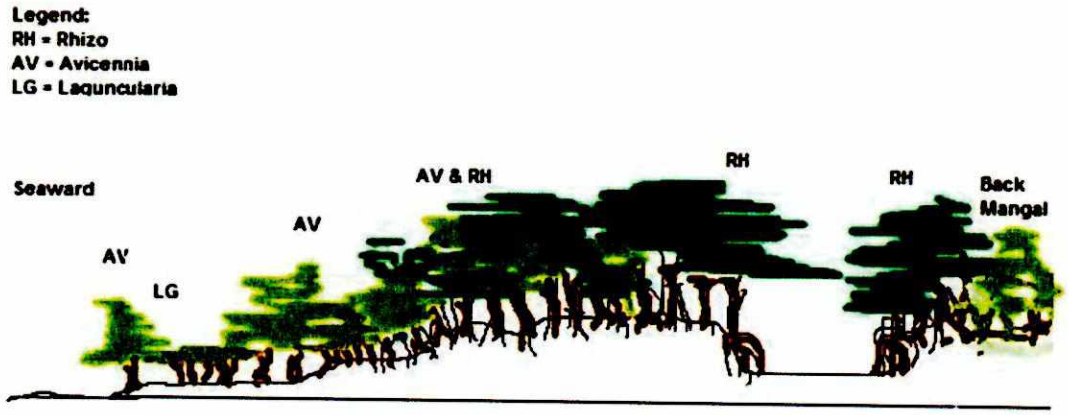


Figure 2: Composition of mangrove forest

2.5 NATURAL ENVIRONMENT FOR MANGROVES

The development of mangroves depends on a tropical climate, fine-grained alluvium, shores free of strong wave and tidal action, brackish water or saline conditions and a large tidal range. These factors influence the occurrence and size of mangroves, the species composition, species zonation, other structural characteristics and the functions of the ecosystem.

2.5 (a) Climate

Light, temperature, rainfall and wind all have a strong influence on the mangrove ecosystem. Apart from playing a significant role in the development of plants and animals, they also cause changes in physical factors such as soil and water. Light is vital for photosynthesis and growth processes of green plants. It also affects the respiration, transpiration, physiology and physical structure of plants. Mangrove plants are long-day plants and require high intensity of full sunlight. This makes tropical coastal zones an ideal habitat. The optimum light requirement for mangroves ranges between 3000 – 3800 kcal / m^2 / day. The amount, duration and distribution of rainfall determine the development and distribution of plants and animals. Rainfall can influence the air and water temperature, the salinity of the surface and ground, which in-turn affect the survival of mangrove species. Mangroves prefer an annual rainfall ranging between 1500 – 3000 mm. Like light, temperature is also important for physiological processes such as;

photosynthesis and respiration. The temperature requirement varies with species. In general, the temperature required for optimal growth of mangrove species varies between 18 and 26 ^{0} C. Wind is required for pollination and seed dissemination. It can also increase evapotranspiration of plants. Strong winds are capable of impeding plant growth and causing abnormal physiological characteristics.

2.5 (b) Tidal and Wave action

In coastal areas, tidal and wave action have a strong influence on the zonation of plant and animal communities and water salinity found within mangroves. Water salinity varies during spring and neap tides. During spring tides, highly saline water intrudes further into the mangrove areas than during neap tides. Tidal ranges between high and low tides, or intertidal zone can affect the root systems of mangroves. They prefer to have large tidal range with little undercurrent wave action.

2.5 (c) Salinity

Mangrove vegetation grows in a coastal saline environment; however, it is capable of tolerating only a certain degree of salinity. This tolerance of a saline environment varies with the species. Several mangrove species can withstand conditions of very high salinity. There is no clear evidence indicating the maximum interstitial water salinity that mangrove species can withstand, but the optimal range is 28-34 ppt (Aksornksae, 1993).

2.5 (d) Soil

Mangroves develop under tidal regimes in salt and brackish water environments, such as; estuaries, deltas and sediment-accreting open coasts. They may colonize sandy shores and corals, but the common soil substrates are clayey deposits (GFC 2001). Mangrove soils are formed by the accumulation of sediment derived from coastal or river bank erosion or eroded soils from higher areas transported down along rivers and canals.

2.5 (e) Morphological Processes - Mud Banks, Sea Wall and Groynes

Guyana's intertidal zone is made up of long, sloping, ever-moving mud banks that originate at the mouth of the Amazon River. Huge deposits of fine silts and clays from the Amazon are carried northwest along the coast in slow moving 'slings'. As these mud banks, which extend out from the shore as far as three miles, progress along the coast, a pattern develops, where mud builds in one region as the crest of the bank passes, followed by a period of depletion as a corresponding trough follows. The high banks provide ideal conditions for mangrove forest growth, whereas the troughs appear to lead to erosion and depletion. Local experience is that a severe erosion period lasts for about three years at any one place. This is the situation under which the mangrove forest of the north coast of South America has evolved, and with which it can be presumed to have been in some sort of dynamic equilibrium. However, in recent decades, as the mangrove belt has been progressively depleted, the dynamics of the system seem to be overriding the forest's ability to recover from an erosion cycle.

The sea defence structures also probably play a role in the destabilization of the mangrove forest. They interrupt the normal wave-energy flow onto the land, and restrict the ability of mangrove stands to shift their boundaries as sea levels rise. Sea wall construction has also been responsible for damaging healthy stands during the construction process.

Further, complications are possibly created when fresh water running off the land is interrupted by sea defence structures and channeled into drainage canals, thus altering the natural dispersion of fresh water into the mangrove forest. In the communities along the coast there is a strong feeling that allowing the groynes, originally constructed by the Dutch, to deteriorate has accelerated the erosion of the mangroves. This is a subject of much discussion, as it is generally recognized by the engineering community that groynes – solid structures that run out into the sea perpendicular to the sea wall – are only effective in causing the deposition of heavy (sand) particles. They do not work with clays and silts. Nonetheless, their presence appears to have some protective effect on mangroves down-current from them. The specific impacts of these situations are poorly understood.

An alternative to groynes, in the form of low-crest, low-cost structures running parallel to the shore and acting as wave-force breakers, has been proposed. These can be constructed at relatively short notice, and could be the essential element in efforts to protect established and developing stands from erosion.

2.6 ECOLOGY OF MANGROVES

The mangrove forest of Guyana is a complex ecosystem because it represents an inter-phase between two contrasting types of communities: the terrestrial, as represented by shrubs, grasses and agricultural crops, and the marine as represented by sea grass. There is an abrupt transition from mangal to marine communities, while transitions to terrestrial communities, such as; fresh water swamps, are gradual in some places (Pastakia, 1991).

Trophic structure or nutrient cycling and energy flows in mangrove ecosystem are quite complex. In simple terms, when mangrove plants receive sunlight for photosynthesis, they produce organic substances and grow. Parts of plants like branches, leaves and litter may fall on to water or soil, and are eventually decomposed by microorganisms like bacteria, fungi, phytoplankton and benthic fauna, or so-called detritus consumers and converted into minerals and nutrients. In turn, microorganisms themselves become a source of food for small aquatic animals, which are preyed upon by shrimps, crabs and larger fish at higher trophic levels. Some die and decay and become nutrients that accumulate in the mangrove soil. Finally, larger fauna and fish become food for larger animals and human beings, which are consumers at the highest level of food chains or energy flow in the ecosystem.

2.7 DISTRIBUTION AND OCCURRENCE OF MANGROVES

In 1992 the total area of mangrove forest in Guyana was estimated at 80,432 hectares (GAHEF, Table 1.) .However, due to the fact that the distribution of mangroves along the coast of Guyana is a highly dynamic situation, subject to rapid and dramatic change; and there is a lack of a sound geo-referenced baseline datasets and updated images, it is difficult to ascertain the location and extent of mangrove forests in the country today. Nevertheless, even without such information, it is easy to recognize that in the least developed regions of the Guyanese coast, solid stands of mangrove forest still thrive. Most notably, along the Waini-Pomeroon coast, a large intact mangrove ecosystem still exists. Pristine stands are also found on the smaller islands within, and along parts of the shore of the Essequibo River. Additional patches of mature mangrove can be found at the mouths of the larger rivers, but the survival of these stands appeared to be threatened by industrial development and by cutting and burning.

Table 1: Regional Estimates of Mangrove Forest in Guyana (GFC, GIS Analysis, 2001)

1	49,100	61
2	11,200	14
3	5,240	7
4	3,540	4
5	7,252	9
6	4,100	5

2.8 POSSIBLE EFFECTS OF GLOBAL WARMING

The averaged global surface temperature is projected to increase from 1.4 to 5.8 ^{0}C over the period 1990 to 2100. These results are the full range of 35 Special Report on Emissions Scenarios (SRES), based on a number of climate models (IPCC WG 1 Third Assessment Report, 2001). It is also projected, over the next century using the Atmospheric Ocean Circulation General Model that the temperature is likely to rise globally by 4.2 ^{0}C due to the tripling of carbon dioxide concentrations in the atmosphere. Thus, there is an agreement from several sources on the possible increases in temperature, though this figure may vary from region to region.

One of the results of this projected increase of temperature will be higher sea levels due to thermal expansion. Global mean sea level is projected to rise from 0.09 to 0.88 meters between 1990 and 2100 (IPCC WG 1 Third Assessment Report, 2001). Also, the sea volume will increase due to the melting of ice caps that will contribute to increase of water in the oceans. Large scale impacts of climate change on oceans are expected to include; increases in sea surface temperature and mean global sea level, decreases in sea ice cover, and changes in salinity, wave conditions and ocean circulation. The oceans are a responsive component of the climate system with important physical and biochemical feedbacks to climate.

Many marine ecosystems are sensitive to climate change, thus low lying coastal wetlands will be threatened and this may wipe out habitats and create inland migration of species. The prospect of creating setbacks to accommodate the migration, and also the developing of increased saline and higher temperature resistant species are therefore two of several options available for planners to mitigate against the projected adverse effects of climate change on these ecosystems.

2.9 LEGISLATION AND INSTITUTIONAL ROLES IN THE MANAGEMENT OF MANGROVES.

At least ten agencies are involved directly or indirectly in the management of mangroves in Guyana. These agencies are as follows; The Guyana Forestry Commission (GFC), Sea and River Defence Department (S&RDD), Fisheries Department, Environmental Protection Agency (EPA), Lands and Surveys Commission, Georgetown Sewage and Water Commission, Ministry of Housing and Water, Hydrometeorological Service, National Drainage and Irrigation Board and the Regional Democratic Councils.

The principal agencies are the S&RDD, GFC, the EPA and the Department of Fisheries. Of these, the two with the most significant, day-to-day involvement with mangrove management are the S&RDD and the GFC. The Forests Act mandates the Guyana Forestry Commission with the overall management of Guyana's State Forests. The National Forest Plan gives the GFC the responsibility for the development of a national mangrove management plan. The Sea and River Defence Department has the responsibility for both man-made and natural defenses. These are found mainly outside the State Forest areas. The Fisheries Department has an interest in mangroves because mangrove forests are known to be feeding, breeding and shelter grounds for many marine species that are of ecological and commercial importance (fishes, crabs, crustaceans and mollusks). The Environmental Protection Agency has a coordinating role in the management of the coastal zone. A detailed chart of all relevant legislation, the agencies that operate within these laws, is attached (**appendix 2**).

2.10 PREVIOUS MANGROVE MANAGEMENT PROGRAMMES

There have been a number of efforts directed at managing the mangrove forests in Guyana, but none have resulted in significant actions. Poor financial support is the principle cause of failed implementation of good plans. The GFC, in collaboration with the EPA, wrote and adopted the first Mangrove Management Action Plan of 2001. There have been several partial updates of this plan since then, but none have been finalized or adopted. A Code of Practice for Mangrove Harvesting (2004) also exists as a draft document at GFC. This is an incomplete document but contains useful information to be used in the drafting of a new Code of Practice aligned to such new legislation as may be passed. The GFC has considerable resources dedicated to using GIS-based information in the management of forests. Very little of this exists or is available, that is relevant to mangrove management. Data on maps and surveys also resides at the S&RDD, the EPA and at the Division of Lands and Surveys, but none has been proven able to provide the

MPO with useable mangrove inventory information. The EPA developed a comprehensive National Biodiversity Action Plan (2007), a very complete treatment of national environmental issues that incorporates an Integrated Coastal Zone Management Plan. No resources were provided for the implementation of this plan. Small pilot planting projects were conducted in Region 4 by the S&RDD staff. These met with mixed results but have proven to be a valuable learning tool and demonstration projects. The lack of identifiable success of these projects (excepting the small planting project at Mon Repos, which was generally successful) can be attributed to poor institutional support and inadequate resources.

2.11 MAJOR ISSUES

There are forest policies and legislation in place, however, these are fragmented and not comprehensive, and do not deal with mangroves specifically. Moreover, there is no clear mandate for the management of mangrove; thus, there is no coherent policy or strategy for the management of this resource currently. The current administrative structure involves several governmental agencies, having cross-sectoral roles for coastal resources that are specific to their interest. Regional Officers and personnel from Sea and River Defence Division have tried to supervise and regulate felling and extraction of mangroves. The effectiveness of their control has been limited because of a shortage of manpower, lack of training in forestry practices, and a lack of guidelines based on silvicultural or management practices for sustainable utilization of mangroves. Moreover, no comprehensive assessment or inventory of the resource exists (Evans, 1998).

For effective management of mangroves it is important that the principal agencies; S&RDD, GFC, the EPA and the Department of Fisheries, enforce the applicable laws, which have direct or indirect responsibility within the coastal zone and the mangrove forests. The GFC has representation along the coast with personnel stationed at New Amsterdam, Springlands, Parika and Mabaruma. However, there is the need for more manpower to successfully implement control over the exploitation of mangrove vegetation.

Failure to treat the mangrove ecosystems as a critical element in sea defense strategy is a major concern. As such, mangroves have been regarded as a common property to be exploited without control. This attitude and the practices, which flow from this have endangered or eliminated large areas of mangrove forests, with potentially dire consequences in terms of coastal erosion and loss of valuable biological resources and ecological services.

The limited data on mangrove ecosystems in Guyana is a major issue affecting the management of the resource. Rational management of mangrove forest is based on an understanding of the forest and its environment, which can only be obtained through research.

3.0 ACTION PLAN

3.1 ESTABLISHMENT OF THE ADMINISTRATIVE CAPACITY FOR THE MANAGEMENT OF MANGROVES IN GUYANA.

3.1.1 MANGROVE ACTION COMMITTEE

The management of the mangrove forests in Guyana is a matter of concern to all citizens, and affects the interests of a large number of governmental and non-governmental agencies. It is vital that these interests and concerns be managed as a collaborative resource rather than as source of conflict. Since the conception of the mangrove action project, a strong Mangrove Action Committee (MAC) has been established. MAC is made up of representatives of all stakeholders who represent inter-agency commitment to the restoration and management of mangroves. The function of the committee is to oversee the progress towards meeting the goals of the Mangrove Management Action Plan and the indicators for the release of EU funds. Having established its Terms of Reference, the committee will focus towards maintaining implementation momentum between all agencies.

3.1.2 ESTABLISHMENT OF MANGROVE PROJECT UNIT AND OFFICE

3.1.2. (a) Office location and constitution.

The designated lead agency for the new Mangrove Project is NARI. This is conveniently situated close to many proposed project sites, houses the central nursery, and is able to provide housing for volunteers and visiting experts. Facilities for the expansion of the office have been considered. It is essential that the office be provided with the equipment and resources necessary for its efficient operation. This will include, at a minimum, ready access to broad band internet connection, mobility and staff support. Perhaps the most significant potential barrier to effective operation of the office is instability and lack of autonomy for the principal officers, who need independence and support if they are to be able plan the day-to-day implementation of the mangrove management plan.

3.1.2. (b) Staffing Needs

Project Coordinator: In order for the project to have consistent, sustainable management, a strong and independent project coordinator is necessary. The Coordinator will report directly to the MAC, and will be responsible for the day-to-day running of the project, preparation of reports and the overseeing of all developments.

Office Administrator/Financial Control Officer: The work of the Project Coordinator and

the Forestry and Community Development specialists will need the support of a full-time Office Administrator with the experience and training to undertake detailed control of the project finances. It is essential that proper accounting for funds committed to, and received by the Project. The responsibilities of this position will include; the day-to-day running of the office, and providing back-up for the technical staff when they are out of the office.

GIS/Forestry Officer: The management of the country's mangrove forest requires the full-time employment, at the project office, of a GIS-trained forester. Establishing and maintaining a reliable inventory of the mangroves is of prime importance. There are large and unresolved questions about the availability, and relevance of historic data; both maps and images. Decisions have to be made concerning the process of acquiring new mangrove data and the tools and methodologies to be used for survey/monitoring of forest dynamics. Whatever course is settled on, the Project office must have in-house available expertise, and be up-to-date with all the issues related to mangroves in Guyana. In addition be able to provide current, reliable data on the changing status of the country's mangrove stands. The design and supervision of planting programs and on-going monitoring programmes must be closely coordinated with the GFC and UG, but the day-to-day forestry-related work of the project will need the presence of an expert at the project office.

Community Project Coordinator: The actual rehabilitation/protection action will take place on site-by-site basis. Each site, located within specific communities, will have, as an essential component of its initial design, a community involvement requirement. This will include at a minimum; contacting Regional and Neighbourhood Democratic Council officials, and through them, establishing relationships with such groups as farmers, fishermen, environmental clubs, schools and youth groups. The coordination of educational workshops, and trainings as needed will also will also be a function of the coordinator. Initial work done at Mon Repos, Buxton and at various locations along the coast, found that communities are anxious to be involved and have demonstrated enthusiasm and cooperation. Financial support for community involvement is proposed. Communities can be engaged in the provision of seed, seedlings, labour, materials and equipment for site projects, and suitable compensation should be arranged, such that real benefits can be realized by communities for their participation.

Regional Mangrove Management Officers: They will report directly to the Project Coordinator, and are a necessary addition to the central office capacity. As activities expand, the need for reliable eyes-on-the-ground will increase, and the Project Coordinator will need direct contact with his own staff in all regions. As specific projects develop, the Regional Officers will have essential roles to play in the community involvement operations, and in the on-going coordination of all subsequent actions. It is anticipated that these positions can be filled from within the NARI system as they are located throughout the coast. Initially, they can be stipend-supported part-time positions. As need expands in the future, they can be converted to full-time as appropriate.

Technical Assistance: If sufficient stability, independence and support can be provided

for the project coordinator, the need for long-term expert assistance will be greatly reduced. The following recommendations are made.

- A Senior Expert with specific knowledge of mud bank movement and stabilization to be engaged for 2 months before the end of 2010.
- A Senior Expert, with specific expertise in mangrove rehabilitation/planting projects, would be engaged for 3 months before the end of 2010.
- The current Mangrove Specialist, who has institutional experience with this project, would be engaged for 6 months (September – November 2010 and January-March 2011) to coordinate and report on the work of the Senior Experts and to assist with the implementation programme as determined by the MAC.

3.2 PROMOTION OF THE SUSTAINABLE MANAGEMENT OF MANGROVE FOREST.

The mangrove forest supplies a number of economically significant products, including - timber, firewood, tannin, and honey. It provides the environment for many species of flora and fauna, including; crabs, shrimp, birds and many species of fish. All of these resources must be managed to guarantee sustainability. To this end, the Code of Practice for Mangrove Harvesting (2007) that exists (Annex 5) as a draft document at GFC must be finalized. The new Code of Practice aligned with the new legislation must be drafted. The Code of Practice will increase awareness about environmental, social and economic values of mangrove ecosystems for making informed decisions about their appropriate use and management.

3.2.1 MONITORING, REPORTING AND ENFORCEMENT PROGRAMS

3.2.1.1 MONITORING AND REPORTING.

The questions of effective monitoring and reporting are frequently being raised within communities in which mangroves have been damaged, but few attempts made to stop the damage or to enforce laws. Efforts over recent years have been hampered by lack of resources on the part of the the GFC and S&RDD. In order to effectively patrol and report on activities along the sea defence zone, in which most mangroves are found, a full complement of S&RDD rangers is needed. This issue is being addressed and the S&RDD hopes to have these officers in place well within this year. Historically, an informal relationship has existed with the GFC, who have provided enforcement capacity.

Conversation and persuasion have been the main tools of prevention, with actual prosecution being very rare. It is recommended that this relationship be reviewed, updated and formalized with an MOU between the GFC and the S&RDD. If capacity shortfalls are identified after these discussions are held, action should be taken to complement the capacity as needed. The Regional Mangrove Officers, and community members, are two resources that can be utilized as soon as they are in place. Training sessions will be conducted by the MPO for the S&RDD and NDIA rangers, GFC officers, and community groups involved. Protocols for reporting must be established, and should be formalized within the MOU.

3.2.1.2 ENFORCEMENT.

Enforcement policies, procedures and penalties need to be reviewed and strengthened, particularly in light of the addition of stronger protective legislation, with respect to land use, agriculture, fisheries and sanitation. As with other new rules and regulations, these will need to be developed in consultation with all appropriate agencies and stakeholders and submitted for approval through the proper channels. The development of new policies and formalized agreements between agencies responsible for any aspect of enforcement should be overseen by the MAC. Closer collaboration with communities needs to be functional. Likewise NDCs, RDCs, GDF and the GPF should play a more active role in supportive enforcement activities. Special consideration for law enforcement needs to be taken into account for those communities with Toushoas, policing groups and relevant representatives. In addition, these communities will be represented as an autonomous body in key forestry development, titling and land-use plans related to the action plan.

The resulting agreements should be included in an MOU between relevant parties. The reluctance of institutions to prosecute violators should be addressed. It is intended that a successful visibility campaign, especially the running of workshops in communities adjacent to mangrove sites, will raise awareness of mangrove species identification, management and use and legislation. The role of coastal dwellers in mangrove planting, protection and enforcement procedures will be addressed. It is suggested that if a case of repeated violation is identified, a successful prosecution will go a long way towards strengthening the overall enforcement effort.

3.3 ESTABLISHMENT AND COMPLETION OF A LEGAL FRAMEWORK FOR MANGROVE ECOSYSTEM MANAGEMENT AND ENCOURAGE COMMUNITY-BASED MANGROVE MANAGEMENT

3.3.1 LEGAL FRAMEWORK FOR MANGROVE ECOSYSTEM MANAGEMENT.

An initial review of legislation has revealed that, in order for the protection of mangroves in Guyana to be effective, loopholes in the current legislation need to be closed such that all mangroves are given uniform and assured priority for protection.

Fortunately the legislative framework for immediate protection already exists, as it is within the power of the Minister to declare any tree as a protected species. Such an action would initiate a change in status for all mangroves. On the 29th, January, 2010 in exercise of the powers conferred upon him by section 42 of the Forest Act and after consultation with the Guyana Forestry Commission the Minister of Agriculture made an amendment of Regulation 17 of the Principal Regulations by the substitution of the following:

"Protected Trees" 17. (1) "No bullet-wood tree or red, black or white mangrove trees shall be felled without first obtaining the permission in writing of an authorized forest officer not below the rank of an Assistant Commissioner of Forests"

Further consultation with the legal officers from affected agencies (e.g. Fisheries and the NDIA) will be needed to ensure that unanticipated harm is not done to vital national interests. Following such discussions, and the acceptance of the legislative changes, it will be necessary to develop new regulations and a code of practice to determine new rules for mangrove management. Permitted uses, procedures for obtaining use permits and, enforcement approaches will need to be re-written. Existing legislation, as summarized in the table found at **Appendix 2** must be understood and utilized. The powers granted to the Regional Democratic Councils offer particularly useful opportunities for increased surveillance and protection of mangroves. Developing partnership relationships with the regional authorities will greatly strengthen the efforts to protect mangroves.

3.3.2 COMMUNITY-BASED MANGROVE MANAGEMENT

The mangrove management action plan cannot succeed without regard to the requirements and aspirations of all people. Success depends *inter alia*, on being able to match management objectives with the interest of local populations and by extension, secure their support and commitment (FAO 1994). A degree of "self management" should be encouraged among the various users of the mangrove environment so that they can be involved in protecting this ecosystem. In addition to nation-wide awareness and

education campaigns, a programme of community involvement and ownership is needed. This is of paramount importance. The investment by the MAC and the MPO in real grass-roots participation is one of the proposed actions that will distinguish this activity from those of the past. This effort should be coordinated with the Ministry of Local Government, which has in its mandate, willingness to assist with the mobilization of local communities.

Community involvement will be focused on the project reforestation sites. The communities that are closest to the sites will become participants in site development and monitoring. This will be the primary focus of the Community Project Coordinator. Community involvement in public concerns has a useful precedent in the NDIA Community Officers. These are stipend-supported members of the community who report on drainage and irrigation issues and are available for assistance with community projects. The addition of a full force of S&RDD Rangers and the appointment of Regional Mangrove Officers will add valuable resources for community mobilization.

As soon as a site is identified as a potential work site, community contacts must be initiated. The local government officials and S&RDD engineers should be the first to be contacted. The potential resources within each community will vary and making contact with all appropriate bodies will depend on Community Project Coordinator's ability to find these on a site-by-site basis. Ad hoc contacts will be developed and should be encouraged. A roster of potentially interested groups and individuals will be developed. A site visit for interested parties, and at least one workshop to fully explain the project and to arrange for continuing participation, will be held.

Roles and responsibilities for community members and groups will vary by site and include provision of planting materials and equipment (tools for planting, transport of materials, stakes, and mud-boards (marans)), labour for planting or construction of protective structures, on-going monitoring and public education. Support for such efforts must be fair and prompt. A significant budget amount is proposed to pay for services in the communities that must realize real benefit from their involvement. Exact remuneration will have to be determined on a case-by-case basis.

In addition to the obvious need for community involvement at project sites, the development of close relationships with regional authorities is necessary whether or not a specific project is an immediate prospect. It is suggested that regional workshops would be conducted early in the implementation phase, enabling the MPO to establish ties to the regions from the outset of the project. This will address issues such as anti-littering of mangrove areas, communal pasture development, landless farmers and monitoring and enforcement, and alternative livelihoods and mangrove legislation.

3.4 SUPPORT OF RESEARCH AND DEVELOPMENT OF GUYANA'S MANGROVE FOREST.

3.4.1 COASTAL RESOURCE BASE-LINE DATA

It is impossible to overstate the need for accurate, current and updateable base line inventory information on the mangrove fields and the relevant, related coastal resources, such as drainage systems. This information, where it exists today is fragmented between various agencies, derived from incompatible sources and often hard to find.

This is a prime reason for the strong suggestion that the MPO have a GIS/Forestry Officer whose job it is to collect and evaluate existing data and work with the relevant agencies and the GIS expert at the Sea Defence's Capacity Building Project Office, to devise a plan for the development of sound, useable data.

There are many options for new surveys, including high-tech aerial photography which must be done to current best practices standards (geo-referenced and high resolution). Other practices such as satellite imagery and laser technology may be employed where economically feasible.

The MAC will review and asses the options. This represents a unique opportunity for the country to acquire a valuable technology that can be shared by all the agencies involved in coastal resource planning. The sharing of the acquiring cost will be investigated. It is suggested that a MOU be signed between agencies on this matter.

3.4.2 TECHNICAL RESEARCH

3.4.2.1 RESEARCH ON MANGROVES

Technical research aimed at resolving some of the overall and critical questions underlying the issues of mangrove loss and restoration is essential. Such research should be spearheaded by UG, the lead academic institution in the country. Key topics concerning the ecology of Guyana's mangroves, such as the impact of agricultural pollution; the best practices for planting and the causes of sudden erosional loss, pest, and disease among others, have not been answered in the specific context of the Guyana coast. Addressing these questions will require the combined efforts of many agencies. Input from and collaboration with, at least, the GFC, Sea Defences, the EPA, and all relevant departments within UG should be considered. Organizations such as WWF, Iwokrama, and international researchers, also have potential roles to play. Cooperation between agencies and researchers must be developed for the shared attainment of research goals. To facilitate these goals a shared database on mangrove research should be established. The database will consist of completed and solicited research proposals, institutional contact lists, relevant academic papers, research/institutional budget criteria, guidelines on institutional procedures, and relevant public educational activities related to mangroves. It is suggested that an MOU be signed between all agencies agreeing to the protocols for the sharing of expenses, resources, and information related to the database.

The first step in developing this database requires the solicitation, and approval of a detailed mission statement and proposal from UG. A detailed plan outlining how the database will be developed, what it will incorporate, and how it will be sustained needs to be outlined. Following its approval, a detailed research proposal from UG needs to be solicited. A detailed plan for the investigation of specific topics is needed. For the first year, it is recommended that the mission statement and proposal for the database be solicitude and reviewed, along with proposals for the long and short term research priorities. Overseeing coordination of database and research responsibilities internally at UG and amongst different local agencies and institutions, supervising the database and ongoing research, will require the designation of a Chief Research Scientist at UG, and it is recommended that this person be identified and appointed early on.

3.4.2.2 RESEARCH ON MUD BANKS AND THEIR STABILIZATION

This research is of equal importance but extends beyond the reach of the Mangrove Action Plan. Discussions will be needed to determine where responsibilities lie in planning and funding the engineering research needed to better understand the dynamics of the mud bank movements and how to manage this to the benefit of all those affected.

3.4.2.3. RESEARCH ON FISHERIES AND TOURISM

The undervaluation of natural products and ecological services generated by mangrove ecosystems is a major driving force behind the conversion of this system into alternative uses. This trend of undervaluation is partly due to the difficulty involved in placing a monetary value on all relevant factors, but lack of ecological knowledge and a holistic approach among those performing the evaluation may be even more important determinants (Ronnback, 1999). In the Guyana there is a lack of knowledge of the economic value of coastal fisheries and tourisms as they relate to mangrove. Research in these areas is very important as it will address areas that have high socio-economic value to neighbouring countries such as Barbados and Trinidad. The life-support functions of mangrove ecosystems also set the framework for sustainable fisheries and tourism in these environments. Estimates of the annual market value of capture fisheries supported by mangroves ranges from US$750 to 16 750 per hectare, which illustrates the potential support value of mangroves (Hamilton and Snedaker, 1984)

3.5 DEVELOPMENT AND EFFECTIVENESS OF MANGROVE ECOSYSTEM PROTECTION AND REHABILITATION.

3.5.1 THE APPROACH TO PLANTING

The selection and development of sites for replanting and/or the building of protective structures is the key to the successful implementation of this programme. The questions of when, where and how to plant, and what other options exist for the re-establishment of a mangrove forest, are ones that have been much studied world-wide, and which must be

considered here. The success rate of large-scale replanting efforts, many started in the 1990's in the Philippines, has generally been low. The consistently poor results from these projects prompted the re-evaluation of this approach, and resulted in the development of a logical, ecologically sound set of recommendations upon which to base the decision of whether, and how, to plant mangroves. Failures were generally attributed to the selection of sites that are unsuitable for the establishment of mangroves.

The spontaneous regeneration of mangroves, as observed at Ruimzeight over the past twelve months, is a phenomenon that needs to be recognized and understood. This capacity for revegetation of bare mud flats leads to the supposition that if conditions are suitable, mangroves will re-establish themselves without human intervention, and that if conditions are not suitable, no amount of planting will result in the establishment of sustainable mangrove forest. These basic ecological principles have been codified into a set of decision-making steps that have been adopted world-wide, and are recognized as the Ecological Mangrove Restoration approach. They are as follows:

- Understand the autecology (individual species ecology) of the mangrove species in the vicinity of the restoration site, paying particular attention to patterns of reproduction, zonation, propagule distribution and seedling establishment.

- Understand the normal hydrologic patterns controlling the distribution and successful establishment and growth of the targeted mangrove species.

- Determine what modifications and stresses of the previous mangrove environment are currently preventing natural secondary succession.

- Design the restoration program to first re-establish the appropriate hydrology at an appropriate restoration site, and then utilize natural volunteer mangrove propagules recruitment for plant establishment.

- Only plant propagules or seedlings after determining through steps 1-4 that natural recruitment will not provide the quantity of successfully established seedlings, rate of stabilization, or rate of growth of saplings set as goals for the restoration project.

In abbreviated, layman's terms, we can summarize these steps as follow:

1. Understand which mangrove species belongs at your site, and what condition it needs to grow successfully.

2. Understand the existing conditions at the site.

3. Figure out what is preventing the normal growth of mangroves there.

4. Amend the site conditions such that they meet the needs of the mangroves you

want to grow.

5. Only plant mangroves if you have been through steps 1-4 and sufficient natural re-growth is not occurring.

In practical terms, this means that if natural re-growth is not occurring, there is probably something about the site that is preventing this, and planting projects will fail. In this case, modifications to the site will be needed. The most likely sources of problems are the conditions existing on the mud banks. Observation suggests that when a mud bank reaches sufficient elevation and stability, mangroves appear through natural recruitment. Thus, the task is to encourage accretion and stabilization of the mud bank. This means structures, designed to reduce wave energy and permit the deposition of sediments. Both groynes (structures that extend perpendicularly into the intertidal zone from the sea wall) and breakwaters (parallel to the sea wall) have their place in this programme. In both cases, low-cost, permeable, low-crest structures are proposed, based on the current engineering thinking regarding the best way to break wave energy.

It is strongly recommended that these principles - the current best practices model for mangrove restoration - be adopted. It is equally important that the investigation – through research, the advice of outside experts, and through on-site pilot projects – of the best way to stabilize the mud banks such that mangrove restoration can proceed (through natural recruitment or planting).

The use of breakwaters to protect new (or mature but eroding) stands of mangroves is of particular interest. Catastrophic losses of mangrove stands are a common occurrence. It is thought that the narrow strips of new recruits, as seen at Ruimzeight, are not deep enough to either have much impact on the sea defences or to be sustainable, and protecting them from sudden erosion is an important goal. Similarly, large tracts of mature mangroves that are being destroyed (apparently) by natural wave forces can be found, and their protection should also be a high priority. Experience with the use of breakwaters to achieve this is almost entirely lacking, and the construction of some length of breakwater and the monitoring of its effect on mangrove loss will be an important source of information on which to base future actions.

3.5.2 SITE SELECTION CRITERIA

A clearly defined set of criteria for the selection of action sites need to be developed. This process cannot be initiated until the underlying approach to restoration, whether to adopt the EMR protocols detailed above, is determined. If this set of suggestions is approved as the policy of the MAC, rules for selection and the treatment of sites should be aligned with them.

The possession of a reliable inventory of existing mangroves is also needed before rational choices can be made. The relationship between mangrove stands and the existing sea defences should be included in the selection criteria, as an area of eroding trees has

greater significance if it is protecting an earthen bank rather than a hard structure. It is recommended that certain pristine but vulnerable stands such as; the small islands in the Essequibo River, be earmarked early on as deserving enhanced protection.

3.5.3 NURSERY CAPACITY AND PROPAGULE ACQUISITION.

Once these principles have been applied to a site, and planting has been deemed an appropriate approach, plant production facilities will be needed. The existing NARI nurseries provide an excellent base on which to build capacity. They exist in every region and possess the skills and experience needed for mass production.

Significant expansion will be needed if the recommendations for future projects are adopted by the MAC. For the first year, it is proposed that 25,000 *Avicennia* seedlings be produced and planted at the Mon Repos site. The expansion of capacity at Mon Repos will serve as a model to be copied or adapted for future projects. Expansion needs will include the addition of staff, equipment and production areas.

Propagule acquisition. If the planning process results in the demand for very high numbers of seedlings, sources will have to be investigated and evaluated. During the field reconnaissance trips, a large area of *Avicennia* seedlings was identified at Cottage (Mahiacony) from which small 'wildlings' can be harvested. There is general agreement in the literature that this represents a suitable stage (6-12 inches tall) for transplanting, or for growing on under nursery conditions to a slightly more advanced stage of maturity.

Avicennia seeds (pre-germinated propagules) were gathered from the beach at #63 Village (Region 5) and successfully grown on at the NARI nursery in Mon Repos. Conversation with staff at the nursery in Region 6 suggests that gathering seeds where mature mangrove stands exist does not present a problem to knowledgeable local people, but if propagules are needed in very large numbers, sourcing them will have to be part of the on-going research on the whole mangrove resource.

Figure 3: Avicennia propagules at the high tide line.

3.5.4 SPECIFIC PROJECT SITES

Three sites have been identified as priority project sites. Efforts were made to select sites that would exemplify good decision making and provide valid experience and add to the knowledge base of the people involved. The development of expertise, competence and locally-based understanding of the issues, challenges and solutions that surround the complex question of mangrove reforestation, is an expected outcome of these projects.

Three sites were selected as prime project locations, the successful development of which will be one of the stated indicators (I Km of coast protected) for the release of the second tranche of EU funding. The sites selected (each represent a specific approach to restoration, and for ease of implementation and maximum visibility for decision-makers) are all within easy reach of Georgetown.

3.5.4.1 PLANTING AT MON REPOS.

Goal - Planting and research for 300 metres of beach

The beach at Mon Repos (approximately 500 Km from the sluice to the rock structure at

Triumph) is an excellent study site for planting trials. A small mature stand of black and white mangrove exists just west of the sluice outlet. From there, extending down the beach, natural recruitment of both species is occurring, on an apparently stable and expanding high mud bank. Although recruitment is good, it does not yet extend all the way down the beach, but does provide evidence that conditions are suitable for regrowth.

Earlier pilot planting projects (2009) were carried out at the edge of the mature stand, by S&RDD engineers and crew. This planting was largely (about 65%) successful, where mangrove seedlings were introduced into developing patches of sea grasses. The presence of grasses can be used as an indicator that the mud bank is stable enough to support plant roots. Mangroves planted in raw open mud during this trial did not survive. This site, therefore, offers a variety of alternatives for planting. Well-thought-out planting design, using a variety of techniques and environments can provide information to guide future efforts. It is recommended that the University of Guyana, SRDD and the GFC be involved in planning the planting, and in setting up monitoring systems from which sound data on survival can be developed.

The beach at Mon Repos is a busy place. It is used by boat builders, kite-flyers, and fishermen while cattle and goats wander onto it freely. There are many complex issues to be addressed with the local residents. Alienating and disregarding the essential local population would almost certainly guarantee its failure. A community involvement project at Mon Repos, where the population is closely connected to the site, can be used as a model for future sites. Lessons learned can be applied throughout and beyond the life of the programme.

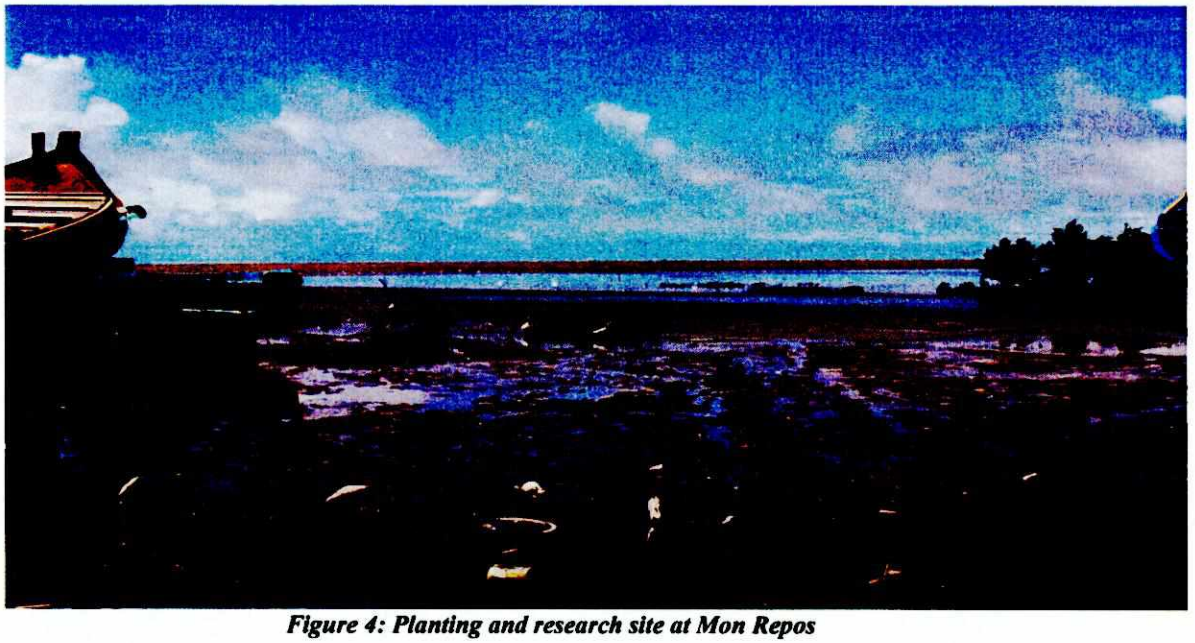


Figure 4: Planting and research site at Mon Repos

3.5.4.2 GROYNES AT KITTY

Goal – Mud bank stabilization via groynes to affect 300m of shore.

The need to build a body of knowledge and some practical experience with building low-cost protection structures is paramount. The stretch of shoreline from Kitty (Celina's resort) to Kingston (The Pegasus Hotel) offers an ideal location to build experimental groynes.

The presence of the old groyne that extends seaward from the Celina's site, suggests that such structures do indeed stabilize and hold mud. Between this and the wharf structure at Kingston is a stretch of relatively high mud, with evidence that natural recruitment would occur if conditions permitted establishment of incoming seedlings. Evidence of this can be found in the number of seedlings that have found a foothold in the rocks below the sea wall. The mud bank is apparently neither high nor stable enough to provide the level of stability that the seedlings find in the rocks. This suggests that much could be learned from constructing groynes here and monitoring the resulting changes in wave action and mud accretion. Discussion has been held with S&RDD engineers on the cost and design of two groynes, located on the sites of previous (now almost totally defunct) structures. Design and costs must be finalized and agreed on.

Little community contact has been made at this site. Some key community leaders from the private sector have been informally contacted, but community development needs to receive attention here. The site is extremely visible, and offers a unique opportunity for education and participation. It can be emphasized that negative publicity, resulting from poorly planned and premature release of information, would be extremely damaging to the whole programme, while a positive perception of this project will go a long way to allaying public fears over the success of the mangrove rehabilitation plan.

3.5.4.3 PROTECTION (BREAKWATER) AT RUIMZEIGHT

Goal – Breakwater protection of 500m of newly regenerated mangrove fringe.

One of the most significant examples of natural regeneration can be found along the coast in Region 3 (from The Best to Blankenburg). The easiest access to this stretch is the earthen bank that runs close to the road at Ruimzeight. The new trees (a combination of black and white mangrove) form a stand that extends an estimated 10 to 30 meters seaward. Beyond the dense stand is a variable width of smaller plants, widely space, and apparently in the process of being eroded. When established, they are capable of pushing the edge of the stand farther out to sea. The placing of a breakwater at the outer edge of such a stand may reduce losses and encourage additional establishment Information on what to expect from such an approach is almost non-existent, therefore, whatever the outcome, it represents a significant learning opportunity.

Discussions have been initiated with SRDD regarding the design and construction of a low-cost, permeable, low-crest structure, and these must be completed. As the whole stretch of coast currently exhibiting this re-growth phenomenon is several miles long, advantage can be taken of the most appropriate and accessible stretches. It is essential to monitor and record the effects of the structure on wave action and mangrove loss so the results can inform future plans.

Community involvement is important. Properly executed, this project could provide an excellent opportunity: to utilize local knowledge in selecting the location for a structure, to hire a local workforce, and to involve local residents in monitoring and data collection. During field visits to the area, many local groups and individuals expressed interest in the study but there were no formal engagement. As with other sites, it is strongly recommended that meetings are held and information shared before any development of the site takes place.

3.5.5 FUTURE DEVELOPMENT

In order to develop 10km each in the second and third years of the project, many additional sites will need to be developed. The best stands of undamaged mangroves exist in Region one, and their protection, as well as their value as a control group for the study of mangrove loss as it relates to the presence of sea defence structures, are critical.

The following potential sites were identified during field reconnaissance. These sites reflect a wide range of the issues facing mangrove restoration, and a very small sample of all the potential sites available for development. On-going surveys will facilitate the selection of other sites. The selection criteria identified above should be applied.

Region 1	Shell beach area	Understanding and protection of pristine stands
Region 2	Bounty Hall	Erosion protection of mature stands
	Lima	Beach/mud bank stabilization and planting.
		Back /mangal planting.
	Better Hope to Charity	Mature stands of Black mangroves eroding. Protection (Breakwater)
Region 3	Essequibo River - Small islands	Understanding and protection of pristine stands
	Waller's Delight (or proximate other community)	Additional protection following results of Ruimzeight project.
	Windsor Forest	Potential site for planting and biodiversity studies

	Farm	Natural erosion process. Monitoring
Region 4	Buxton	Community involvement and education (children and older youth groups and leaders) and mud bank stabilization (small twig/branch structure) plus plant production by community, and planting and monitoring.
	Hope Beach	Mud bank/natural regeneration monitoring. Biodiversity studies. Drainage/sluice maintenance impact studies.
	Greenfield	Potential area for planting
Region 5	#6 Village	Protection of new stands from goat grazing. Planting.
	#7 Village	Potential area for planting
	Cottage	Swamp rehabilitation for mangrove colonization by improved flushing of stagnant flood water. Seedling collection – impact, collection methodologies.
	Abary/Profit	Mature stand- protection from cutting and burning (Public Awareness). Honey production. Mature stand loss from erosion - monitoring
	Trafalgar	Mangroves stand loss from pollution/root smothering. Public Awareness
Region 6.	#19 Road	Saline/sodic land reclamation for mangrove planting. Honey production.
	# 50-63 Villages	Mature stand loss from erosion - Protection - Groynes/Breakwater. Conflicts with agriculture. Cutting/clearing – Public Awareness

3.6 INCREASE OF PUBLIC AWARENESS AND EDUCATION ON THE BENEFITS OF THE MANGROVE FORESTS

3.6.1 PUBLIC AWARENESS

Sensitivity and awareness need to be developed at the very outset of the project. Much depends on the success of public awareness and education campaigns. The recognition of the vital roles that mangroves play; the extraordinary environment to which they have adapted and their vulnerability to external pressures, should become part of the Nation's consciousness. As this understanding grows, and a sense of shared national responsibility fostered, the work of restoration and protection will be made easy. This will be addressed through two projects – a website and a media campaign.

3.6.1. (a) Web Site

The entire campaign for public involvement and understanding should be supported and enhanced by a quality website. Through it, information can be released, educational materials distributed, newsletters published, and reports of damage to mangroves reported. The website needs to be designed, launched and hosted by a professional body with experience in the creation of public-service sites designed to serve a national programme.

3.6.1. (b) Media Campaign

A national public awareness campaign, to run for a two year period, is proposed. A professional organization with proven experience in media campaigning should be contracted to produce and release information in an appropriate time frame. This should be initiated as soon as the company is selected from tendered proposals. The principal component of the campaign should be a series of radio and TV programmes.

3.6.2 PUBLIC EDUCATION

A public education campaign is proposed as a second part of the sensitivity program. This will include academic curriculum development at UG and the GSA. Lesson plans for schools, a nationwide mangrove awareness day conducted by students (school caravan), field guides, educational tours and workshops for the public at large will be conducted. Trainings for staff from various agencies involved in mangrove management, such as SR&DD, NDIA, GFC, the Fisheries Department, Community workers, relevant regional officers is proposed. The Ministry of Education should be involved in all aspects of this campaign from the outset. Their involvement is required in developing new curriculum content for the country's educational institutions.

- **UG Curriculum**. If the University of Guyana is to develop and conduct a research programme for understanding mangroves. Courses will be needed to train student researchers in mangrove ecology and management. A short course in Coastal Resource Management should be developed by the first semester of the 2010/2011 academic year. This could be further developed and included into curriculum of the BSc. Degree in Forestry. The Guyana School of Agriculture has expressed interest in offering courses in mangrove management. This would be an excellent opportunity of producing technical staff with knowledge of mangroves. A course is proposed for the first term of the 2010/2011 academic year. Budget support for the development of these courses is recommended.

- **Lesson plans.** The Guyana Biodiversity Education Development Foundation, a non-profit organization that focuses on hands-on training for children, was approached on the topic of lesson-plan development. They proposed the development and delivery of school lesson plans (for three separate age groups) to be delivered as part of the Integrated Science Curriculum. This could be fostered through Biodiversity clubs in the schools and communities. The University of

Guyana students could assist in the delivery of these lessons. There could also be education month activities that may include televised quiz competitions, nature walks, club activities (eg 4H club). These students could also be involved in the planning and execution of a school 'Mangrove Caravan'.

- **Field Guides.** The University of Guyana has agreed to the concept of developing field guide documents on mangrove ecology and management. These guides would cover the ecology and environmental services provided by mangrove forests so that the general public could develop a basic understanding of mangroves and their use. These materials can be distributed to schools, community groups, staff and the general public.

- **Tours and Workshops.** Educational tours and workshops, targeting the general public, will be an important component of the education program. Nursery production, planting and protection sites and intact mangrove stands all provide good opportunities for educational tours. Educating specific sub-groups will be emphasized (environmental clubs, fishermen, cattle hand/owners and farmers). These would largely be the responsibility of the MPO, but UG students and the GBEDF could be involved as appropriate.

- **Trainings.** Specific training programs, targeting the nation's mangrove workforce, will be required as soon as such people are hired. In particular, Sea Defence Rangers, Regional Mangrove Officers, NDIA personnel and any community members involved in long-term management projects, will need to be trained on the essentials of mangrove management. One-day and one-week training programmes, will be implemented within the first year.

4.0 VISIBILITY AND SUSTAINABILITY

4.1 LONG TERM SUSTAINABILITY

The Mangrove Management Plan will be funded for three-to-five year, depending on the committee's decision on how to disburse funds for the period. After that, alternative sources of funding will be needed to continue the programme. The MAC, therefore, must develop a long term sustainability plan before the end of the EU funding period, and submit this to the Government for approval. Success in securing ongoing funding will depend on the outcome of the first 3-5 years. As such, sustainability must be built into the initial phases of the programme so that momentum and a working plan are in place at the end of the EU funding period. This is possible if:

- The Management Committee supports and facilitates the efforts of the Project Coordinator.
- The MAC ensures real communication among all stakeholders since shared ownership of the project is as important at this level as it is at the grass-roots level.
- New legislation is enacted to protect mangroves and a new code of practice developed for the use (and penalties for misuse) of all three mangrove species.
- There is a stable, autonomous and appropriately financed Mangrove Project Office.
- There is on-going research to build locally relevant information on issues dominating the mangrove reforestation effort.
- There is a current, high quality mangrove inventories that are continuously updated.
- There is centrally located and readily available and accessible information from current documents as well as new studies/research.
- The awareness, training and education programs increase national awareness of the importance of mangroves.
- There is grass-roots involvement in all projects since wider ownership of the project enables a more stable and sustainable future.
- There is development of appropriate partnerships across all levels of society to safeguard and sustain mangrove ecosystems through shared ownership and responsibility among national and local government, communities and private sector (e.g. Digicel, GT&T, Demerara Tobacco Company etc.).

- There is transparent and effective monitoring of research projects, work projects, and all actions affecting mangroves.

- There is fair and firm enforcement of laws.

4.2 VISIBILITY

Important steps are required to ensure visibility of the programme.

- The website must be of high quality in appearance and be easy to access the available information. It should provide interactive opportunities for the public as well as a means of timely communication (of changes) to the public.

- The media campaign should raise public awareness and create interest in well-planned events (site tours, workshops) that are by press releases.

- The education campaign is also a major contributor to visibility. Lessons and workshops will provide visibility for the mangrove program. They can be advertised on the website and reported in press releases.

- Reports from the MAC, the MPO and any visiting experts should provide readily available information on progress.

- The activities at the selected sites, and the community involvement should result in increased local knowledge and understanding. These activities will increase visibility.

Relationships with the press need to be thoughtfully managed. The press should only be briefed by well-prepared and informed people capable of providing accurate information.

5.0 REFERENCES

1. **Ackroyd, C. 2010.** Initial Technical Assistance for a Mangrove Project in Guyana, Technical Assistance for Capacity Building and Institutional Strengthening of the Sea Defences Sector, Projected to be implemented by MWH.

2. **Aksornkoae, Sanit, (1993).**Ecology and management of Mangroves. IUCN, Bangkok, Thailand

3. **European Union, 2010.**Technical Assistance for the capacity building and institutional strengthening of the Sea Defences Sector. Inception Report-mangroves.

4. **Evans, I.J. 1998.** The Restoration of mangrove Vegetation along the Coastal Belt of Guyana. Msc Thesis. University of Aberdeen, UK

5. **FAO. 1994.** Mangrove Forest Management Guidelines. Forestry Paper 117. Rome.

6. **FAO. 1994.** Mangrove forest management guidelines. FAO Forestry Paper No. 1119. Rome.

7. **Guyana Forestry Commission and Integrated Coastal Zone Management (ICZM)-EPA, November, 2001.** National Mangrove Management Action Plan.

8. **Guyana Low Carbon Development Strategy , 2009.** Transforming Guyana's Economy While Combating Climate Change

9. **Hamilton, L.S., Snedaker, S.C. (Eds.), 1984.** Handbook for Mangrove Area Management. UNEP and East West Center, Environment and Policy Institute, Honolulu

10. **Hussain, M., 1995.** Silviculture of Mangroves. Unasylva. 181 (6): 36-42

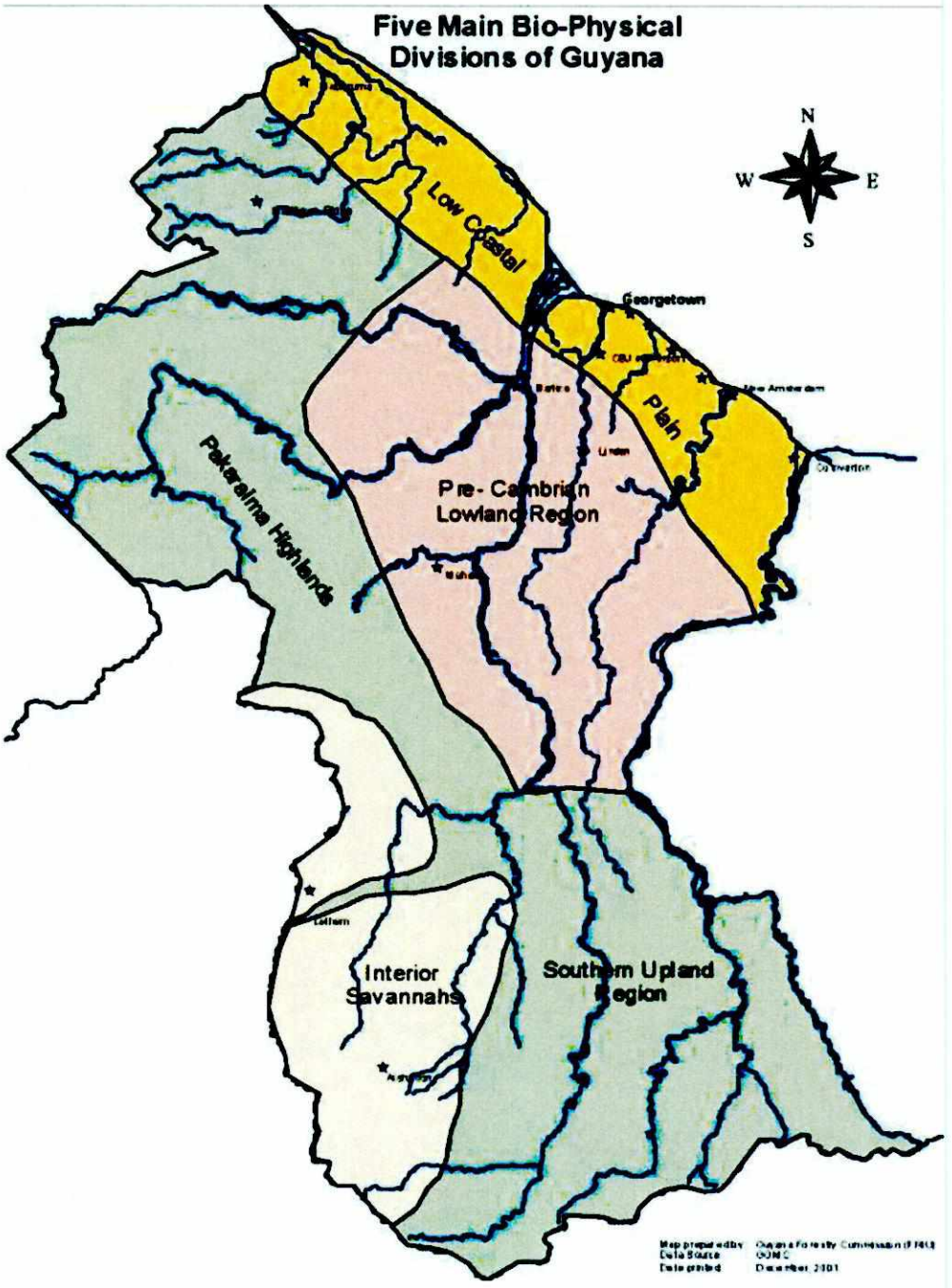
11. **IPCC WEI Third Assessment Report, 2001.**

12. **Pastakia, C.M.R. 1991.** A Preliminary Study of the Mangroves of Guyana – Aquatic Biological; Consultancy Ltd.

13. **Ronnback Patrik, 1999.** The ecological basis for economic value of seafood production supported by mangrove ecosystems; Department of Systems Ecology, Stockholm Uni6ersity, S-106 91, Stockholm, Sweden

6.0 APPENDICES

APPENDIX 1
FIVE MAIN BIO-PHYSICAL DIVISIONS OF GUYANA



APPENDIX 2
LEGAL FRAMEWORK FOR MANGROVE MANAGEMENT

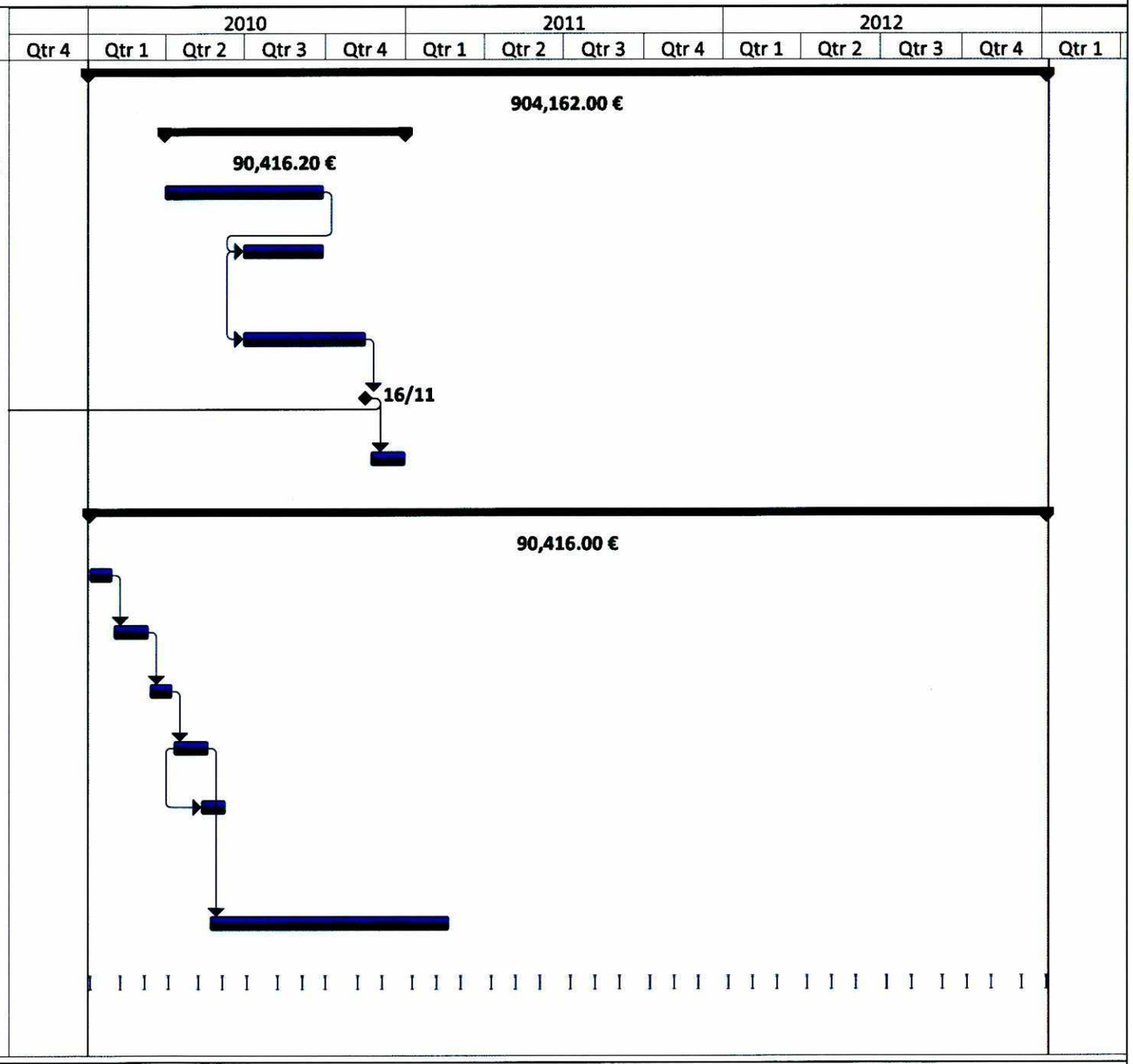
ISSUES AND CONCERNS ON MANGROVE	LAWS, POLICIES, RULES AND REGULATION
Conservation and Protection of natural resources including mangrove	***Guyana Constitution Article 36*** states that in the interest of the present and future generation, the state will protect and make rational use of its land, mineral and water resources, as well as its flora and fauna, and will take all appropriate measures to conserve and improve the environment.
	The Forests Act 2009 Part 3. 5.23. (1) mandates the EPA to declare a specific area of state forest to be a specifically protected area for a period not exceeding 25years (a) declare a specified area of State forest to be a specially protected area for a specified period not exceeding 25 years ;Purpose **of Part 3,5.22 (1) is to** 1) conserve biological diversity 2) protect specific trees and plants 3) conserve soil and water reserves 4) protect forests from fires, pest, diseases and degradation ***Forest Act 2009 Part 3. 5. 30*** Minister can make order for protection of trees and plants any tree or plant, **Part 3. 5. 31 Minister can** declare **private land** to be a forest conservation area.
	Environmental Protection Act of 1996 mandated that the will provide for the management, conservation, protection and improvement of the environment,; danger of extinction; (2) any person who in any marine reserve without permission granted under subsection 3 (b) **takes or destroys any flora and fauna other than fish is guilty of an offence.**
	Fisheries Act 1957 Part 8 Marine Reserves and Fishing Priority Areas, Section 21. (1). (a) to afford special protection to the flora and fauna of such areas and to protect and preserve the natural breeding grounds and habitat of aquatic life with particular regard to flora and fauna in danger of extinction; (2) any person who in any marine reserve without permission granted under subsection 3 (b) **takes or destroys any flora and fauna other than fish is guilty of an offence.**
Mangrove as Forest	***The Forests Act 2009, Part 1 5.2 (b) (1)*** defines forest with reference to mangroves
Mangrove as part of state forest and as state land	***Forest Act 2009. Part 1. 5.3.*** state the **Minister can declare public forested land** as state forest
	Civil Act Article 4.1 define foreshore of Guyana as the part of the shore of the sea and tidal navigable rivers which is covered by the medium high tide between the spring tides and the neap tide, the soil under tidal waters called land shall be deemed to be under **state land** ***Sea Defence Act of 1998*** declares that "sea defence includes – any shell bank or reef, sand bank or reef or other natural feature which serves as a protection of the sea coast against the erosive action of the river current". In **Part 3 Section 12 of the Act** declares that "all sea defences which are or shall be in existence in any district shall by force of this Act become the property of the state".
Jurisdiction over mangrove forest	***Environmental Protection Agency*** states that their functions is to take steps necessary for the effective management of the natural environment so as to ensure conservation,

ISSUES AND CONCERNS ON MANGROVE	LAWS, POLICIES, RULES AND REGULATION
	protection, sustainable use of its natural resources; establish, monitor and enforce the environmental regulations; assessed environment impact of the project ;and promote and encourage a better understanding and appreciation of the natural environment and its role in social and economic development;
	Sea Defence Act 1998 defined sea defence as (c, e)"All land fifty (50) feet landwards from the centre of any sea or river dam or sea or river wall and all land on the other side of such sea or river dam or sea or river wall in the direction of the sea or river to the toe of such sea or river wall ; and declares that "sea defence includes – any shell bank or reef, sand bank or reef or other natural feature which serves as a protection of the sea coast against the erosive action performed by the Ministry or its agents at the expense of the Board
	Guyana Land and Survey Commission Act mandated the commission to take charge of and act as **guardian** over all public lands, rivers and creeks of Guyana,
	Municipal and District Council Act Part II Sec. 7 (2) states that the jurisdiction of the City Council shall extend to low water mark of spring tide of the Demerara River and to all structure thereon (2) town council shall extend to low water mark of spring tides of the Berbice River and to all structures. Part IX 302 (19) **to plant, trim, preserve or remove trees, flowers and shrubs in any public places.**
Island and embankment (beach) for protection and rehabilitation and regulations on cutting and burning mangroves	***The Forests Act 2009 Part 3. 23 (b)*** prohibiting any disturbance of the soil, vegetation, rivers, or creeks in that specially protected area; and **Part 3.31. (1)** The **Minister** may by public notice make an order – (a) **declaring any forest on private land to be a forest conservation area**; and (b) prohibiting, restricting, or regulating all or any of the following - (i) entry into the forest conservation area (ii) cutting, damaging, taking, or removing any forest produce in the forest conservation area; (v) clearing, cultivating, or turning of soil in the forest conservation area; (vi) grazing or pasturing of livestock in the forest conservation area; (vii) setting of fire in the forest conservation area; (2) No order may be made except on the advice of the Commission that the order is necessary for – (a) **conserving the forests of Guyana and securing the proper management of forest land**; (b) **preventing soil erosion, coastal erosion, or erosion of the banks of rivers or creeks;** (c) preventing the deposit of mud, stones, or sand in rivers or creeks or on agricultural land; (d) maintaining water supplies in springs, rivers, canals, reservoirs, aquifers, or water conservancies; (e) **minimising the risk or mitigating the impact of storms, winds, floods, or landslides;**
	The Environmental Protection Act of 1996 Part 10.68.1 Minister may make regulations for giving the effect to the provisions of this Act for **the protection of particular species of prescribed fauna and flora** (j.) **protecting the coastal and marine resources and establish, monitor and enforce the environmental regulations**
	Sea Defences Act of 1998 Sec.13 (1) and Sec. 16 (b) mandated to make regulations for **(a) protecting the growth of Underwood, shrubs, and trees, on or near** the foreshore or between high and low water marks (b) and the protection of the land and soil between high and low marks ; and generally, conserving the foreshore; and require estate to protect the foreshore by sowing seed, planting shoots to promote the growth of or the other tree, underwood, or shrubs, between and low water marks **on the foreshore courida**
	Civil Act Article 4.3 states that no one shall remove any sand, shell, gravel, shingle or

ISSUES AND CONCERNS ON MANGROVE	LAWS, POLICIES, RULES AND REGULATION
	other mineral substances or any seaweed or vegetation from the lands without the permission of the Minister responsible for sea defences and are subject to the like penalties.
	The Forests Act 2009, Part 3.31. prohibits the cutting, damaging, or taking any forest produce, or carry out any other kind of forest operation in a State forest; occupy or use any land in a State forest;
	Sea Defence Act of 1998 Sec.13 (1 Sec. 14, 15 and Sec. 16 (b) (a) (b) Sec, 26 states that everyone who infringes any of the provision of this Act shall be liable on summary conviction of twenty-two thousand five hundred dollars (G$ 22,500)
	Municipal and District Council Act sec. 302(28). states the power of the council to regulate the **cutting of wood on land vested in the council.**
	Local Government Act part IV sec 51. Cutting of trees will have fix fees
	The Forests Act 2009 Part 3.24., Part 3. 25 (2), Part 6. 68 b.(iv) section 25(2), section30(3), section 31(4), section 23(5)- prohibits person in any State forest to throw down a lighted match or lighted or inflammable material; or do anything else likely to result in any forest produce being burnt or damaged. Penalty range from G$250,000 to 1,00000
Cattle grazing	***Municipal and District Council Act sec. 287,290 28).*** stated the power of the council to regulate the **grazing of animals**; impounding the stray animal found in public places
	Local Government Act Part IV sec 50 states that grazing of animals on common land of the village and in country district will be impound and sec.102 (1-5) straying animals
Community Involvement and Participation	***Guyana constitution Article 25*** state that every citizen has a duty to participate in activities designed to improve the environment and protect the health of the nation.
	Article 74 (1) states that it is the duty of the Local Democratic to ensure in accordance with the law the efficient management and development of their areas and to provide leadership by example (3) to maintain and protect property , improve working and living condition and raise the level of civic consciousness..
	Local Democratic Organs Act Part II Sec. 7 states that duties of the local democratic organs is (a) maintain and protect property (b) protect and improve the physical environment (f) **raise the level of civic consciousness (awareness)**

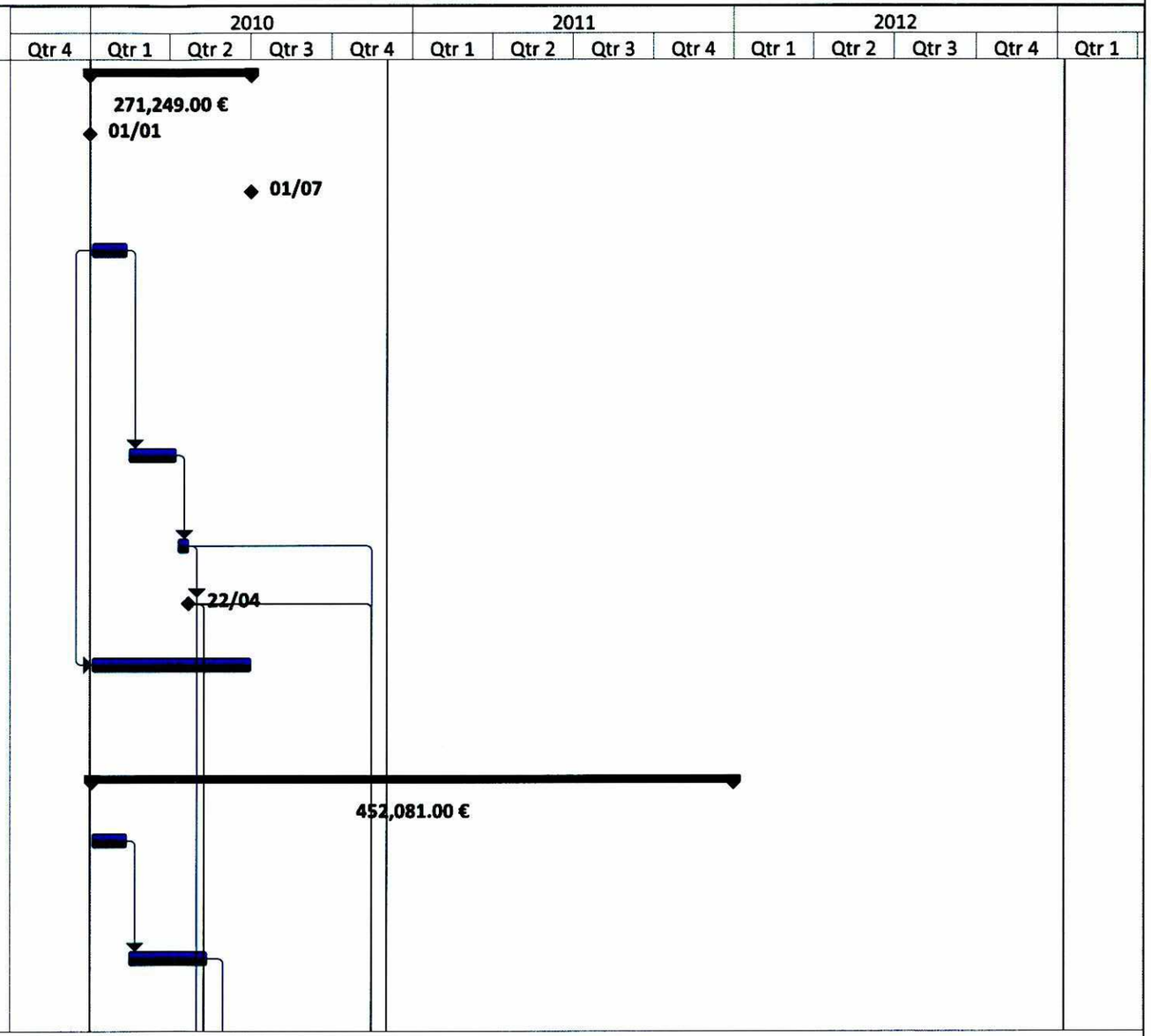
Appendix 3. Mangrove Management 3 Year Action Work Plan

ID	Text1	Task Name	Duration	Predecessors	Resource Names
1	1	**Institutional Development and Capacity Building**	**788 days?**		
2	1.1	**Legislation**	**199 days**		**Legal Officer,MAC,MWH**
3		Review current relevant legislation and policies	130 days		
4		Formulate policies for additional mangrove protection	65 days	3FS-65 days	
5		Consult with stakeholders and their legal officers	100 days	4SS	
6		Submit new policy for approval	0 days	5	
7		Publicize results	30 days	6	
8	1.2	**Mangrove Action Committee**	**788 days**		
9		Identify all stakeholders	20 days		
10		Conduct initial interview with same	30 days	9	
11		Stakeholders consultation	20 days	10	
12		Nominate committee members	30 days	11	
13		Review and adopt mangrove management plan and submit to Cabinet for approval	20 days	12SS+20 days	
14		Develop guidelines on mangrove management	198 days	12	
15		Monthly meetings to develop strategies and monitor progress	**788 days**		**MAC,MPO**



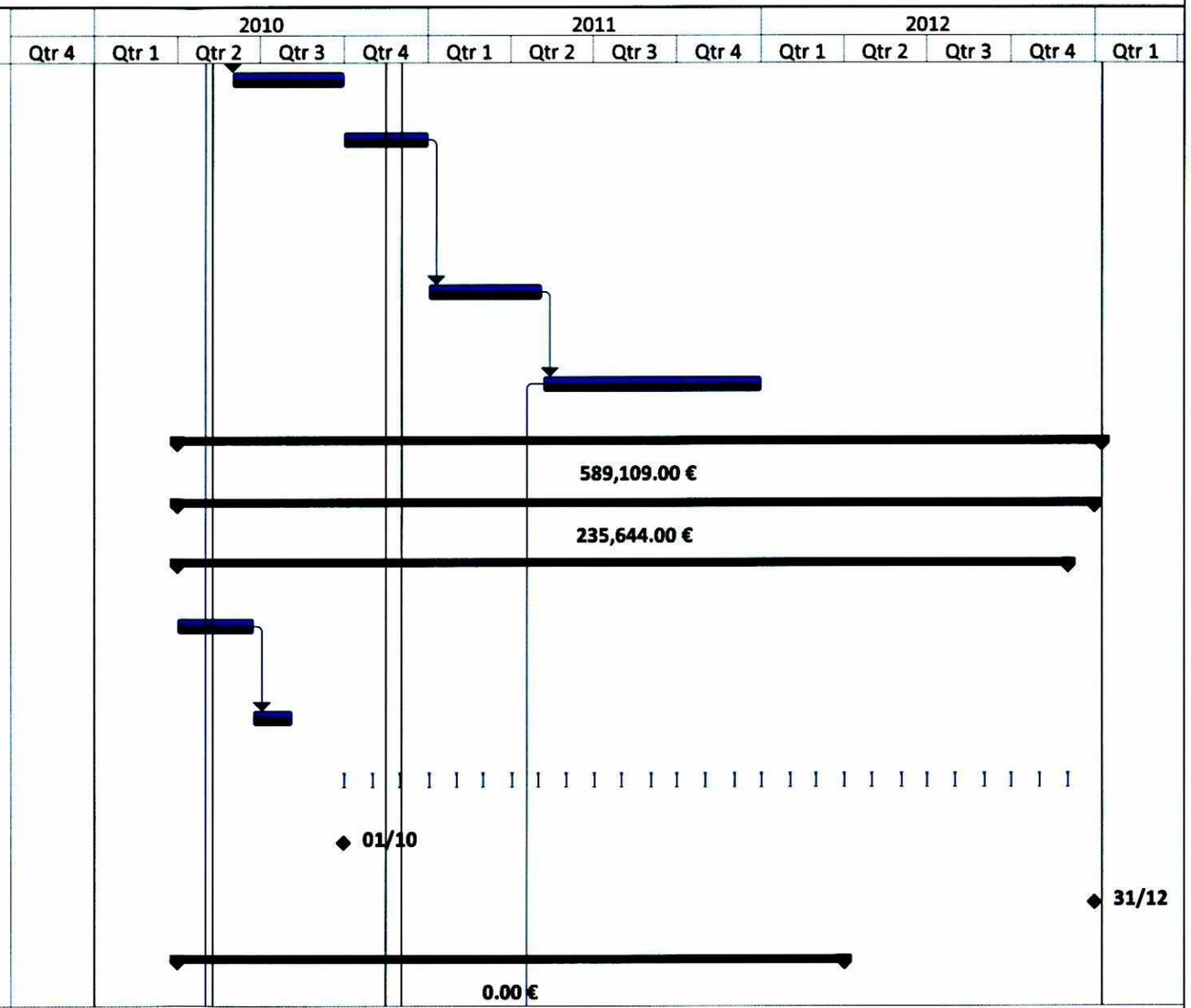
Appendix 3. Mangrove Management 3 Year Action Work Plan

ID	Text1	Task Name	Duration	Predecessors	Resource Names
53	1.3	**Mangrove Project Office**	**130 days?**		
54			0 days?		
55			0 days?		
56		Identify staffing needs (Project Leader, GIS/Forester, Office Administrator/Financial Manager, Community Coordinator , Drivers, Regional Officers	30 days		MAC
57		Develop TOR's , advertise positions, hold interviews, select and engage	40 days	56	MAC
58		Hire staff as approved	10 days	57	NARI
59		Announce new positions on website	0 days	58	MAC
60		Identify and seek approval for purchase of office equipment, supplies and vehicles	130 days	56SS	MPO
61	1.4	**NARI Nurseries**	**523 days**		
62		Identify capacity needs in Region 5 for production of 25,000 seedlings for Mon Repos planting	30 days		MAC,MPO,NARI
63		Acquire nursery equipment and staffing to meet the needs	65 days	62	



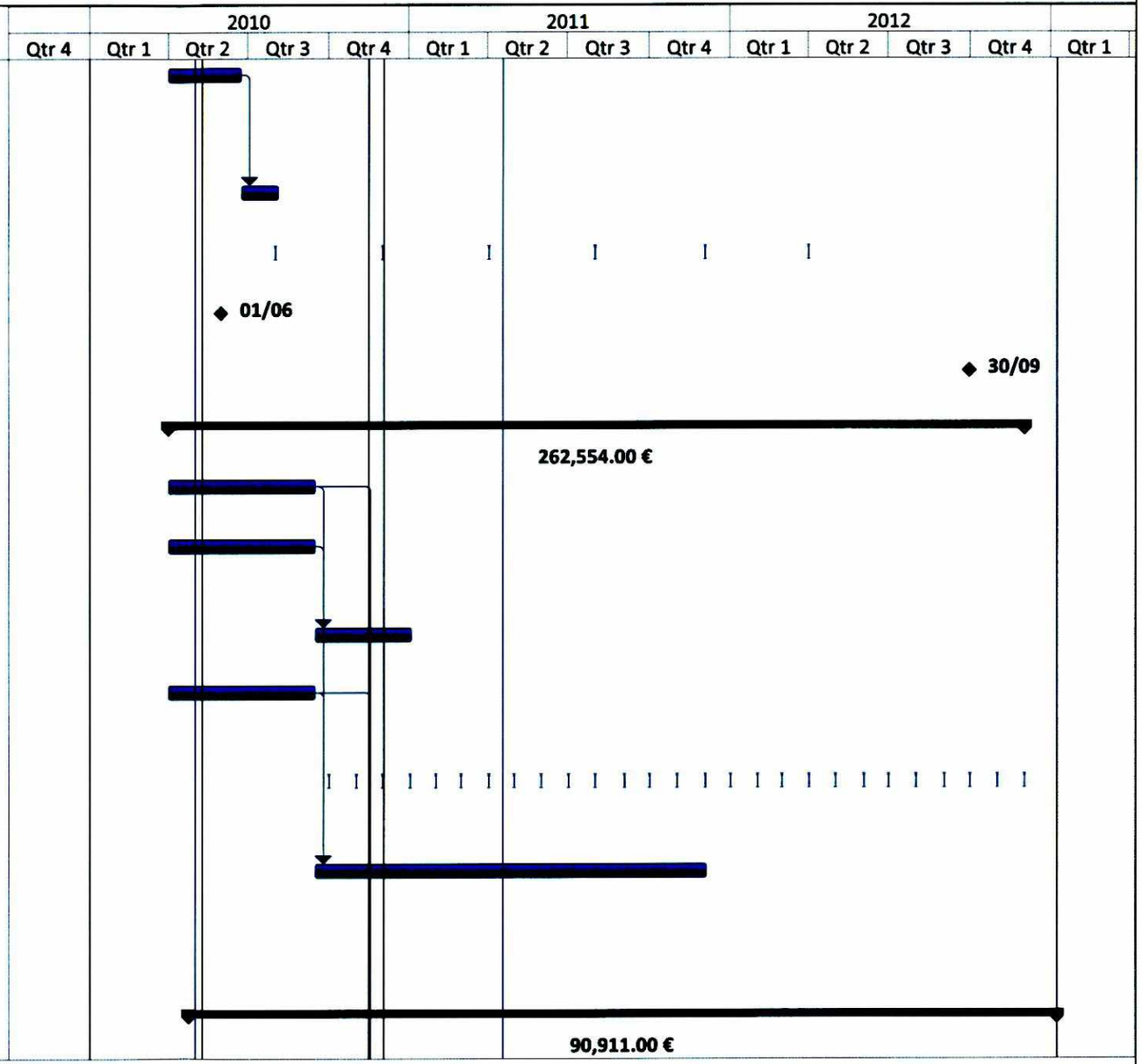
Appendix 3. Mangrove Management 3 Year Action Work Plan

ID	Text1	Task Name	Duration	Predecessors	Resource Names
64		Produce 25,000 seedlings	88 days	63	
65		Identify capacity needs in Region 2,3,4 & 6 for production of 250,000 seedlings for 2011 planting sites	67 days		
66		Acquire nursery equipment and staffing to meet the needs	90 days	65	
67		Produce 250,000 seedlings	171 days	66	
68	2	**Public Education, Awareness and Training**	**726 days?**		
69	2.1	**Public Awareness**	**720 days?**		
70		**Develop website**	**699 days**		**MAC,MPO**
71		Solicit 3 proposals from private sector for design and hosting	60 days		
72		Select one (1) proposal, award contract	30 days	71	
73		**Update and Maintain Website**	**568 days**		
101			0 days?		
102			0 days?		
103		**Media Campaign**	**524 days**		**MAC,MPO**



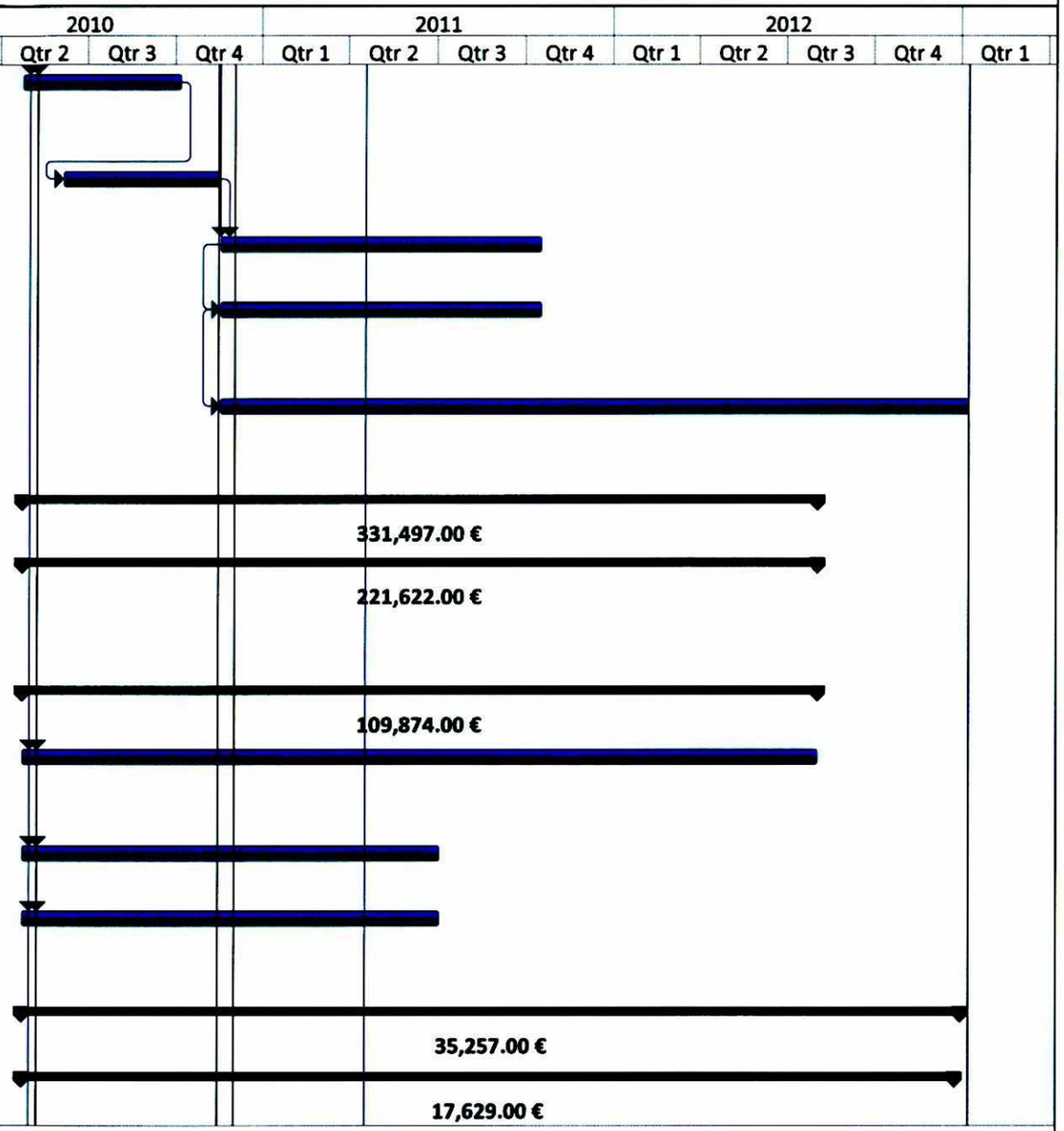
Appendix 3. Mangrove Management 3 Year Action Work Plan

ID	Text1	Task Name	Duration	Predecessors	Resource Names
104		Solicit 3 proposals from private sector for nationwide media campaign	60 days		
105		Select one (1) proposal, award contract	30 days	104	
106		**Review and approve all segments**	**438 days**		
113			0 days?		
114			0 days?		
115	2.2	**Public Education**	**699 days**		
116		Develop curriculum on mangrove ecology	6 mons		GSA,MoE,UG
117		Develop lesson plans for school children and community groups	6 mons		GBEDS,MoE,UG
118		School Caravan	4 mons	117	GBEDS,MoE,UG
119		Develop field guides to mangrove identification and ecology	6 mons		GBEDS,UG
120		**Educational Tours and Workshops including nurseries and Project**	**568 days**		**MPO**
148		Trainings for Nursery Staff, Sea Defense Rangers, Regional mangrove officers, and other regional stakeholders	320 days	116,119	MPO,UG
149	2.3	**Community Involvement**	**710 days**		



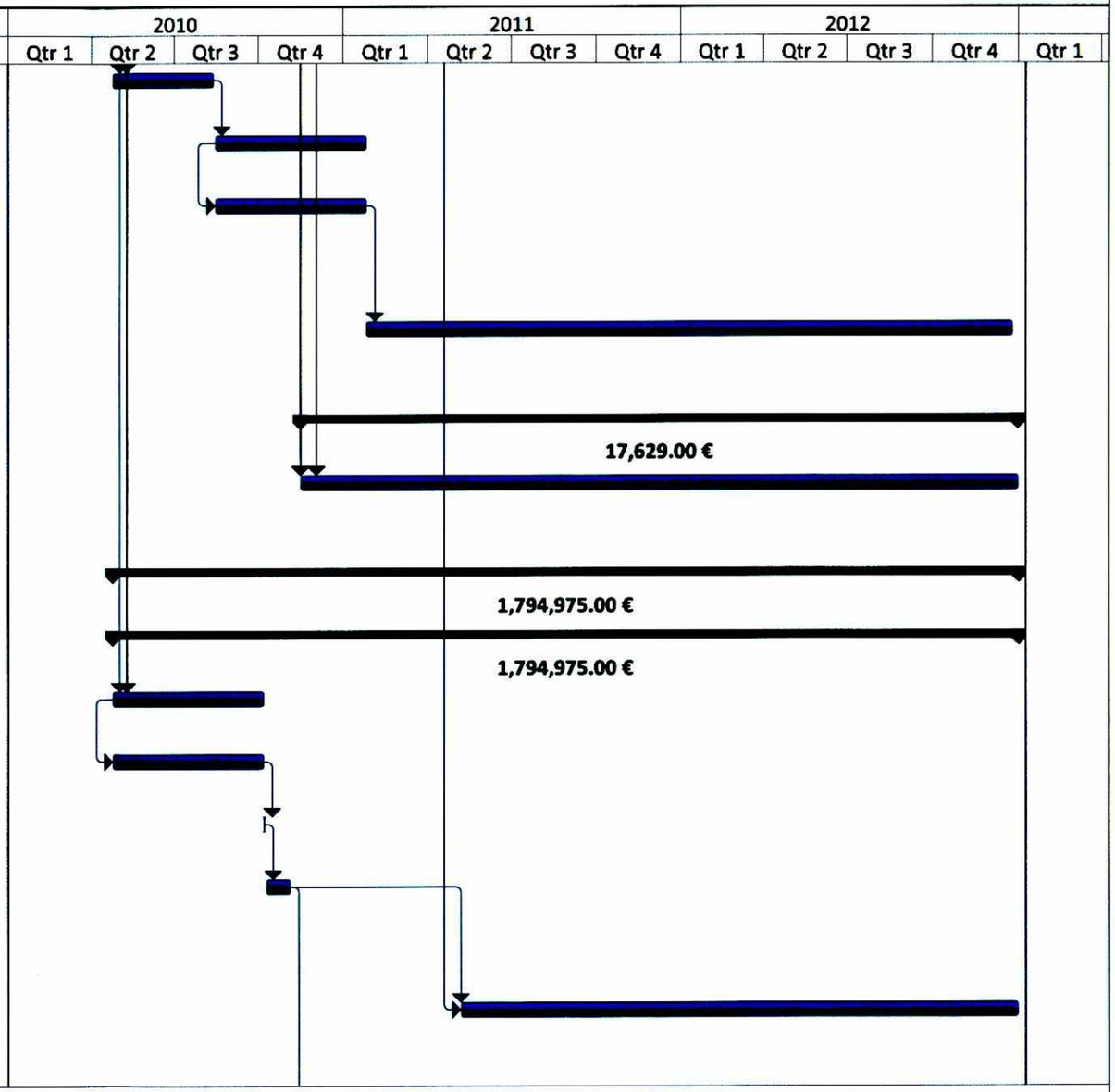
Appendix 3. Mangrove Management 3 Year Action Work Plan

ID	Text1	Task Name	Duration	Predecessors	Resource Names
150		Consult community leaders in each project sites	6 mons	58,59	MAC,MCYS,MPO,NDC,RDC
151		Identify interested groups and individuals	6 mons	150FS-90 days	MAC,MCYS,MPO,NDC,RDC
152		Hold workshops and site visits	12 mons	116,119,151	MAC,MCYS,MPO,NDC,RDC
153		Identify specific objectives for community involvement	12 mons	152SS	MAC,MCYS,MPO,NDC,RDC
154		Provide support for execution of plans and maintain relationship	28 mons	153SS	MAC,MCYS,MPO,NDC,RDC
155	3	**Research and Development**	**597 days**		
156	3.1	**Coastal survey and profiling all mangroves and relevant coastal feature including saline/sodic land**	**597 days**		**Climate Change Office,EPA,Fisheries,GFC,Land & Surveys,MAC,MoA,MPO,Sea**
157	3.2	**Technical Research**	**597 days**		
158		Solicit proposals for long and short term research projects	597 days	58,59	EPA,GFC,NARI,UG
159		Establish mangrove learning resource	314 days	58,59	UG
160		Establish location and protocols for shared use of information	314 days	58,59	MAC,MPO
161	4	**Monitoring, Reporting and Enforcement**	**704 days**		
162	4.1	**Monitoring and Reporting**	**700 days**		**MAC,MPO**



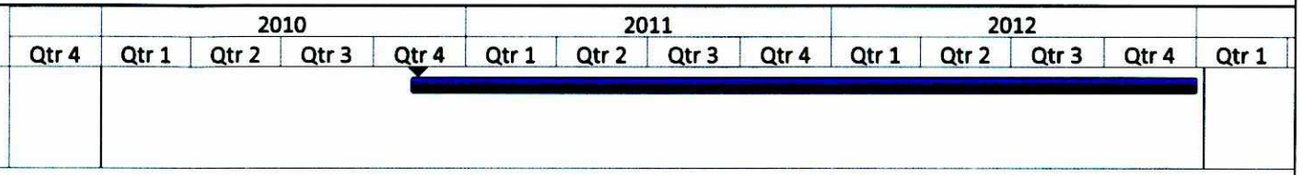
Appendix 3. Mangrove Management 3 Year Action Work Plan

ID	Text1	Task Name	Duration	Predecessors	Resource Names
163		Identify existing and proposed M&R roles	4 mons	58,59	
164		Coordinate agencies and determine capacity	6 mons	163	
165		Arrive at agreement on permanent roles, responsibilities and resource needs	6 mons	164SS	
166		Augment capacity and provide training as needed	500 days	165	
167	4.2	**Enforcement**	**556 days**		
168		Enforce law and initiate prosecution as appropriate	556 days	6,58,59	Sea Defenses
169	5	**Mangrove Restoration Program**	**705 days**		
170	5.1	**Site Development Plans**	**705 days**		
171		Identify site and issues to be address	6 mons	58,59	MAC,MPO,NDC,other relevant
172		Determine suitability under EMR protocols	6 mons	171SS	
173		Develop comprehensive site plans	1 day	172	
174		Establish community connection and plans for community involvement and support	1 mon	173	
175		Execute plans, establish on-going monitoring and reporting strategies	432 days	67SS,174	



Appendix 3. Mangrove Management 3 Year Action Work Plan

ID	Text1	Task Name	Duration	Predecessors	Resource Names
176		Conduct awareness and education programs as appropriate	564 days	174	



APPENDIX 4
FINANCIAL PLAN

NMMAP 2010-2012 FINANCIAL PLAN (EUROS)

Program Areas	Year 1	Year 2	Year 3	Total
1 Institutional Development and Capacity Building	404,162	250,000	250,000	904,162
1.1 Legislation	40,416	25,000	25,000	90,416
1.2 Mangrove Action Committee	40,416	25,000	25,000	90,416
1.3 Mangrove Project Office	121,249	75,000	75,000	271,249
1.4 NARI Nurseries	202,081	125,000	125,000	452,081
				904,162
2 Public Education, Awareness and Training	269,109	160,000	160,000	589,109
2.1 Public Awareness	107,644	64,000	64,000	235,644
2.2 Public Education	134,554	64,000	64,000	262,554
2.3 Community Involvement	26,911	32,000	32,000	90,911
				589,109
3 Research and Development	151,496	90,000	90,000	331,497
3.1 Coastal Survey	113,622	63,000	45,000	221,622
3.2 Technical Research	37,874	27,000	45,000	109,874
				331,497
4 Monitoring, Reporting and Enforcement	15,258	10,000	10,000	35,257
4.1 Monitoring and Reporting	7,629	5,000	5,000	17,629

Program Areas	Year 1	Year 2	Year 3	Total
4.2 Enforcement	7,629	5,000	5,000	17,629
				35,257
5 Mangrove Restoration Program	814,975	490,000	490,000	1,794,975
5.1 Site Development Plans	814,975	490,000	490,000	1,794,975
TOTAL	**1,655,000**	**1,000,000**	**1,000,000**	**3,655,000**

APPENDIX 5
PERFORMANCE INDICATORS

Performance criterion 1: Publicity (mangrove information web site) and mangrove monitoring system

Performance criterion 1 has two different indicators: web site set-up (year 2) and operation of the mangrove monitoring system (Year 3).

Indicator Year 2 (nominally 2011): The web site for public access to information on mangroves shall be fully operational, providing information on mangrove status, regulations, community involvement etc. A system for updating and maintaining the web site shall be in place. This shall be achieved with a description of the web site operation delivered to the EU delegation by **30 September 2011.**

Indicator Year 3 (nominally 2012): A monitoring system for the coastal mangrove belts and stands shall be functional, with the anticipated following elements:

Satellite and/or fly-by imagery and planning for updating the images at appropriate intervals
Community rangers recruited, trained in mangrove data collection and mobilised, particularly on sites where there are rehabilitation or protection activities underway
Integration of the Community Ranger activities with those of the Sea and River defence Rangers (responsible primarily for monitoring of artificial sea defences).
Integration of the mangrove monitoring with the MRV programme (Monitoring, Reporting Verification) for the state forests to be set up by the Guyana Forestry Commission under the REDD+ action.
A functional database for mangrove status for recording monitoring data.

The monitoring system shall be in place and functional by **30 September 2012** and full information and description shall be delivered to the EU delegation by this date.

Performance criterion 2: Length of coast protected by rehabilitated/replanted mangrove stands

The National Mangrove Management Action Plan aims to restore, rehabilitate and protect mangrove belts wherever they occur as part of overall forest protection. The use of mangroves in under the sea and river defence policy is particularly orientated towards reducing the effects of wave action and stabilisation of the foreshore to prevent inundation of the coastal zone. It is therefore more relevant within this SPSP to use length of coastline protected rather than area of mangrove replanted. The criterion will therefore be:

Additional length of coastline protected by mangrove rehabilitation/replanting. In this case, "protected" means a mangrove zone of sufficient depth (perpendicular to the coastline), usually 50-200m, to provide a sustainable mangrove stand on suitable substrate conditions. Where

necessary, this must include the provision of appropriate new or rehabilitated protective structures (groynes or other constructions) in place and functioning. It is accepted that, where protected structures have been built, replanting may not be possible until accretion has developed. In these cases, which should be justified, provision should already be in place for later planting. This may include demonstrating that mangrove seedlings are available in nurseries or where they can be collected and give a timetable for the planting operation. The parts of the coastline selected for intervention need not be continuous lengths.

For some areas, protective, engineering structures may not be deemed necessary, but in all cases effective measures must be in place to control damage by animals, harvesting or other human intervention.

The length of coastline "protected", as defined above, shall be identified and quantified on large scale maps, described and supported by photographic records before and after intervention. The supporting documentation for this shall be complete and delivered to the EC delegation by **the relevant date each year**. In each year of the programme, the length of coastline protected in this way shall be additional to that previously targeted (before 2010) and the length of coastline for which supporting evidence is provided in year 2 shall be different from that selected for year1.

The indicators for performance criterion 2 are:

Year 2 (for payment of variable tranche V1):**1 km coastline protected by 30 September 2011**
Year 3 (for payment of variable tranche V2): **10 km (additional) coastline protected by 30 September 2012**

The weightings and calculation method for the variable tranches are shown below:

Table A1-1: Scoring, weighting, targets and deadlines for variable tranche payments V1,V2:

Tranche V1		**Score**	**Weight**	**Payment amount €**
Web site functioning by 30.09.11	YES NO	1 0	30%	1 x 500,000 x 30% 0
0-0.5 km coastline protected 0.5-1.0 km coastline protected 1+ km coastline protected	by 30.09.11	0 0.5 1	70%	0 0.5 x 500,000 x 70% 1 x 500,000 x 70%
Total max V1 (euro)				**500,000**
Tranche V2				
Monitoring system operational by 30.09.12	YES NO	1 0	30%	1 x 1,000,000 x 30% 0

0-5 km coastline protected 5-10 km coastline protected 10+ km coastline protected	by 30.09.12	0 0.5 1	70%	0 0.5 x 1,000,000 x 70% 1 x 1,000,000 x 70%
Total max V2 (euro)				**1,000,000**

Regional Stakeholders' Workshop on Mangrove Restoration

Government of Guyana

European Union

REPORT

REGIONS 1, 2, 3, 4, 5, 6

REGIONAL CONSULTATIONS

MWH

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BACKGROUND

Climate Change is a major issue for Guyanese and the Second Draft LCDS has, as its central theme, forest conservation that includes the protection of coastal areas from the sea. Mangroves contribute substantially to sea defence by damping off wave action and protecting coastal banks from erosion, however, due to natural and artificial effects mangroves ecosystem have been degraded. Under the European Union's Global Climate Change Alliance Budget line, a programme linked to sustainable Coastal Zone Management has been developed. The overall objective of the programme is to abate climate change (carbon sequestration through reforestation and forest preservation) and to mitigate its effects via sea defences. The project will include rehabilitation, protection and sustainable use of mangroves, their monitoring and the enforcement of forest legislation, mangrove research, formulation of a Code of Practice for mangrove management, public awareness and education and policy and legislation review.
The Government of Guyana (GoG) through the Ministry of Agriculture (MoA) has identified the National Agriculture Research Institute (NARI) through its Climate Change and Agricultural Adaptation Unit as the lead agency for the overall coordination of the programme and a Mangrove Action Committee (MAC) has been formulated to oversee the implementation of the programme. The committee comprises representatives of 12 government agencies namely; Guyana Forestry Commission (GFC), Ministry of Public Works and Communications – Sea Defences – Work Services Group, Environmental Protection Agency (EPA), the Fisheries Department, the National Drainage and Irrigation Board (NDIA), the University of Guyana, the Ministry of Education, the Ministry of Local Government and Regional Development, the Ministry of Finance, the Ministry of Agriculture, the Guyana Marine Turtle Conservation Society and the National Agricultural Research Institute (NARI).
An Updated National Mangrove Management Action Plan (NMMAP) has been developed and will be the guiding document for the Guyana Mangrove Restoration Project. The acceptance of the document by stakeholders and its approval by CABINET is the performance criteria for disbursement of the initial tranche of budget support from the EU to GoG.

OBJECTIVES OF THE WORKSHOP

- To review and discuss the Updated National Mangrove Management Plan from different stakeholders' perspective
- To understand how different stakeholders are affected in different ways
- To understand the recommendation presented by different stakeholders

PROCESS

The regional stakeholders' workshops on mangrove restoration are an opportunity for the project to critically reflect on our approach and how it is perceived by different stakeholders. The idea is

to document the process of the interaction to better understand how different stakeholders perceive the issue and how they think it should be addressed. The process will guide the project in terms of linking people and research and provide ideas for how we plan the next steps and what is relevant for the analysis, through facilitated participatory group discussions.

The description of the process below builds mostly on concrete insights. The chosen cases are situated within contexts in which the historical legacy is characterized by conflicting interests in terms of the management, governance and use of coastal resources. Situated within all cases are mangroves which serve as arenas for discord but also in some cases reconciliation. The Updated National Mangrove Management Action Plan is about providing insights, tools, approaches and theory into operationalising mangrove management in Guyana, and in this context it is important to foster the reconciliation.

In the series of regional stakeholders' workshops, stakeholders were be provided with a platform to critically reflect upon the influence of NMMAP both from the stakeholders' and the project's perspective. They were able to develop, contest, deconstruct earlier, and reconstruct new common visions and plans through a phase of scenario development. In short support a strategic action planning process.

CONSULTATION SESSIONS

The consultation team included Mangrove Project Office, MAC and NARI personnel:

- Director NARI — Dr. Oudho Homenauth
- Project Coordinator — Bissasar Chintamanie
- MAC Chair — Annette Arjoon-Martins
- Mangrove Specialist — Owen Bovell
- Community Development Specialist — Paul McAdam
- Admin/Finance Officer — Kene Moseley
- Team Leader-EU TA — John Townend

Presenters for the sessions were Bissasar Chintamanie, Owen Bovell and Paul McAdam.
Regional representatives from each Region gave remarks at the consultations. Closing remarks were made by Mr. John Townend – Team Leader - European Union Technical Assistance to Works Services Group.

MAIN ISSUES

GENERAL VIEWS:

- At all consultations, stakeholders gave their support for the project.

- Stakeholders were of the view that more public awareness needed to be done to ensure that all communities are aware that mangroves are a protected species and the importance of mangroves to our sea defence

SUGGESTIONS AND RECOMMENDATIONS

1.0 Mangrove Action Committee

1.1 RDC's o setup mangrove management committees to feedback to MAC
1.2 Newly established National Livestock Development Board should be included on the Mangrove Action Committee
1.3 The Religious community should be represented on the MAC
1.4 Private sector should be represented on the MAC
1.5 MAC and Forestry officials should set up a system to notify relevant authorities about developmental plans, for example building of wharfs for farm access, and gathering of firewood in a sustainable manner. This information will be passed on by Toushao to forestry staffers and MAC for the go-ahead.
1.6 Establish Regional Mangrove Committees which will be responsible for the monitoring of mangroves in their Region and report to the MAC. This committee representatives should come from the NDCs
1.7 Ministry of Amerindian Affairs should be included on the MAC to ensure that Amerindians have a representative that they can identify with

2.0 Monitoring, Reporting and Protection

2.1 Better enforcement of existing laws to prosecute persons who destroy mangroves.
2.2 More rangers should be used to protect areas.
2.3 The Guyana Police Force needs to be involved with the project.
2.4 Institute realistic fines for destroying mangroves
2.5 Need for community rangers for practical monitoring and inventory
2.6 GSA should be utilized for the monitoring and reporting aspect of the project
2.7 Buttonwood should be included under the list of protected mangrove species
2.8 Install signs indicating that it is illegal to destroy mangroves
2.9 Permission should not be granted for construction of houses along key areas of the coastline.
2.10 NDCs should not give permission to residents to occupy lands on mangrove areas for farming and squatting purposes
2.11 Boundaries should be extended from 50m to approximately 200m
2.12 Rangers should be employed from the community they would be expected to monitor
2.13 Placement of signs along public areas such as beaches and access paths to warn persons about dangers of harming mangroves.
2.14 GFC should include community participation during inventory for follow up and reporting

2.15 Penalty for destroying mangroves should be clearly stated and published so that the general public is made aware
2.16 Provision of alternative grazing lands for cattle and other animals.
2.17 Residential development along key areas of coastline should be stopped.
2.18 Explore the establishment of common pastures for cattle farmers
2.19 Fence mangrove areas to protect them
2.20 Ministry of Agriculture to provide cattle industry with data on mangrove forested areas
2.21 Establish barriers between mangroves and pastures
2.22 NDCs with the support of EPA need to establish garbage dump site to alleviate the problem of dumping garbage in the mangrove forest
2.23 Areas should be dredge when the tide is going out to prevent the silt from killing the mangroves
2.24

3.0 Restoration

3.1 Use of old barges/boiler/scuttled ships/wrecks to promote soil accretion offshore.
3.2 Use of palms/coconut trees and grass to reinforce sea defence dams
3.3 Construct groynes with local materials, Greenheart/hard wood, tyres filled with garbage, derelict vehicles
3.4 Future Development of mangrove restoration should include from Mon Repos to Buxton
3.5 Rehabilitate old channels
3.6 They are no mangroves at the following areas:
- No. 7 Village; Belladrum; Cottage – Litchfield; No. 5 Village; Profit, No. 4 Village

3.7 Crop grass can be planted to boost mangroves

4.0 Research and Development

4.1 Better data collection and research for future use.

5.0 Public Awareness and Education

5.1 More community meetings to focus on smaller groups.
5.2 More youth education, possible through schools with the Ministry of Education.
5.3 More community involvement in the project
5.4 Introduce Mangrove as a topic in Geography
5.5 Interschool debating competitions
5.6 Have school talks by mangrove project personnel
5.7 Educate GSA students on Mangrove Management and Restoration
5.8 Educational tours to deforested mangrove areas
5.9 Develop practical apiculture programme at GSA since to encourage this as an alternative livelihood programme that can be established in the mangrove forest
5.10 Conference on mangrove restoration which will include the Caribbean and South American countries
5.11 Increase public awareness on the importance of mangroves

5.12 More community development council leaders and Toushao should be informed, possible through the Amerindian Affairs Ministry.

5.13 Public awareness program needs to include signage near mangrove sites prohibiting person from dumping garbage in the mangrove and from destroying the mangroves

5.14 Public awareness program should target fishermen to educate them on the damage caused to the mangroves forest and effects this would have on their fishing.

6.0 Alternative Livelihood

6.1 Community incentive programs should be developed to motivate communities with mangrove stands to manage their areas.

6.2 Program should be developed to compensate farmers who have mangrove stands on their property to encourage them not to destroy the mangroves for farmlands

6.3 Economic activities need to be sustained with viable alternatives

6.4 Despite titling of lands, concessions still be given to access lands (specific to Region 1).

6.5 Serious concerns about the grazing of cattle. Livestock farmers will be displaced on the West Coast. Suggested solutions:

6.6 Acquire land for farmers and provide other facilities (MMA/ADA should provide state land)

6.7 Provide fenced pasture for cattle farmers

6.8 Some cattle farmers will be forced to sell and seek other employment, arrangements should be made to support affected farmers by setting up apiculture programs

6.9 Mangroves are being burned for use as fire wood. It is suggested that support be provided for installation of solar panels to families for cooking

APPENDIX 1 - ATTENDANCE FOR REGIONS 1, 2, 3, 4, 5, 6

Dates: April 16 - May 28 2010 **Total number of persons registered: 497**

April 16, 2010	2	Anna Regina, Essequibo	Charity, Reliance, Bush Lot, Adventure, Better Success, Devonshire Castle, Anna Regina, Dartmouth, Airy Hall, Mainstay, Affiance, Bounty Hall, Pomona, Queenstown, Golden Fleece, Cotton Filed, Lima, Suddie, Henrietta, Pomeroon River, Three Friends, Tapakuma, Windsor Castle, Cullen, Hampton Court, Onderneering	81
April 23, 2010	6	# 63 Village, East Berbice	Rosignol, New Amsterdam, Bath, N0. 68 Village, No. 51 Village, No, 62 Village, No. 60 Village, Bloomfield, No. 6 Village, Kildonar, No. 52 Village, No. 64 Village, Edinburg, Skeldon, No. 58 Village, No. 54 Village, Nurney Village, Springlands, Corriverton, Black Bush Polder, Brothers Village, Rose Hall, No. 17 Village, Queenstown, Crabwood Creek, Eversham Village, Williamsburg, Tain, No. 70 Village, Albion, Cane Field, Kilroy, No. 69 Village, Adventure, Hamshire, Bush lot	104
April 30, 2010	3	Crane, West Coast Demerara	Zeelugt, Cornelia Ida, Parika, Verngenogen, La'Union, Best, Klien Pouderoyen, Anna Catherina, Windsor Forest, La Jalousie, Vreed-en-Hoop, Greenwich Park, Rumzeight, Zeeburg, Crane, Stewartville, Vergenoegen, Tuschen, DeKenderen, Den Amstel, Farm Village,	111
May 7, 2010	4	Mon Repos, East Coast Demerara	Cane Grove, Mon Repos, Chateau Margot, Enterprise, Golden Grove, Kuru Kururu, Better Hope, Bladen Hall, Vigilance, Foulis, Tuschen, Nabacalis, East LaPenitance, Enmore, Friendship, Patentia, Haslington, Triumph, Victoria, Lusignan,	90
May 14, 2010	5	# 28 Village, West Cost Berbice	No. 28 Village, No. 3 Vilalge, No. 30 Village, Bath, No. 29 Village, Woodley Park, Blairmont, Lichfield, Perth, Hopetown, Golden Grove, Cotton Tree, Onverwagt, Lovely Lass, Dundee, No. 29 Vilalge, No. 30 Village, Shieldstown Settlement, Brittania Village,	59
May 28, 2010	1	Kumaka, Mabaruma	Barima River, Kumaka, Mabaruma, Hosororo Hill, Bumbary, Khan Hill, Aruka River, Wanakai Creek, Waini, Arukama Village,	52

APPENDIX 7
CODE OF PRACTICE FOR HARVESTING MANGROVES 2007

ACKNOWLEDGEMENTS

This Code was developed through consultations with many stakeholders across the country. The GFC is grateful to all the members of the Mangrove Management Team (Module 5) of the Guyana Sea and River Defenses Project. Special thanks are due to Mr. Phillip Da Silva and Ms. Cathelijne van Haselen for their enormous support, input and patience and also for providing helpful comments on parts of this draft and assisting with the reviewing and researching of documents.

The GFC wishes to thank all those who have reviewed the code and contributed to the material; they are as follows: Dr. Raquel Thomas (Iwokrama), Dr. I. Ramdas (Environmental Protection Agency), Mr. Eustace Alexander (Conservation International Guyana), Mrs. A. Dalrymple (Guyana Sea Defence), Mrs. Dawn Maison (Ministry of Fisheries, Crops and Livestock), Mr. Williams (Ministry of Amerindian Affairs), Mr. Z. Rahaman (Hydro meteorological Service)

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1.0 INTRODUCTION

Guyana is situated on the northeastern coast of the South American continent and has an area of 214,970 km^2 with a land area of approximately 197,000 km^2. Guyana's coastal zone is 430 km long and 26-77 km wide and lies between 0.5 to 1.0 m below the level of high spring tide of the Atlantic ocean; making it particularly vulnerable to flooding, erosion and salinization.

A large portion of Guyana was under mangrove vegetation 20-30 years ago, but since that time there has been serious depletion, especially in regions 3 and 4 and parts of 2 and 5 (Evans, 1998). The total area of mangrove forest in Guyana is estimated at 80,432 hectares (GAHEF, 1992). The mangrove protective belt has deteriorated due to the harvesting of mangroves for fuel wood, the bark for tannin and by the natural cycle of erosion and accretion. This depletion is a cause of serious environmental and economic concern. The recently identify movements of sediments in angles, drive by the Amazon' s Atlantic currents have also played its part in the natural destruction cycle of mangroves.(CZM – Centre Publication No 1)More recently society has recognized the importance of conserving mangrove forest ecosystems and appreciates the values and the benefits of mangroves.

One such benefit was clearly identified during an overseas Development Assistance Project on sea wall defence from 1979 – 1984. The project concluded that, "the best coastal protection you can have in Guyana is a long sloping foreshore, leading to mangroves and a small earthen dam behind that." (FAO, 1994)

Many individuals for much of history have regarded mangroves as wastelands. Until recently, the mangrove vegetation was not valued for its role in sea defense, mechanical defenses being preferred, and commercial harvesting or simply clearing of mangroves were common (Evans, 1998; EPA, 2000).

Mangroves have been known as naturally resilient plants which have withstood severe storms and changing tides for many years, but they are now being impacted by different activities which may lead to their disappearance. These forests are among the most threatened habitats in the world and are disappearing at an alarming rate. [More than inland tropical forests, and so far, with little public notice].

Primary production of mangroves supports numerous forms of wildlife as well as estuarine and near-shore fisheries. Consequently, the continuing degradation and depletion of this vital resource will reduce not only terrestrial and aquatic production and wildlife habitats but also more importantly, the environmental stability of coastal forests that afford protection to agricultural crops. In addition protection is also offered to approximately 90% of the Guyana's population of 750,000 who live within the coastal zone. The Guyana's capital city and most of its economic and more important establishments are located on the coast.

Deforestation of mangroves is contributing to fisheries declines, dehydration of clean water supplies, salinization of coastal soils, erosion, and land subsidence, as well as the release of carbon dioxide into the atmosphere. In fact, mangrove forests fix more carbon dioxide per unit area than phytoplankton in tropical oceans (GFC & ICZM – EPA, 2001).

The Guyana Forestry Commission's national forest policy and national forest plan, and the establishment of the integrated coastal zone management committee (ICZM) under the environmental protection agency, have demonstrated the government's commitment to sustainable mangrove management.

At present there is no legislation in Guyana dealing specifically with mangroves management. To address this, the National Mangrove Management Action Plan was prepared in 2001 (SSPA Project Team, 1994; GFC/ICZM, 2001). This dealt mainly with the current status of mangroves and the urgent need to preserve and increase coastal mangroves for the purposes of national sea defense (GFC & ICZM, 2001). It also stated that there is "need to formulate "*minimum operational standard*" for mangrove harvesting and that it should concentrate on the setting of prescriptions, guidelines or requirements covering aspects of harvesting and regeneration of mangroves in Guyana" (NMMAP, GFC & ICZM, 2001).

The action plan also identified the area for monitoring the utilization of mangrove for the production of non-timber products also including hunting and fishing, and precautionary actions by coastal users to be included into the standards.

In view of the vulnerability of coastal areas to sea level rise of the country and the degraded state of the mangrove ecosystem, there is a need to develop a code of practice for mangrove management

This code is based mostly on a study done on the "Socio-economic context of harvesting and utilization of Mangrove vegetation" and has been developed with the sole purpose to assist in minimizing the negative effects caused by mangrove harvesting.

The code should not be seen as a static document. It will be reviewed and updated regularly as technical knowledge is enhanced, new technologies are introduced and operating standards improved.

1.1 SCOPE AND COVERAGE

In May 2001, the document "Socio-economic Context of the Harvesting and Utilization of Mangrove Vegetation" was prepared as a first step in the development of a Code of Practice for management of mangrove ecosystems.

Formulation of this Code of Practice is based on existing knowledge, experience and concepts regarding Forest Management. The Code of Practice will identify linkages and co-ordination needs among stakeholder agencies, NGOs, communities and users of the mangrove resource. The Code of Practice will consider legislative aspects and enforcement mechanisms required for the effective conservation, protection and sustainable use of mangroves.

The development of the Code of Practice has become necessary to guide the Guyana Forestry Commission (GFC) in its management of mangrove ecosystems. The Code of Practice is therefore designed to be used as a tool for mangrove management. It is directed to all stakeholders concerned with the conservation and sustainable utilization of mangrove resources. The Code of Practice provides principles, guidelines and recommended actions and practices applicable to the conservation and management of mangrove ecosystems. Given the vulnerability of the coastal zone of Guyana and the role of mangroves in coastal protection, the code also addresses the integration of mangrove management within the context of Integrated Coastal Zone Management.

It recognizes previous and current efforts, initiatives and programmes regarding mangrove management. The Code of Practice is a set of guidelines and requirements covering all aspects of mangrove utilization in Guyana. It is not in itself an assurance of sustainable forest management. If used correctly, it can effectively, help the implementation of standards or guidelines, participate in the planning process of stakeholders, and integrate with other sustainable forest management instruments, particularly yield regulation. The code will assist in minimizing negative impacts of mangrove harvesting.

This Code of Practice is intended to guide and assist in the creation of mechanisms for adequate legislation and the development, implementation and monitoring of coordinated policies for the protection of mangrove resources.

The Code provides guidelines and standards, that if followed will allow Guyana's mangrove resources to be managed and utilized sustainably with minimal adverse impacts on mangrove ecosystem and resources. Implementation of the Code will help ensure that important ecosystem and other services and values are recognized, maintained and protected during utilization processes.

This Code of Practice will not address clear felling harvesting of mangrove resources for timber as this is strictly prohibited. There are two different types of statements in the Code: 'shall' and 'should' statements. The 'shall' statements are to be applied in a practical manner to all

utilization operations. The 'should' statements show the desirable practice for most situations and should be interpreted taking into account local conditions.

The Code will not be applied with retroactive effect to past activities. However, stakeholders who intend to use these resources should be aware of the activities that previously caused or have the potential to cause significant negative impacts, will have to be discontinued to start the rehabilitation process.

1.2 OBJECTIVES

The objectives of the Code of Practice for Mangrove harvesting are to serve as an instrument of reference to help the Guyana Forestry Commission to establish or to improve institutional framework required for the exercise of sustainable management of mangrove forests and ecosystems.

The *specific* objectives of the Code of Practice are:

- To mitigate adverse environmental impacts on mangrove ecosystems caused by human activities and natural phenomena.
- To minimize those non-sustainable or conversion activities that lead to destruction of the resource.
- To ensure that destroyed or degraded mangroves are allowed to re-colonize or, where appropriate, are actively rehabilitated or restored.
- To promote the protection of aquatic resources and their supporting environments both upstream and in coastal areas.
- Conserve and intensify the protective function of the mangrove forest in designated areas along riverbanks, estuaries, and all other marginal forestlands.
- To increase awareness and educate on benefits and importance of the mangrove forests.
- Maintain a healthy and productive mangrove forest, with the capacity to regenerate.
- To promote better harvesting techniques and optimize utilization of mangrove products.

2.0 EXISTING FOREST POLICY AND LEGISLATIONS

There is no articulate or specific legislations or polices on strategy for the management of mangrove resource in Guyana at the present time. However, the current administration structure involves several government agencies, having cross sectional roles for coastal resources that are specific to their interest. There are clauses in the Environmental Protection Act, the Sea Defense Act, the Fisheries Act and the Forests Act, which are legal instruments and can be interpreted to include and regulate the management of mangroves.

The Guyana Forestry Commission is the body that has sole responsibility for policy formulation and implementation for planning, monitoring, inter-institutional cooperation, consultation and community development for mangrove management.

For more information on the clauses relating to mangroves in four legal namely the Environmental Protection Act, the Sea Defense Act, the Fisheries Act and the Forests Act see Annex I.

3.0 PUBLIC AWARENESS AND IMPLEMENTATION

- All stakeholders concerned with the conservation and management of mangrove ecosystems should collaborate in the fulfillment and implementation of the objectives and principles contained in this document.

- Conservation of mangrove ecosystems must be a national concern and as information, data and knowledge increase the operational standards will be revised where applicable.

- The implementation of this Code of Practice will be done in stages.

- The code will first be implemented on a voluntary basis to allow stakeholders time to adjust to the changes, to develop further management capacity and to train supervisors and operators.

- After the code has been publicly released GFC will assume monitoring against the standards described in the code.

- The result of monitoring will be evaluated to determine an operator's performance and will be made available to the public.

- Mechanisms will be put in place to reward compliance while non-compliance with critical standards will have penalties attached.

It is anticipated that through education on the required operating standards and the scientific reason behind these standards, operators gradually will become the supporters of improved mangrove utilization and harvesting practices and eventually self-regulation will occur.

The following measures are recommended to promote compliance with the appropriate Rules and Regulations:

- Licensing systems to legalize the activities of legitimate mangrove users.
- Designated mangrove forest areas set aside to meet the subsistence fuel wood and timber needs of stakeholder user communities and individuals.
- Penalties for violations should reflect the severity of the mal-practices concerned.
- Speedy disposition of cases involving violations of laws and regulations are strongly urged to protect mangrove resources, and as a deterrent to would-be violators.
- Education of all stakeholders in key aspects of mangrove legislation
- Develop actions to promote the organization of local communities to ensure supervision and the full respect of the law and local planning.

4.0 MANGROVES

4.1 What is a mangrove?

There are three main types of mangrove species occurring in Guyana. These are (Hussein, 1995):

- *Avicennia germinans* also known as "Courida" (Black mangrove);
- *Rhizophora mangle* (Red mangrove)
- *Laguncularia racemosa* (White mangrove).

Herbarium records at the Smithsonian Institute and the University of Guyana suggest a fourth species, *Rhizophora harisonii*, found mainly in riverine areas.

4.2 Importance of Mangroves

Mangrove ecosystems are considered some of the most productive ecosystems in the world. They offer traditional subsistence benefits to people living in coastal communities. Mangrove forests are the major coastal ecosystem found in Guyana, and provide a number of commercial and traditional products which include sawn timber, charcoal, fuelwood, pulpwood, tannin, and pharmaceutical products. In addition they also provide nutrient enrichment for aquatic and terrestrial flora and fauna.

Hence as complex coastal ecosystems, that are highly valuable and which provide numerous benefits to communities and the nation as a whole. They have the potential to directly generate numerous commercial products and are also important spawning and nursery ground for many marine prawns and fishes. Several mangroves and associated mudflats are important foraging and stopover sites for both resident and migratory birds. These unique habitats have been known to be important roosting and nesting sites for many avian species.

Mangroves play an important environmental role in stabilizing shorelines and preventing coastal erosion. The degree of protection afforded by mangroves depends upon the width of the forest. The vegetation colonizing the tidal zone acts to prevent or reduce erosion of the shore through three main processes:

- Dissipation of wave and current energy
- Trapping of sediments in suspension by the root systems of mangrove trees and other pioneer species colonizing the tidal zone, thus accelerating the sedimentation process
- Stabilization of the substrate by the plant roots

Mangroves also provide opportunities for education, scientific research, recreation and eco-tourism. The mangrove forest is suitable for apiculture, and honey has become an exportable commodity. For example, there are numerous beehives in mangrove forests in the Abary area.

5.0 THE CODE OF PRACTICE

Three essential requirements for stakeholders to correctly apply the principles outlined in the Code of Practice of mangrove utilization are that, stakeholders must:

- know what is to be done;
- know how to do it properly;
- Be motivated to do it in the proper way.

5.1 PLANNING

Planning should be done in a simplified manner so that it is acceptable to all stakeholders. Sound planning includes biological, silvicultural, environmental, market, financial and socio-economic considerations. Other important considerations are the locality of the areas to be harvested, map of the area, densities of the Mangrove stands and the amount to be harvested.

The code of practice ensures that Mangroves are not over harvested, thus preventing any negative consequences for the industry by the people involved in the cutting and processing.

Hamilton and Snedaker (1984) recommended that a mangrove resource management plan should provide for the following:

- Protection of the mangrove forest and cessation of projects in practices that have a detrimental effect on the ecosystem.
- Protection of the interests of both people and wildlife that depend on the forest for their subsistence.
- Exploitation of mangrove resources should be placed on a sustainable use basis. Projects, which would disturb the ecosystem and subsequent cause deforestation and erosion, should not be permitted.

5.2 SURVEY AND INVENTORY

For the management of mangrove ecosystems and the implementation of a Code of Practice, it is required as a first step, that the GFC should undertake a survey and inventory of all mangrove areas using standard methodologies. Below, the basic information required and also a number of methodology references are presented.

The Guyana Forestry Commission would determine the inventory intensities for areas less than 20,000 hectares and greater than 50,000 hectares.

5.2.1 Guidelines for Mangrove Survey and Inventory

Basic information required:

Biophysical features

- Location, Area and Demarcation (defined by maps, satellite imagery and GPS)
- Climate (major features e.g. rainfall and temperature)
- Tidal/Hydrological regime
- Dominant Soil Type (colour, organic matter content and texture)
- Water chemistry (salinity, pH, colour, transparency and nutrients)
- Type of forest (primary, secondary, degraded)
- Structure of the forest (density of forest, height of trees, basal area of trees).
- Species inventories (flora and fauna and note special features including rare/endangered species)

Management features

- Existing or proposed land zoning system
- Land/water use and Ownership
- Local knowledge/Traditional uses
- Ecosystem products, functions and attributes
- Pressures and threats on the area
- Potential areas available for rehabilitation/restoration

5.3 EXCLUSION AREAS AND BUFFER STRIPS

Buffer strips are crucial in the management of Mangrove forests. Watercourse buffer strips and wildlife strips dispersed throughout the forests are very important in the maintenance of genetic resources.

Some areas to be excluded are as follows:

- Conservation areas

- Declared protected areas under national legislation are to be excluded from harvesting.
- Areas of cultural importance
- Areas required for community needs
- Sites susceptible to degradation

The Following should be adhered to in exclusion areas and Buffer strips;

- No tree shall be felled within exclusion areas or their buffer strips.
- Machine access within exclusion areas and their buffer strips is not allowed.
- No earthworks, or spoils from earthworks, shall end up in an exclusion area or its buffer strip.
- No harvesting debris shall be pushed into exclusion areas or their buffer strips.
- The minimum required buffer strip protection for conservation and declared protected areas should be 20 m.
- For rivers and creeks, 30 m & 20 m respectively each side. Vegetation should be retained on both sides. (No felling allowed)
- A 50 m wide strip in erosion prone areas should be maintained.

5.4 HARVESTING

Where permission is granted, harvesting should be done in a sustainable manner to ensure that optimum growth is achieved and in accordance with the rules and guidelines stipulated by the Guyana Forestry Commission. It should also take into account all the relevant biological, technical, economical and social aspects of the mangrove community.

- No harvesting of mangroves and associated vegetation should be done in mangrove areas without permission from the Guyana Forestry Commission.

- No person shall fell, cut, lop, tap, bleed, or injure, take or extract any bark, leaf, seed, fruit, gum or other part or substance from, or transport, remove or export any protected mangrove tree or plant in a state forest.

- Harvesting should not be done within the one half of a mile of mean high water mark or along any land along the sea foreshore.

- No harvesting should be done in areas that are being managed for sea defenses.

- No harvesting of mangroves should be done for fuel wood along the coast.

- In areas where mangrove harvesting is the only activity, Zonation is considered which would give protection to the mangrove ecosystem. Areas of such would be assigned a multiple use status for controlled harvesting.

- Mangrove forests that act as natural barriers or buffers against shore erosion; strong winds and storm floods should be left untouched.

- Mangroves near or adjacent to traditional productive fry and fishing grounds should not be alienated or released for development.

- Mangroves on small islands should in no case be disturbed.

- In Mangrove areas adjoining the mouth of major river systems a buffer zone area should be created to have mangroves preserved on both sides of the mouth of the river fronting the sea.

- When harvesting, strips of 20 m width should be left undisturbed between harvested areas to provide seeds for natural regeneration.

- Pole suppliers must apply and obtain SFPs

- For SFP operations, information on which areas are expected to be harvested should be freely available on request by GFC from the State Permission Holder.

- On request, GFC should issue a "Collectors Pass" for collection to work in a particular area over a specified period of time.

- Cutting, catching aquatic species and grazing by domestic animals are not allowed.

- Any clearing must be in accordance with requirements set by the operational standards.

- Researchers should not cause serious effect to the mangroves resources or its environment.

- Approval for research in any area should be acquired from the Guyana Forestry Commission before commencement

- Impact assessments carried out in areas where mangroves are found should include direct/indirect effects of proposed projects on mangrove forests and surrounding community.

5.4.1 HARVESTING CYCLE

Principles are established in accordance with the relevant international and national law for sustainable management of mangrove forest ecosystem,

The cutting cycle duration is 20 years. Thus, if a certain area (block) has been harvested in year 1, the next harvests may be carried out in year 21, 41, 61, etc

5.4.2 MINIMUM CUTTING SIZE

Only trees that are **7m** in height are allowed to be cut for barks.

5.5 PURCHASERS

Purchasers play an important role in helping to make the code a success. Buyers should stick to the guidelines presented in the Code since this would ensure that the harvesters are following the rules.

- Purchasers should insist on proof of adherence to harvesting standards from suppliers

5.6 MONITORING

All stakeholders, interested parties and private individuals concerned with the conservation and management of mangrove ecosystem must collaborate in the fulfillment and implementation of the objectives of this code.

5.6.1 Monitoring by GFC

Guyana Forestry Commission has the exclusive responsibility for monitoring of mangrove forest in Guyana.

- Monitoring of the mangrove forest must be done at all levels i.e. that is from planning to harvesting and then to processing.
- Monitoring of all other activities taking place at certain site/locations in the mangrove forest must also be done.
- Guyana Forestry Commission will conduct checks on large users at different locations to ensure that the mangrove harvested are within harvestable range and no clear felling is done in areas where mangrove forest is used as wind breakers (barriers).
- If found to be in violation of the minimum mangrove size, they may be fined and or placed before the court.

5.6.2 Monitoring by local communities

Local communities that are solely dependent on mangrove forest for economic, social, financial, and environmental reasons:-

- Should assist in protecting the mangrove forest from large scale harvesting.
- Have a responsibility to inform the GFC if a problem should arise.
- Rangers may be elected from among residents for the purpose of protecting the mangrove forest ecosystem.
- All people have a responsibility for protecting mangrove forests.

5.6.3 Monitoring by responsible agencies

Monitoring would be done by governmental, non-governmental, agencies and other stakeholders to ensure that standards in the code of practice are adhere to thus, ensuring sustainable management.

Such agencies include: The Environmental Protection Agency, ICZMC, Guyana Sea Defence, Fisheries Department, National Protected Area System, Regional Democratic Councils, Tourism and Hospitality Association, University of Guyana, National Law Enforcement Agencies, National Resource and Environment Advisory Committee National Agriculture Research Institute, NGOs, Purchasers and other stakeholders.

6.0 CONTROL AND ENFORCEMENT

To attain the objectives, it would be practical to follow IUCN guidelines along with strict controls which must be instituted in protected areas where various types of utilization are permitted, to ensure that the resource being used and the other objectives of the protected area are not compromised.

Any formula for control of harvesting of products in mangrove forests should consider:

- The territorial element (Forest License - TSA, WCL or SFP) into harvesting so that a given area is designated as being for the sole use of people from one village who will defend their privilege against outsiders.
- The benefit to be derived by each household should be fairly distributed; otherwise those left out will not respect harvesting limits. However, to avoid creating an attractive zone which draws more people, harvesting rights should be granted only to original households.

Monitoring Officers or Forest Rangers should be familiar with the rules and regulations of mangrove areas.

It is best if they possess real handling power, for example to arrest law breakers, and confiscate arms, tools, logs, cattle and illegally collected produce.

There should be simple legal proceedings in delivering arrested persons into the hands of the law and filing charges.

Timber thieves have to be tracked down, identified or arrested and persuaded through legal action to cease their activities inside protected areas.

In all law enforcement matters, the management authority should try to develop a humanitarian image. The agency should however be firm but sympathetic and understanding of the needs of local people. It should be uncompromising in its determination to protect the integrity of protected areas.

The code of practice hopes to ensure that all the rules and guidelines are administered and adhere to.

7.0 SILVICULTURAL MANAGEMENT

The silvicultural system to be applied will depend on the ease with which the mangrove species can regenerate themselves naturally in the disturbed environment caused by the forest harvesting and utilization and the degree to which they lend themselves to regenerate artificially. Clear and selective felling are two Silvicultural systems that may be applied to mangroves. Silvicultural management objectives are provided in **Table** below.

Silvicultural Management Objectives	**Actions needed to improve and maintain sustained production**
To provide for wood production To provide coastal protection To provide areas for scientific research To promote biodiversity conservation in mangrove ecosystems To promote the rehabilitation of degraded mangrove ecosystems	• Emphasis placed on sustained yield • Thinning on a silvicultural schedule rather than on an end – use demand schedule • Retention of enough trees to provide for natural regeneration rather than create a dependence on artificial regeneration. • Use extraction methods that minimize damage to trees and the ecosystem • Refrain from clear felling activities. • Retain buffer strips to stabilize river banks, coastal areas and to protect natural processes. • Conduct scientific studies on regeneration rates, growth and yield of wood and products, site damage, utilization, seasoning and preservation of

	wood. • Maintain socioeconomic balance between user groups. • Give due consideration to the practicability to actually enforce management prescriptions. • Avoid ad hoc decisions concerning utilization of mangroves and resources. • Devise management objectives to encompass the total ecosystem with the subsequent preparation of composite or integrated plans applicable to prudent management of the total terrestrial, coastal and marine resources.

Mangrove forestry and silviculture objectives may have an economic, environmental or aesthetic basis, or a combination of these. The specific objectives for mangrove forest management include fuel wood production, shoreline and river channel stabilization and protection. Fisheries and wildlife support and conservation, storm and flood protection, ecological and biodiversity restoration. Habitat rehabilitation, promote awareness and educate stakeholders on benefits and importance of the mangrove forests and to promote better harvesting techniques for the optimum utilization of mangrove resources.

The primary objectives for mangrove forest management should be clearly defined and prioritized. Where possible multiple-use management should be considered the ultimate goal of management.

In locations where pristine mangrove forests no longer exist, the priority should be to protect mature stands that are still reproductively viable. Given the fact that mangrove trees have very good dispersal mechanisms it is also important that in disturbed areas trees and shrubs may still be considered as valuable and capable of supporting sustainable forest management and mangrove rehabilitation efforts.

Degraded and destroyed areas should be identified and prioritized for rehabilitation. Natural regeneration should be encouraged where possible, but interventions should also be considered as an option when natural regeneration is difficult.

Careful technical assessments should be undertaken prior to any decision on replanting if deemed necessary to rehabilitate a site. When this is the case local species should be used.

Any rehabilitation programme should involve community members and other stakeholders. This will provide an opportunity for involvement and success.

All harvesting of mangrove resources must be done in a sustainable manner and in accordance with the rules, regulations and guidelines stipulated by the GFC to ensure that optimum growth is achieved. It should also take into account all the relevant biological, technical, economical and social aspects of the mangrove community.

8.0 INTEGRATION OF MANGROVE MANAGEMENT INTO INTEGRATED COASTAL ZONE MANAGEMENT

Mangrove ecosystem management is an integral part of the coastal zone management process in Guyana. Strong coordination is required at all levels between the concerned stakeholder agencies for mangroves and other coastal and riverine resources.

To ensure an integrated approach to planning and management of mangrove ecosystems, mangrove management should be an integral part of an Integrated Coastal Zone Management programme.

Coordination among concerned agencies and land users is required. To coordinate and promote environmentally sound development of mangrove resources, the National Mangrove Coordination Committee should be continued, and supported by the Government. The committee should focus on achieving the following:

a) Consensus: To achieve a national consensus, seminars and workshops to discuss mangrove management policy and land use should be organized by the committee.

b) Development strategy: A strategy for the sustainable management and use of land and aquatic resources, including conservation of wildlife and bio-diversity, should be prepared and implemented.

c) Coordination: Close liaison should be fostered between the Services of Forestry, Fisheries, Environment, Agriculture, Sea Defense and NGOs who have an interest in mangroves.

d) Social forestry: In forestry there is an economic and social welfare sub-sector. Sufficient mangrove forests should be designated for the local supply of goods and services needed by the rural communities.

The functioning of the mangrove ecosystem is closely linked to terrestrial land use practices. In particular, changes in water-flow regimes affect mangroves, and the overdrawing of ground water or excessive removal of mangrove vegetation may increase the danger of aquifer salinization and contamination.

Consequently, the coastal zone should be considered as an integral component of overall regional land use planning and development so that appropriate land use policies and action programmes

may be formulated. Priority should be given not only towards the rehabilitation of degraded coastal lands but also the rational use of land on a sustainable basis, including the planned development of sustainable forest/marine products.

Many of the uses and services of mangroves are compatible such as wood harvesting, bark and honey collection, coastal protection and small scale capture fishery. Others are less so, and hence a zonation of the area according to primary land-use objectives is necessary. This underscores the need for a holistic approach within the framework of integrated coastal zone management planning (FAO 1994).

The National Mangrove Management Committee should be tasked with updating Mangrove Management Plan and the development of Operational Plans so as to provide coordinated, cross-sectoral actions for implementation and monitoring. The national Mangrove Management Plan should continue to address the following:

- Stakeholder participation at all stages of planning and implementation.
- Assessment of the status of mangroves and the success of management initiatives in the respective areas and progress reporting.
- Local academic and research institutions with the appropriate expertise of implementation, monitoring and evaluation of mangrove ecosystems.
- Performance criteria on criteria on the effectiveness of implementation repeated at least every 3 to 5 years.

9.0 HEALTH AND SAFETY

The Forestry Sector is one of the most hazardous industries in Guyana. Good health and safety performance in forestry is feasible. The following practices and standards are based on the Code of Practice for Health and Safety in Forestry Work of the International Labour Organisation, Geneva and on the Occupational Health and Safety Laws of Guyana.

- Employers have the main responsibility for *health and safety* in forestry work; therefore is responsible for installing and maintaining work systems and methods which are safe and without risk to health.

- All operators of any kind of machine or mechanical device should receive all the necessary training and instructions to ensure competency to safely operate equipment for the job they are assigned to do.

- Basic first-aid training (and refresher course) should be provided to all personnel involved in field operations etc. Also a kit should be provided to every crew or should be located close to where crews are working.

- No machine should be operated by a person who is drowsy, under the influence of alcohol, medicine or drugs, suffers blackouts, or is suffering from any physical or mental distraction that could contribute to unsafe operation.

- Working hours should not exceed the number prescribed by national law or collective agreements.

- All persons should be provided with and wear all the necessary safety equipment needed.

- Periods for rest, which includes: short breaks during work hours, sufficient breaks for meals, nightly rest and weekly rest should be arranged for all workers.

- In the event of injury or illness which requires medical assistance, provision should be made for quick evacuation.

- In case of emergency, transport or a means of communication should be available at the worksite to contact rescue services.

- Workers applying hazardous chemicals must receive training and full information on the risk involved and the use of protective equipment and first-aid techniques.

REFERENCES

1. Aksornkoae, Sanit, (1993). ***Ecology and Management of Mangroves***. IUCN, Bangkok, Thailand.
2. FAO. 1994. ***Mangrove forest management guidelines***. FAO Forestry Paper No. 117. Rome.
3. Guyana Forestry Commission and Integrated Coastal Zone Management (ICZM)–EPA, November, 2001. ***National Mangrove Management Action Plan***.
4. Allan, C., Williams, S. & Adrian, R. May, 2002. ***The Socio-economic Context of the Harvesting and Utilization of Mangrove vegetation.*** GFC, Guyana.
5. Guyana Forestry Commission. 2002. *Code of Practice for timber harvesting*. 2nd edition.
6. Pastakia, C.M.R. (1991). ***A Preliminary Study of the Mangroves of Guyana***–Aquatic Biological; Consultancy Service Ltd.
7. Van der Meer, Dr. J.W., Olliver, G. & Strand, T. August, 2003. Guyana Sea Defences "***Elaboration Study for the Sea Defences Project***" Final Project Proposal. European Commission, Government of Guyana. AGRIFOR Consult S.A., Belgium.
8. World Bank, ISME, center Aarhus (2003). ***Draft Code of Conduct for the Sustainable Management of Mangrove Ecosystems.***

ANNEX I: LEGAL CLAUSES IN DOCUMENTS RELATING TO MANGROVES

There is no specific legislation on mangroves in Guyana. However, there are clauses in four legal instruments, namely the Environmental Protection Act, Sea Defence Act, Fisheries Act and the Forests Act that can be interpreted to regulate the management of mangroves. However, there is a need to develop laws dealing with the present and future conditions of the mangrove ecosystem. A well formulated legislation based on the socio-economic realities of Guyana that if properly implemented, may help to guide the effective and coordinated management of the resource.

The Environmental Protection Act 1996 Part 1 Subsection (m) declares that "natural resources means the living plants, animals and organisms, ecosystems, forests, waterways, soils and other biological factors within the natural environment, and the geologic formations, mineral deposits, renewable and none renewable assets and the habitat of living plants, animals and organisms". This declaration can be interpreted to include mangrove vegetation.

Part 4, Section 4 of the Act states that "*every environmental impact assessment should be carried out by an independent and suitable qualified person approved by the agency and shall (a) identify, describe and evaluate the direct and indirect effects of the proposed project on the environment including flora and fauna and species habitat*". Mangrove forests serve as habitat for a large number of species, therefore this declaration should also apply to mangrove forests.

Part 10, Section 1 declares that "*the Minister may make regulations for the purpose of giving effect to the provisions of this Act and in particular but without prejudice to the generality of the foregoing, such regulations may contain provisions in relation to (a) standards and codes of practice with respect to protection and rehabilitation of the environment and the conservation of natural resources and (j) protecting the coastal and marine resources*". Mangrove forests are included in natural resources as well as coastal and marine resources.

The Sea Defense Act 1973 Chapter 64:02, Section 2 (d) declares that "sea defense includes – *any shell bank or reef, sand bank or reef or other natural feature which serves as a protection of the sea coast against the erosive action of the river current*". Mangroves are included in this declaration, since mangroves are established on sediment accreting open coast and serve as a protective belt.

Additional declarations that include mangrove forest are:
Part 3 Section 12 of the Act declares that "*all sea defenses which are or shall be in existence in any district shall by force of this Act become the property of the state*".

Part 5 Section 18 (1) states that "*no person shall without the previous written sanction of the Board, make or cause or permit or suffer to make (a) any drain trench or cutting in the earth so as to affect any sea defense*". According to Section 20 "*any person who shall, without the consent of the board, obtain, remove any earth, sand, shell, clay, gravel, shingle, mineral substance, or any sea–weed, or vegetation, or any* other matter *or thing whatsoever from any sea*

defense or from any land along the foreshore within one half of a mile of mean high water mark, shall be liable to a fine of one hundred and fifty dollars."

Indirect reference to mangrove forests can also be found in the Fisheries Act 1957 Part 8, Marine Reserves and Fishing Priority Areas, Section 21. (1). The Act declares that "the Minister may, by order published in the Gazette, declare any area of the fisheries waters and, as appropriate, any adjacent or surrounding land to be a marine reserve where he considers that special measures are necessary: (a) to afford special protection to the flora and fauna of such areas and to protect and preserve the natural breeding grounds and habitat of aquatic life with particular regard to flora and fauna in danger of extinction; (2) any person who in any marine reserve without permission granted under subsection 3 (b) takes or destroys any flora and fauna other than fish is guilty of an offence".

The Draft Forests Act 1997 does not explicitly name mangrove forests and there are no regulations guiding use, planning and management of mangroves. However, Part 2, Section 4 (1) states that *"the Minister may by order declare any area of public land in Guyana to be State Forests and may from time to time vary or revoke such order"*. This can be interpreted to include mangrove areas that are not State Forest.

Mangrove forest (category 1) once declared State Forest can be included in the subsection on Conservation of Biodiversity, Part 4, 12 (1) which declares that *"no person shall fell, cut, lop, tap, bleed, or injure, take or extract any bark, leaf, seed, fruit, gum or other part or substance from, or transport, remove or export any protected tree or plant in a state forest"*.

ANNEX II: ZONATION

Proposed Zonation Criteria for Mangrove Forests (Source Mangrove Management Action Plan, 2001)

Category	Sub-category	General Criteria	Description
Permanent Protection Forests		Large mangrove forests (areas greater than 100 hectares), habitat for rare species, richness and diversity of species.	Mangrove areas managed for protective and scientific functions.
Reserve Forests		Mangrove areas that are crucial for erosion control.	Areas managed for the production of mangroves and approved goods and services.
	Zone 1 **Rehabilitation**	Degraded mangrove forest, and mangrove areas being established by natural process.	Areas managed for the rehabilitation of mangroves.
	Zone 2 Multiple-use	Mangrove areas with potential for provision of approved goods and services.	Mangrove forest managed for the production of fire wood, bark, fish, honey etc.

Permanent Protection Forests

Existing large mangrove areas that should be considered for this category are:

Areas	Description
Region 1 (Barima – Waini)	The coastal forest between the Waini and Pomeroon rivers, and are within the tentative delineation for Shell Beach proposed protected area.
Region 2 (Pomeroon – Supenaam)	The stretch of coast lying north west of Better Hope, until the outfall of the Cozier Canal (Essequibo).
Region 5 (Mahaicony – West Berbice)	The mangrove forest at Profit, West Coast Berbice.

Reserve Forests

Zone 1	Several areas of coastal Guyana should be targeted for rehabilitation with mangroves. One indication that the land may be ready for mangrove is the presence of colonising grasses and shrubs such as *Spartina braziliensis* and *Batis maritima* or a few seedlings of mangrove species scattered over such land. Mangrove areas for rehabilitation are:	
	Area	**Description**
	Region 3 (East Essequibo and West Demerara)	The East Essequibo and West Demerara areas in region 3 have limited lands that are suitable for rehabilitation. A suitable area is available at Ruimzeight. The predominant species in the existing mangrove forests is *A. germinans.* This is also a pioneering mangrove species of the coast, it establishes well and is better adapted to seaward conditions than the riverine and

		inland species, *R. mangle* and *L. racemosa*, respectively.
	Region 4 (Demerara – Georgetown – Mahaica)	The shoreline along Georgetown is very much disturbed and will be extremely difficult to rehabilitate. However, a long stretch of land that is suitable for mangroves is available from the east of Kingston to Bel Air, Georgetown. Some natural mangrove vegetation exists along this stretch of land and *A. germinans* can be planted.
	Region 5 (Mahaicony – West Berbice)	In the central part of the Region consisting of Phoenix, Traflagar Onverwagt, Yeoville and Mon Chosi, re-colonisation by mangrove species has already started. The process of reestablishment of mangroves can be enhanced through planting of suitable species, such as *A. germinans*, which is in this area.
Zone 2	Mangrove areas that should be managed for multiple sustainable use are:	
	Region 3 (East Essequibo and West Demerara)	Mangroves along the Coast of Wakenaam and Leguan. The mangrove area fronting the West Demerara Regional Hospital.
	Region 5 (Mahaicony – West Berbice)	The western part of Region 5 from Mahaica to Profit has a mangrove forest stretching over 20-25 Km. There is need for supervision of activities in this area. It can also serve as a major source of planting stock for areas in Regions 5 and 6 as well as neighboring Regions.

ANNEX III: LOGICAL FRAMEWORK

OBJECTIVES	ACTIVITIES REQUIRED
Conservation To reduce destruction of coastal and riverine mangrove ecosystems, to promote improved management, and to conserve biodiversity in these ecosystems.	• Directly protect critical mangrove areas from destruction, degradation and other anthropogenic activities that have negative impacts on the resource. • Promote natural regeneration where possible. • Recognise, protect and enhance local cultural and social values of mangrove resources. • Promote and support traditional management approaches. • Establish Protected Areas where necessary to protect and conserve mangrove ecosystems and resources. • Implement and enforce buffer zones where necessary. • Encourage community participation in management of mangroves. • Integrate mangrove management and conservation measures with Integrated Coastal Zone Management.
Develop and implement appropriate policies and strategies for the management and conservation of mangrove ecosystems and resources.	• Review, develop and implement structures and mechanisms for management and conservation of mangroves. • Promote research on mangrove ecosystems, species, genetics and habitat functions. • Use research experience and results to inform policy reform and development. • Promote interagency collaboration in mangrove management. • Review, strengthen and harmonise appropriate legislation to promote sustainable utilization of mangroves. • Develop awareness and education programmes to disseminate information for better policy conformation and decisions. • Empower local communities for participation in management and conservation of coastal resources. • Undertake Environmental Impact Assessments (EIAs) before any proposed development work in mangrove areas is approved.
Improve the options available for stakeholder communities and individuals dependent on mangrove ecosystems and resources.	• Increase livelihood options of stakeholders. • Strengthen stakeholder capacity for their involvement in management and conservation efforts. • Promote sustainable livelihood options. • Provide education and awareness support. • Recognize and seek to resolve equity, gender, traditional and user right issues. • Undertake Environmental Impact Assessments (EIAs) before any proposed development work in mangrove areas is approved.
Implement measures to ensure the continued productivity of mangrove ecosystems.	• Identify and encourage the use of best management practices for utilization of mangrove resources through research, education and awareness by resource users. • Identify and promote alternative sustainable uses of the resources. • Undertake Environmental Impact Assessments (EIAs)

OBJECTIVES	ACTIVITIES REQUIRED
	before any proposed development work in mangrove areas is approved.
Implement measures and policies to ensure the continued role of mangroves in coastal protection.	• Directly protect critical mangrove areas from destruction, degradation and other anthropogenic activities that have negative impacts on the resource and so impair coastal protection function. • Promote natural regeneration where possible. • Investigate possibility of rehabilitation of degraded coastal and riverine mangrove ecosystems.. • Promote and support traditional management approaches. • Establish Protected Areas where necessary to protect and conserve mangrove ecosystems and resources. • Implement and enforce buffer zones where necessary. • Encourage community participation in management of mangroves. • Integrate mangrove management and conservation policies with Integrated Coastal Zone Management policies. • Review, strengthen and harmonise appropriate legislation to promote sustainable utilization and conservation of mangroves. • Undertake Environmental Impact Assessments (EIAs) before any proposed development work in mangrove areas is approved.