



Ramsar Convention

Monitoring  
Procedure

Final Report

**NARIVA SWAMP**

**TRINIDAD AND  
TOBAGO**

Gland, Switzerland, February 1996

CONVENTION ON WETLANDS OF INTERNATIONAL  
IMPORTANCE ESPECIALLY AS WATERFOWL HABITAT  
(RAMSAR, 1971)

CONVENTION RELATIVE AUX ZONES HUMIDES  
D'IMPORTANCE INTERNATIONALE  
PARTICULIÈREMENT COMME HABITATS DES OISEAUX D'EAU  
(RAMSAR, 1971)



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## I SUMMARY

In 1992 Trinidad and Tobago designated Nariva Swamp for the List of Wetlands of International Importance maintained under the Ramsar Convention. Nariva is one of the largest freshwater wetlands in the Caribbean and has the most varied vegetation of all wetlands in Trinidad and Tobago. It is specially important for large numbers of waterfowl and the main site still sustaining populations of anaconda (*Eunectes murinus*) and manatee (*Trichechus manatus*). It supports considerable populations of molluscs and crustaceans, and several species of fish live and reproduce in the area.

As a result of human activities, mainly illegal agriculture activities in the marsh, the Government of Trinidad and Tobago formally requested during the Kushiro Conference (1993) the inclusion of Nariva Swamp in the Montreux Record -a subset of Ramsar sites in need of priority conservation attention. In 1994 Trinidad and Tobago requested the Ramsar Bureau to apply the Monitoring Procedure and organise a mission to Nariva Swamp to address several specific issues.

A three-member Ramsar team visited the Nariva Swamp in April/May 1995, accompanied by representatives and officials of different Government Departments, NGO's, local associations, and inhabitants of the local communities. Field work in Nariva occupied eight days and visits meetings and presentations in the Port-of-Spain area another seven days.

This report has been compiled by the members of the Monitoring Procedure team and is submitted by the Ramsar Bureau to the Government of Trinidad and Tobago. As requested by the Government, the report presents an analysis of the extent of the present problems (section IV) and a set of recommendations for action (section V).

The report recognizes the efforts that the Government of Trinidad and Tobago is making for the conservation and the restoration of the Nariva Swamp, and suggests that some of the action taking (or to take) place in Nariva should be used as demonstration models both elsewhere in Trinidad and Tobago, as well as in the rest of the Caribbean. However, the Monitoring Procedure mission concluded that further action is needed if the Nariva Swamp is to be removed from the Montreux Record.

Particular problems arise from the land tenure situation of the site, the use of water resources, and the complex administration of the site -which results in lack of a coherent conservation and socio-economic development policy -and its implementation- for Nariva and the local communities which depend on and influence the wetland.

Lowland areas in Trinidad, like Nariva, are under heavy farming and other agricultural pressures, leading to actual and potential conflict between conservation of water and wetland resources, and their wise use. No further loss of the Nariva Swamp to agriculture should occur, and planning measures should ensure that activities carried out are within the wise use concept and take place only in the areas of least impact to the ecological character of the site. The preparation of a management plan, an economic evaluation and an environmental impact assessment (of activities in Sector B) of the Nariva Swamp catchment area are strongly recommended. Hydrologic and hydraulic studies should be carried out as soon as possible to guide all conservation and wise use activities in the area.

Particular difficulties arise due to the existing and proposed conservation categories and boundaries given to the Nariva Swamp. The efforts currently being made are welcome but a revision of the boundaries and the categories is essential, and must take into account a multiple and wise use approach.

Some activities exercised by the local communities have been sustainable until recent years. Various reasons have caused this problem, but community participation, training and cooperation, are some of the measures which should be taken into account if conservation interests are to be compatible with long-term economic development of the local communities.

Many of the recommendations given in this report deal with technical issues, and action in the swamp itself, but if the efforts being made by the government of Trinidad and Tobago towards the conservation of this Ramsar site are to be successful, they will have to take stronger account of the needs and interests of the communities living nearby, and adopt an attitude of cooperation as well as enforcement.

It is hoped that the Government of Trinidad and Tobago will provide information on its response to this report in the near future.

## II INTRODUCTION

### ◆ The Ramsar Convention

The Convention on Wetlands of International Importance especially as Waterfowl Habitat was established in 1971 at a conference of the International Waterfowl Research Bureau (IWRB), held in the Iranian town of Ramsar. It currently has 90 Contracting Parties from all regions of the world. States which join the Convention accept four major obligations :

- (i) to designate at least one wetland in their territory for the Ramsar List of Wetlands of International Importance and to maintain the ecological character of the wetland(s) concerned;
- (ii) to make "wise use" of all wetlands in their territory, whether or not they are included in the List;
- (iii) to establish wetland reserves and to provide adequately trained staff for their wardening and management; and
- (iv) to engage in international cooperation, especially in regard to trans-border wetland systems and migratory wetland species.

The main policy-making body of the Convention is the Conference of the Contracting Parties, which meets once every three years. Between meetings of the Conference, the Convention is managed by a Standing Committee composed of Regional Representatives. The day to day running of the Convention is carried out by the Ramsar Bureau (or secretariat) which is based in Switzerland and shares its premises with the headquarters of IUCN - The World Conservation Union. For further details refer to "The Ramsar Convention Manual" (Davies, 1994).

### ◆ The Montreux Record and the Monitoring Procedure/Management Guidance Procedure<sup>(1)</sup>

There are currently more than 700 sites included in the List of Wetlands of International Importance. Approximately 10% are also included in the 'Montreux Record', a register of Ramsar sites where 'changes in ecological character have occurred, are occurring or are likely to occur as a result of technological developments, pollution or other human interference'. Contracting Parties are obliged by Article 3.2 of the Convention to bring such changes to the attention of the Ramsar Bureau. The Montreux Record was established by Recommendation C.4.8 of the 1990 meeting of the Conference of the Contracting Parties (held at Montreux, Switzerland) and formalized by Resolution C.5.4. of the 1993 meeting of the Conference (held at Kushiro, Japan). Resolution C.5.4 stated that the record should be referred to as the Montreux Record; determined that its purpose is - among others - to

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<sup>1</sup> It is being proposed (to the Conference of the Parties in Brisbane 1996) that the term Monitoring Procedure be changed to Management Guidance Procedure to reflect more precisely what its aim is.

identify priority sites for positive national and international conservation attention, and instructed the Bureau to maintain the Montreux Record as part of the Ramsar Database. The Bureau only includes sites in the Montreux Record with the approval of the Contracting Party concerned. Operation of the Montreux Record is reviewed by the Convention's Scientific and Technical Review Panel (STRP).

The Monitoring Procedure is a mechanism which is operated by the Ramsar Bureau, at the invitation of the Contracting Party concerned, to address issues at sites included in the Montreux Record. The aim of the Monitoring Procedure is to bring about the steps necessary for the removal of the site from the Montreux Record.

The Monitoring Procedure usually consists of one or more site visits by Bureau staff and specialists who are expert in the particular issues involved. The specialists may be representatives of other Contracting Parties or partner organizations. A report is then compiled and submitted by the Ramsar Bureau to the Government concerned. The report generally includes a detailed analysis of the situation and recommendations for future action in order to arrive at acceptable solutions.

Since its inception in 1988, the Monitoring Procedure has been implemented in more than 25 countries, and only once before in the Neotropical Region (Bañados del Este in Uruguay, 1993). For further details refer to "The Ramsar Convention Manual" (Davies, 1994).

#### ◆ **Trinidad and Tobago and the Ramsar Convention**

Trinidad and Tobago became a Contracting Party to the Wetlands Convention in December 1992 (date entry into force of Convention, April 1993), and designated Nariva Swamp for the Ramsar List of Wetlands of International Importance. To date Trinidad and Tobago remains the only island nation in the Caribbean which is a Contracting Party to the Convention, and Nariva Swamp remains the only wetland in this country's territory included in the Ramsar List.

Even though Trinidad and Tobago became a Contracting Party to the Ramsar Convention only a few months before the Fifth Meeting of the Conference of the Parties which took place in Kushiro, Japan (June, 1993), the delegation representing the country at the meeting was one of the most active and contributed many useful comments and suggestions. Likewise, the delegation participating in the Second Meeting of the Contracting Parties from the Neotropical Region, in Panamá (June, 1995) played an important role in the discussions and in the decisions taken.

Trinidad and Tobago has recently (January 1995) established the National Wetland Committee (NWC) which deals with Ramsar matters. The Committee was appointed by the Honourable Minister of Agriculture, Land and Marine Resources, it is chaired by the Director of Forestry, Mr Selwyn Dardaine, and it includes representatives of governmental institutions (Ministry of Agriculture -Forestry Division- Wildlife and National Parks Sections, and -Fisheries Division-; Ministry of Planning and Development; Institute of Marine Affairs), the University of the West Indies and local NGO's.

The National Wetlands Committee has endorsed the preparation of a National Wetland Policy as a priority issue and a draft is expected for public comment in February 1996.

Ramsar's administrative authority in Trinidad and Tobago is the Ministry of Agriculture, Land and Marine Resources, Mr W Ruthven Rudder is Permanent Secretary. The "official contact" for the Ramsar Bureau is Mr Selwyn Dardaine, and the "technical contact" Mrs Nadra Nathai-Gyan, of the Wildlife Section of the Forestry Division.

◆ **The Nariva Swamp**

The Nariva Swamp was designated for the List of Wetlands of International Importance on 21 December 1992. It comprises state lands, including the Bush Bush Wildlife Sanctuary, part of the Ortoire Nariva Windbelt Forest Reserve and the proposed Nariva National Park (see Map 3).

The Nariva Swamp qualifies under several of the Convention's criteria for identifying internationally important sites (Montreux Rec. C.4.2 (Rev.)).

- 1a it is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biogeographical region;
- 2a it supports an appreciable assemblage of rare, vulnerable or endangered species or subspecies of plant or animal, or an appreciable number of individuals of any one or more of these species;
- 2b it is of special value as the habitat of plants or animals at a critical stage of their biological cycle;
- 3b it regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity or diversity;

A general description of the Nariva Swamp and the characteristics which made it of international importance can be found in Scott & Carbonell (1986) and Jones (1993).

In view of the fact that the reports for the proposed plans for drainage and agricultural development of the Nariva Swamp prepared by FAO (1957) and the Overseas Technical Cooperation Agency of Japan (OCTA, 1970, in Agristudio, 1991) omitted the physical and ecological aspects of the Nariva Swamp, as well as an evaluation of their possible negative effects on the environment, the Ministry of Agriculture, Land and Marine Resources (Planning Section) requested the University of the West Indies (UWI) to carry out a study of the area. The report prepared by the UWI (Bacon *et al*, 1979) includes the physical, and ecological aspects, and the possible environmental effects of reclamation of the Nariva Swamp. The authors clearly indicate that their report lacks a soil study and an insect populations and epidemiology survey -which were meant to be carried out by other institutions- and that the study could have been greatly improved by consideration of economic and social aspects. However, the report remains the most comprehensive study of Nariva from the natural resources point of view.

Nariva has the most varied vegetation of all wetlands in Trinidad and Tobago, with distinct zones of swamp forest, palm swamp, herbaceous swamp and mangrove woodlands (James,

1992). It is specially important for the large numbers of waterfowl, and it is the major wetland in Trinidad which still sustains anaconda (*Eunectes murinus*) and manatee (*Trichechus manatus*) -the latter under threat because of habitat destruction and because of being trapped in fishing nets-. Traditional methods are used to fish cascadura (*Hoplosternum littorale*) whose whole life history is tied to the ecology of Nariva -to which it is confined-, and conch (*Pomacea urceus*) which are fished with traditional methods and consumed by the local communities. Additionally it was home to the blue and yellow macaw (*Ara ararauna*) which depended on palmiste palm (*Roystonea oleracea*) but is now extinct from the area largely because of habitat destruction and unsustainable harvest of the palmiste palms for palm hearts used in Hindu weddings and poaching of nests for the flightless young birds for the pet trade.

Many studies in the Nariva Swamp area were carried out during the years (1950's and onwards) when the then Trinidad Regional Virus Laboratory (TRVL) -now Caribbean Epidemiological Centre (CAREC)- was specially interested in research on arboviruses. The various visiting scientists were involved in bird surveys and banding, as well as bat and other small mammals, amphibian and reptile surveys. Several species have been mentioned as used and/or consumed by the local population by Price (1955) and Bacon *et al* (1979), such as the palmiste palm (*Roystonea oleracea*); mangroves; fish like the cascadura (*Hoplosternum littorale*), the guabine (*Hoplias malabaricus*) and the yarrow (*Hoplerhythrinus unitaeniatus*); the blue (*Cardisoma guanhumi*) and callaloo crabs (*Ucides cordatus*); the mangrove oyster (*Crassostrea rhizophorae*); or the conch (*Pomacea urceus*). However, only a very few studies (Bacon, 1970; La Croix, 1971) have been carried out on sustainable harvesting of any of these species.

◆ **Inclusion of the Nariva Swamp in the Montreux Record and initiation of the Monitoring Procedure**

The Government of Trinidad and Tobago submitted a formal request for the inclusion of the Nariva Swamp in the Montreux Record during the Kushiro Conference (1993). This was accepted in view of the changes taking place in the ecological character of this Ramsar site. Changes are mainly the consequence of heavy pressure from clearance by illegal rice farmers (at the commercial level) and the use of agrochemicals both by legal and illegal farmers.

The request of the Government of Trinidad and Tobago is translated as its commitment to come to terms with a multiple use approach in Nariva, as a workable conservation exercise, recognised both nationally and internationally.

◆ **Implementation of the Monitoring Procedure on the Nariva Swamp**

The Monitoring Procedure mission, coordinated by the Wildlife Section of the Forestry Division (Ministry of Agriculture, Land and Marine Resources) and by the Ramsar Convention Bureau, visited Trinidad and Tobago from 26 April to 12 May 1995. The Ramsar Convention was represented by a three-person team :

Lirio Márquez, free-lance consultant, specialising in social and community aspects, Puerto Rico.

Michael McCoy, Professor, specialising in organic rice farming and wetland restoration, Regional Wildlife Management Program for Meso America and the Caribbean (Universidad Nacional, Heredia), Costa Rica.

Montserrat Carbonell, Ramsar Convention Bureau, Switzerland

Additionally, the team would have been accompanied by Edgardo Aragón (Costa Rica), a rice farmer, with experience in low application of agro-chemicals and community self organisation, but it was not possible due to personal matters arising at the last moment.

The first two days of the mission involved visits to key officials and meetings with the National Wetland Committee, followed by eight days of field work in the swamp, and further visits to agencies and organizations involved in one way or another in the management, conservation and/or use of Nariva. Local and national personnel were involved in the mission so as to benefit mutually from each others experience.

Prior to the mission the Government of Trinidad and Tobago indicated its expectations, which effectively formed the Terms of Reference of the Monitoring Procedure team, and were as follows :

(a) the mission should visit the area during the dry season, approximately towards the last week in April 1995, and for a period of at least two weeks to allow for field work and meetings in offices,

(b) an analysis of the present socio-ecological problems at major areas (Cocal Kernahan Project, Plum Mitan Rice Scheme and Biche Bois Neuf Area), to evaluate :

- the impacts of resource exploitation (within and outside the Ramsar area, planned and unplanned, commercial and for subsistence), and
- potential mechanisms for sustained multiple use, with adequate mitigatory measures, primarily for the benefit of local communities.

(c) an analysis of the condition of this wetland, which in the last ten years has witnessed drastic alteration of habitat (fragmentation of evergreen seasonal forest, disappearance of open water areas, loss of herbaceous swamp and palm swamp forest), to evaluate :

- the changes in vegetation of the major habitats and impact on wildlife populations, and
- the need for vegetation rehabilitation, and recommendations for the restoration of specially important areas for the conservation of biodiversity.

The contents of this report follow the Terms of Reference, as no modifications or further wishes have been indicated by the Trinidad and Tobago authorities.

The Ramsar Bureau has always stressed the importance of the Monitoring Procedure at Nariva Swamp as a case study, from which lessons could be learned and applied in wetlands

with similar problems, elsewhere in the Neotropics, but particularly in the insular Caribbean region. Especially important are the sharing of coastal management and planning needs, community co-management, national administration and wise use of wetlands, by those other countries with similar population, social and economical realities.

The development of integrated management plans for the Ramsar sites is a high priority under the Convention (Resolution C.5.7). The Bureau hopes that the recommendations in this report will form a valuable contribution to the initiatives which are already underway for the conservation and wise use of the Nariva Swamp. Nevertheless, during their visit to the swamp, the Ramsar representatives emphasized that the Monitoring Procedure should be seen as a framework in which the many factors affecting the management and conservation of the site might be addressed within an international context. It is not the role, or the intention, of the Ramsar Convention Bureau to undermine, through the Monitoring Procedure, the progress which has already been made at local and national levels, but to complement with an international perspective those initiatives and expertise.

### III METHODOLOGY

#### ◆ Methodology

General - Meetings were held in the Port-of-Spain area with various government agencies (see Appendix H, Itinerary) and documents, maps, aerial photos and LANDSAT images consulted and/or purchased, in order to determine as close as possible the philosophical, political, economical and legal frameworks that affect the Nariva Swamp. It was specially important to try to learn how the different institutions, governmental, non-governmental and academic -either national or local-, as well as the private sector participate or influence in the conservation and/or development of the Swamp. Equally important was to learn their opinion about the practical aspects of implementing a wise use strategy for the Nariva Swamp and its feasibility.

Several participative community meetings were held in Plum Mitán, Kernahan and Brigand Hill, to explain the principles, objectives and activities of the Convention on Wetlands and the "wise use of wetlands" concept; to inform them that we had come to Nariva at the request of the Government of Trinidad and Tobago to carry out a Monitoring Procedure (and explain what it means or involves), and to ask for their assistance and collaboration during our stay in their communities. These meetings were aimed at gathering farmers, women, and the whole community in different/separate opportunities. Opportunity was also taken of a National Food Crop Farmers' Association and the Biche-Plum Mitán Farmers and Poultry Growers Association meetings taking place while the team was in the area.

Additionally, in Plum Mitán and Kernahan, each member of the team gave a short talk - including slides- about her/his work. Lirio Márquez explained her work in Puerto Rico with the community of Guanica and the wetland they are trying to restore; Mike McCoy talked about his work with the local farmers of Bagatzí, in Costa Rica, trying to grow rice without agrochemicals use; and Montserrat Carbonell spoke about the Convention on Wetlands.

Social aspects - Most of the work concentrated in the communities immediately adjacent to the Nariva Swamp, Plum Mitán, Kernahan (Kernahan-Cascadoo), in Cocal (not really a community, see Community issues in section IV Key issues), and to a lesser extent in Brigand Hill. Originally it was believed by the team that the first three were the only communities with a direct impact and a direct dependence on the swamp. Later it became apparent that several others, such as Biche, should have been considered in this study.

A rapid assessment of Plum Mitán, Brigand Hill, Kernahan and Cocal, and their impact on the ecosystem was carried out utilizing a personal adaptation of the Participatory Rural Appraisal Methodology (World Resources Institute, 1990). This methodology assumes (a) that popular participation is a fundamental ingredient in project planning; (b) that locally maintained technologies as well as sustainable economic, political and ecological systems are fundamental for the wise use of natural resources; and, (c) that truly sustainable development initiatives must incorporate approaches that local communities themselves can manage and control.

Semi-structured field interviews with various segments of the community -farmers, young men, women- were carried out separately in Plum Mitan, Kernahan, Cocal and Brigand Hill to determine:

- ◆ how long the communities had been established
- ◆ approximate number of people
- ◆ education level
- ◆ migration/growth trend
- ◆ degree of community consolidation, number and type of community organizations present, existence of community leaders
- ◆ links to other communities in the area, to social, agricultural and environmental government organisations and NGO's
- ◆ degree of dependence on the swamp
- ◆ main perceived problems
- ◆ attitudes towards the environment
- ◆ their feelings towards moving out of the area
- ◆ their feelings towards the protected area status of Nariva
- ◆ natural resource use practices and activities

Meetings held at the communities were also used to assess, in a participatory and general manner, what they perceived as their most pressing problems and their relationship with their natural environment.

Exploitation and restoration of the marsh - Much information on past and present agricultural practices and conservation status of the Nariva Swamp and its area of influence, was gathered during the meetings held in Port-of-Spain and at the participatory meetings in the different communities (see above). In addition, an aerial survey was conducted (see Appendix H, Itinerary) to have a better understanding of land use in Nariva and the extent of the deterioration of the marsh and forest. On the other hand, most of the information on rice and vegetable farming, fishing and harvesting of wildlife was obtained through informal conversations with the local farmers both at the communities or in the fields and marsh. In order to get first hand information on agricultural and farming practices being used we visited farmers in the fields they were working, in the Plum Mitan Rice Scheme (Sector A), the Biche Bois Neuf area (Sector B), Kernahan, Cocal and the Black Water River area (south-west of Bush Bush Wildlife Sanctuary).

All irrigation and drainage canals and most water sources for agricultural areas and the swamp were inspected. Due to the severe drought conditions during our visit, access was easy to most places either by car or on foot. It was not possible to go down the Petit-Pool Cut all the way, or to get deep into the palm swamp forest or the swamp (basically because of insufficient time to cut through the very thick, dry vegetation), however, the aerial survey and the aerial photos obtained locally, provided good and useful information.

## IV KEY ISSUES

In addressing the conservation of natural resources, biological, social and economic issues have to be taken into consideration. The Monitoring Procedure team was asked to look into the first two, although at given points it was necessary to investigate -even if only partially- some economic aspects which are shaping Trinidad and Tobago's social structure. As it is, therefore, impossible to keep separate the social and economic aspects of the Nariva area from the conservation of the ecological character and the restoration of the swamp, a brief explanation of the problem -as perceived by the team- is included, which should facilitate the reading of the results, the conclusions and the recommendations, specially to those readers who are not particularly familiar with Trinidad and Tobago social, economic and environmental issues.

The framework for the team's work and the present report has always been the Terms of Reference set by the Government of Trinidad and Tobago (see section II Introduction).

### ◆ Overview of the present situation

National policies, legislation, administration - The Medium Term Policy Framework (MTPF) identifies "environmental protection" as one of its six major goals and objectives (Trinidad and Tobago MTPF 1994-1996), and indicates that Government is committed to the development of the agricultural sector as a primary source of economic activity and a major generator of employment opportunities.

James (1992) indicates that the National Physical Development Plan (1989) sets the policy framework for land use in the country and recommends uses that are compatible with the principles of conservation and long-term sustainability. This document has classified wetland soils as unsuitable for agriculture, and recommended they be left under indigenous growth.

The Food and Agriculture Policy 1995-1997 (draft white paper) includes among the major natural resource and environmental issues, deforestation, destruction of wetlands, loss of plant and animal biodiversity, pollution of land and water, pesticide abuse and over-exploitation of the inshore fisheries; and among the social issues, landlessness and squatting, security of land tenure, small size of landholdings, unemployment, insufficient involvement of youth in agriculture, gender issues and praedial larceny. The same document indicates that landlessness and squatting are closely related and reflect the problems of acquiring land legitimately, and there is the view that most squatters will either be unable or unwilling to make significant investments in the land they occupy and will therefore operate at low levels of technology. It continues to indicate that organization and management of research and extension, research-extension linkages, lack of coordination, inadequate funding and lack of farmer participation in planning research and extension programmes have been frequently cited as causes of problems too; and expresses its concern about the relevance of education and training provided to sectoral needs. It is also relevant that this document mentions that 85% of holdings are below 5ha in size and 50% below 2ha (data extracted from the Central Statistical Office reports 1982, 1986). In addition it states that emphasis must be made on concepts such as competitiveness, sustainable agriculture, appropriate technology, farming systems and gender issues.

At the administrative level, the Food and Agriculture Policy 1995-1997 document indicates that although the water for agriculture issue is addressed by the MALMR, it is not being considered within the context of a national water use plan, while other Ministries develop policies with impact on agriculture without any input from the MALMR.

The MALMR considers in its policy for 1995-1997 eight main objectives, three of which are of direct relevance to the restoration and wise use of the Nariva Swamp Ramsar site :

- (f) promoting the development of rural communities by stimulating the growth of a vibrant agricultural sector and reducing the rural-urban drift;
- (g) promoting the rational exploitation of the forest and wildlife resources;
- (h) promoting appropriate land-use and natural resource conservation measures.

Three main pieces of legislation govern the management of wetlands in Trinidad and Tobago, the Forests Act (Chapter 66:01), the Conservation of Wildlife Act (Chapter 67:01), and the State Lands Act (Chapter 57:01) (James, 1992). The first two refer to vegetation and wildlife conservation measures, but strangely enough only mammals, reptiles and birds are considered "wildlife", leaving amphibians, fish and invertebrates uncovered.

According to James (1992) the administrative responsibility for wetlands which are forest reserves falls directly under the jurisdiction of the Forestry Division, but there are areas of uncertainty as to which agency is responsible. The State Lands Section (Lands and Survey Division, of the Ministry of Agriculture, Land and Marine Resources -formerly Ministry of Planning and Mobilization) does not undertake active management of wetlands which are state lands, but the Forestry Division's role which is limited to patrols and wildlife data collection. Enforcement action against squatters in wetlands is referred to the State Lands Section. On the other hand, the State Lands Act permits development to occur in state lands only with the permission of the superintendent of state lands. However, this provision is not enforced and squatting on state lands continues (James, 1992). The State Lands Act was used to grant leases in Nariva for rice production (Sector A).

An Environmental Management Act, 1995 has been enacted "to provide for management of the environment of Trinidad and Tobago through the establishment of an Environmental Management Authority, an Environmental Trust Fund and an Environmental Commission" which would also be responsible for implementing the Government's international obligations. The Environmental Management Authority is already functioning and the regulations for the implementation of the Act are being prepared.

Past initiatives for development of Nariva - There have been -since the 1950's- several initiatives for the reclamation of the Nariva Swamp. The establishment of the Plum Mitan Rice Scheme in the 50's was started as a request by some farmers in the 1930's (Agristudio, 1991). Since then several studies have been carried out to determine the potential of the marsh for agricultural development, and some included suggestions for agricultural production or aquaculture projects. According to Agristudio (1991) there have been various initiatives funded by international agencies including FAO (1957, 1985), OTCA (1967, 1970), NEDECO (1983), as well as surveys and reports by several national institutions. Most ignored the problems related to the environment, none involved consultation with the local communities, and did not consider the social/economical impacts and benefits the projects might bring. According to Agristudio (1991) in 1990 the Institute of Marine Affairs advised the Ministry of the Environment and National Service to study the extent of habitat destruction in Nariva; to stop further expansion of rice cultivation; to restrict hunting and fishing activities; and to give higher priority to aquaculture projects over agriculture ones.

Bacon *et al* (1979) warned against the consequences of the FAO (1957) and OTCA (1970) proposals. The FAO (1985) aquaculture proposal took the environment into consideration but it had no practical follow up (Agristudio, 1991). The Reconnaissance Study of Agristudio (1991) provided some global conclusions ..."keeping in mind the imperative to respect the natural environment of the Nariva Swamp.....(and) a possible extension of the Plum Mitan Scheme must be looked for within the most heavily impacted areas".

It is important to bear in mind that all development studies carried out so far have been done only at a preliminary level, and that reports such as Bacon *et al* (1979) have helped the government withhold its decision to approve the execution of any reclamation scheme.

Institutional issues - Trinidad and Tobago has a system of Forest Reserves, Game Sanctuaries and Prohibited Areas, which dates back to the beginning of this century. However, it has no National Parks and Protected Areas System. The technical work for its planning has been done but according to Toppin-Allahar (1991) its implementation has floundered because of (a) the absence of a legal framework, and (b) the lack of financial resources required.

According to Toppin-Allahar (1991) the proposed National Parks System "draft legislation provides machinery only for the creation of two of the (six) classes of protected areas to which reference is made in the 1980 plan...Hence, the provisions of the Draft Act can only be described as inadequate to meet the need for legislation in this field." The legal framework for a **Protected Areas System** is still not in place, and it was also noticed that, in general, there is no clear knowledge of the **wise use** concept, both at government organisations and NGO levels, and a perception or acceptance that conservation implies no-use and human exclusion -an either/or approach-. Toppin-Allahar (1991) also suggested that some of the critical problems affecting protected areas can only be remedied by the making of certain policy decisions and their rigorous implementation. She added that the allocation of adequate resources of manpower, equipment and finance to the management of the existing protected areas would make a great deal of difference.

Kacal & Homer (1992) classified **Nariva** as a primary priority for the establishment of a **National Park**, in order to protect the uniqueness of this area, and its wealth of resources. These include a high potential for ecotourism earnings and for increasing the level of natural resource earnings through properly developed activities, provided that public interest and political will are positively involved, and that the communities are involved for their own benefit.

In the field it was realised that the **category/ies of protection/conservation/use** of the proposed Nariva Swamp National Park and the Bush Bush Wildlife Sanctuary do not correspond to the most desirable categories of wildland conservation, management and wise use. It was not possible to have an explanation of why and by what criteria the current limits were placed where they are for the proposed Nariva Swamp National Park. It is not understood why the border was placed so far to the east of Sector A and Sector B, leaving the majority to the Nariva Marsh proper (open, deep marsh) unprotected by some wildland management category. This is only helping the westward push of marsh reclamation by squatters and the obvious legal difficulties for their prompt removal.

The lack of a **management plan** that would set the priorities for short, medium and long term action was clearly felt. Additionally, it was noticed that in spite of the many feasibility studies for proposed development projects in Nariva, an **economic evaluation** of the swamp and areas of influence, and the social impacts and/or benefits development and/or

conservation could bring to the communities is still not available, and there seems to be little awareness of Nariva's true value and potential for wise use.

It was realized that, while not being exclusive to Trinidad and Tobago, there is **lack of adequate funding** at the institutional level within government that would allow for adequate patrolling and extension work in the field. Likewise the **lack of coordination among institutions** was evident although in relation to wetland issues this problem is probably becoming less acute thanks to the work done by the National Wetland Committee.

While it was possible to meet with many young and keen professionals it was obvious that there are **not enough trained personnel**, at the office and field levels, with broad and deeper training and experience in protected areas, management of natural resources, fire control, public awareness, environmental education, and community participation, among other subjects. Most people have been through university or technical schools but only very few have had a chance to attend specialised courses, or postgraduate schools, having learnt by themselves with very limited access to literature or reality elsewhere.

#### ◆ **Community issues**

The only study which considered the social aspects of the communities surrounding the Nariva Swamp was that of Kacal & Homer (1992) in relation to the proposed Nariva National Park, although their survey was undertaken in only one of the communities due to difficulties in contacting persons in the other ones. They indicated that the issues in the area surrounding the proposed park are political, ecological, social and economic.

Before addressing each community separately, it is worth noting several points common to all of them or of a general nature, the main one being that they are directly dependent on Nariva.

There seems to be considerably less information about the human communities in the area than about the natural communities.

Originally it was understood by the Ramsar team that the only two communities which **depend and have a direct impact** on Nariva swamp were **Plum Mitan** on the north and **Cocal-Kernahan** to the south. As work progressed, it became apparent that also **Brigand Hill, Biche, Cascadoo**, and maybe others as well, use the swamp on a regular basis or have close social links with either Plum Mitan or Kernahan.

It was also understood that Cocal-Kernahan was one community, although in fact Cocal is not a community (see below) and is located on the sand bar between the Nariva river and the ocean, and that Kernahan maybe should have been considered together with Cascadoo as a single unit.

Additionally, Plum Mitan, Brigand Hill and Biche on one hand, and Kernahan, Cascadoo and Cocal on the other are strongly linked at the social level, and to a lesser extent economically too. However, each community exhibits a different degree of consolidation.

The team estimated that about 5,000 people depend directly on the Nariva Swamp for their livelihood.

It appears that the **growth of the communities** in the Nariva area or the **lack of economic and social opportunities**, are not perceived as threats to the swamp. Most of the actions taken so far are of an enforcement nature -to forbid persons from entering the area, to forbid hunting and fishing, to prevent animal grazing inside the (proposed) protected areas-.

There has been no recent **agricultural and farming extension and training programmes** in Nariva. Local people do not have the opportunity for training in some tasks necessary for their personal development as for the benefit of their communities.

**Land tenure** (see also section IV Key issues, Exploitation and restoration of Nariva Swamp Ramsar Site, below) is probably the main problem since it leads to financial instability. Most of the farmers/families who have been in the area for several generations lack tenure of the parcels they cultivate, some are on temporary leases, and others requested regularization over 10 years ago but have not yet received any land, or even an answer to their application.

It was noticed during the Ramsar's team visit to Nariva that there is **no community participation** through consultation in the decisions taken for the conservation/development of Nariva -previous teams of consultants have not consulted them and failed to take their input into account-, as is the case with NGO's and most governmental institutions.

Plum Mitan - It was once a prosperous and comfortable agricultural community. Established in the area between 40 and 70 years ago -depending on the different sources. It has always been a rice growing community, many of the original settlers cultivated subsistence rice even before the government's Plum Mitan Rice Scheme was initiated. Most of the people we spoke to refer to Plum Mitan-Nariva as their home, and do not wish to move anywhere else. Houses are made of concrete in most cases, and there are several general and agricultural supplies stores.

Besides growing rice, Plum Mitan has for generations also used the swamp to grow vegetables and melons (during the dry season), to fish cascadura, and other fish species, and harvest the conch and crabs. They also gather firewood from the surrounding forest, as well as plant products for making crafts. Birds are also caught, either for the pet trade or as pets for themselves. Some individuals had water buffaloes which they kept in the swamp. For decades, these activities have had a small impact on the swamp. Currently, people's impact on the swamp is beginning to be felt. This is due mainly to the economic insecurity brought by the lack of regularised land tenure.

It was not possible to find precise information about the Plum Mitan population (number of inhabitants, growth rate, composition, etc) and their activities (and potential alternative activities). However, when the 1970's oil-boom ended, people who had been working at oil-related activities returned to the land, and being an Indian community by large, when men marry they don't leave, but rather bring their wife to raise a new family in the parents' community. The finite carrying capacity of the agricultural lands, the lack of government attention to promoting other economic development alternatives (cottages and other facilities for visitors and tourists), lack of employment/economic opportunities for the younger men and women are some further social issues are impacting on the health of Nariva.

Lack of regularised land-tenure, lack of government support and lack of employment and economic alternatives result in the losing of self-esteem and emotional instability.

There is a certain degree of community consolidation in Plum Mitan. There are several community organizations -farmers' group, women's group, sports and cultural activities group, there is a community centre, a good primary school and several temples/churches-.

Their attitude towards the conservation of the Nariva Swamp is positive, and in general they favour it but they have certain doubts, basically because they have not been informed of what is going on. They questioned how it will affect the lands they are now using, or the activities they carry out (rice and watermelon growing, cascadura fishing, etc); will it bring tourism; what will happen with their applications for land leases and with the large farmers squatting in Sector B.

It was also noticed that little cooperation exists between the small scale farmers in this community. There seemed to be an attitude to only worry about one's own crop. Several rice plots were destroyed by drought because they could not obtain a water pump that other farmers had. Such attitude may stem from the frustration of virtually no outside aid for farming activities. However, several farmers recognised this lack of cooperation and felt that new attitudes were forming.

Cocal - It is not a community. Only one family lives there all year round. The rest of the persons we spoke to, only come to plant vegetables/melons during the dry season and once the rains begin, they return to their homes, mostly in Sangre Grande and Manzanilla.

Kernahan - It is the least developed of the communities visited -although some of the families have been there for about 40 years. Houses are very basic wooden structures -some are shacks- and there is no electricity. There is no potable water either, it has to be brought in by truck, but sometimes the truck does not come as often as it should. There is no school in this community, and most of the children do not receive basic education since transportation to the closest town with school is too expensive and unreliable. When the rains come the area becomes flooded and access is difficult. Families are large (average five children but some have 10 and more), medical aid comes only once per year to provide vaccination to children. Women mentioned that they know about family planning, but when they go to the clinic for the pills, these are unavailable. They also would like to leave the area.

Land tenure has not been regularised; there is lack of job possibilities other than farming; lack of self confidence stemming from lack of government support; there is no agricultural extension support. People in this community are wary of the conservation status of Nariva, since they feel it will threaten their livelihood -they do not see it as beneficial-.

Additionally, several residents (all men) of Kernahan were asked to identify the main problems and very much coincided that in order of priority these were, (a) forest fires; (b) lack of potable water; (c) lack of rice drying sites; (d) bad price for rice; (e) diseases and thrips in vegetables during dry season; (f) no schools; (g) high unemployment; (h) their boundaries are set and are not sure what will happen with the community population increasing; (i) lack of electricity; (j) outsiders destroy fishes; (k) beach erosion from sea level rise; and (l) would like four local men to be hired as wildlife wardens by the Wildlife Section.

Brigand Hill - The connection between this community and the Nariva Swamp was only realised towards the very end of the team's field trip, and it was not possible to collect much information. It was not realised it was a separate community, since physically there is no clear distinction. Children attend school in Plum Mitan and women have their own organization, although they used to take (still do) part in the activities of the Plum Mitan

women's group.

Women in Plum Mitan and Brigand Hill communities, considered the following to be the main problems in the area, (a) high population growth; (b) over-exploitation of resources due to (a); (c) health; (d) education; (e) large farmers invasion; (f) no government support; (g) fires.

◆ **Exploitation and restoration of Nariva Swamp Ramsar site**

We observed on overflights of eastern Trinidad a great deal of forested areas, still. Fortunately, most of the watersheds of the Nariva and Bois Neuf Rivers are still forested. We saw no evidence of clear-cutting and conversion to pastures or crops in upland areas of these watersheds. Apparently the land use of major importance in these areas is cacao production, using natural forest as shade trees. Also, it was noticed that most harvest of wood is done selectively. We believe this practice to be very beneficial as it reduces the amount of sediment load in the rivers that ultimately would drop into the Nariva Swamp. Such sedimentation would destroy the marsh.

Squatting and land tenure - This is probably the most important issue relevant to the survival of the Nariva Swamp within the context of the Wise Use concept of the Ramsar Convention.

According to James (1992) much squatting and shifting agriculture have been occurring in recent times in Trinidad and Tobago.

The illegal squatting of the Nariva Swamp was recorded for the first time in the early 1980's. This has taken place mainly in the Bush Bush Wildlife Sanctuary (Wildlife Section, 1993), but also in other governmental lands within the Ramsar site limits.

By allowing several decades without land leasing assignment, the practice of squatting has developed strongly in the area, to the point that it has almost perpetuated **squatting as an accepted part of the culture**. It certainly is the most acute **problem at the social, psychological, legal and economic levels**.

In order to discuss adequately the issue of land tenure and squatting it seems necessary to clarify the differences between Plum Mitan Rice Scheme (usually referred to as Sector A), Biche Bois Neuf area (usually referred to as Sector B), Cocal and Kernahan.

**Plum Mitan Rice Scheme, Sector A** - Following the suggestion for development of the swamp provided by the FAO (1957) report, the Government of Trinidad and Tobago decided in the 1950's to start implementing the Plum Mitan Rice Scheme, which was reinforced by the rehabilitation study of NEDECO (1983, in Agristudio, 1991).

The soils in this area are ripened clay (NEDECO, 1983, in Agristudio, 1991), and adequate for rice growing.

The Plum Mitan Rice Scheme is meant to provide small land assignments (2 ha to 5 ha) to family farms. Some families have worked in this sector for several generations. At present there are approximately 75 families, of which only seven have regularised land tenure

(renewed each year), several have temporary leases and yet others have placed requests for regularization as much as ten years ago, but have received no answer so far. The Government is working at present on the regularisation of land tenure in this area.

In relation to the specific situation in Nariva, and referring to Plum Mitan Rice Scheme (Sector A), the Agristudio (1991) document indicates "the regularization of the land occupancy of these areas is...an issue of extreme importance which must be given the highest priority".

**Biche Bois Neuf, Sector B** - All farmers in the sector are squatting on state lands, and no agriculture scheme has been developed for it yet. An environmental impact assessment is to be carried out shortly, subject to the availability of funds, by the Ministry of Agriculture, Land and Marine Resources.

This is the most critical area in relation to squatting. Nobody seems to be in favour of past and present activities in this part of Nariva (except the squatters themselves). The general complaint was that these large farmers, squatting in this sector, had taken all the water (at least this year) and ruined many hectares of other farmers' crops, and also dried the natural marsh. The Sector B squatters continue to expand into the deeper parts of the marsh. At present there are eight units/holdings being farmed in this sector. Four units are operated by the Akaloo family, one unit is operated by six members of the Hosein family, and of the other three, two (Jabar and Bhagrattie) are encroaching the proposed National Park. None of the workers we met in these fields came from the Plum Mitan or Kernahan communities.

The western part of Sector B is dominated by ripened clay soils, which are good for rice farming but originally covered by forest, and the eastern sector is dominated by peat soils of which some are being claimed from the marsh, presently.

**Kernahan** - All lands in this area are State owned and outside the Ramsar site limits, however, farming activities (mainly rice and vegetables) are impacting the forest as well as the wetland.

**Cocal** - It was not possible to establish the present tenancy of the land along the sand bar between the Atlantic Ocean and the Nariva River. However, we gathered that part of it is private land, belonging to the Huggins State which also keeps cattle and buffalo. The remaining land is state-owned and it appears that only one farmer has been paying a rent for the use of the land and the rest are squatting on a seasonal basis (during the dry season for the watermelon crop).

Water management - Overall, with the development of the channelization of the Plum Mitan rice scheme since the 1950's, and **during the wet seasons**, the water coming into the flood plain has been **over-drained through the Petit-Pool Cut** out into the sea, provoking the premature drying of the marsh during the dry season (Prof Peter Bacon, pers comm). Also contributing to the excessive loss of water during the wet season is the **dilapidated state of irrigation structures** -along the Mainline Channel- that have to be left open at all times, because it is not possible to close them (during the wet season). Should it be possible to close these gates in the wet season (where the road crosses the Mainline Channel), the excess water would go down the Jagroma Cut into the marsh instead of being lost to sea.

Additionally, we observed that the **Jagroma Cut was deepened** to such a point that it is possible to pump the water back from the deepest part of the marsh (which can run west up the canal) up into the rice fields of Sector B. This virtual "pumping dry" of the Nariva swamp

by the farmers squatting on Sector B to complete their dry-season crop, left the marsh with absolutely no water in it at all anywhere. The result was the lowering of the water table to around 50 cm below soil surface in the deepest part of the marsh.

What we experienced was a very grave mis-management of water resources in the area, and efficient water management is the basis for any serious rice irrigation project -especially in years like 1995 when the Nariva Swamp was going through a very severe drought.

A major problem is the fact that there is not in operation a gravity feed system of irrigation water. Thus, everyone is pumping water whenever and wherever wanted with no control whatsoever. This situation is causing friction between farmers and will continue for years to come. The present system has contributed to the non-cooperation between farmers, and it is suspected that many disagreements and problems have resulted from this type of water management.

The Ministry of Agriculture, Land and Marine Resources recently obtained four large propeller pumps for use to improve the irrigation in the Plum Mitan Rice Scheme. The plans are to put one pump at the low end of Block IV where the Periphery Canal and the Mainline Channel converge. Water would be pumped during the dry season back up from the Petit-Pool Cut up the Mainline Channel to at least Block II. The main objective being that of holding the water table high enough for vegetable farming during the dry season on Blocks II, III and IV (Mr R Salandy, pers comm). It had not been decided yet where the other three pumps would be placed.

The Boat Canal is a natural estuary branch of the Nariva River close to its mouth at the beach which was illegally extended up into the southern part of Sector B a few years ago to raft out rice harvest down to the coastal road. Because of it, salt intrusion from the ocean into the crop and marshland in and around Sector B is a real threat. Excessive drainage of the marsh during wet season via this canal could also be a problem, but the studies being carried out at present by Prof Peter Bacon cannot show any results as yet.

Rice agricultural practices - The price of rice on the world market is increasing tremendously. Only 2% of world rice production is actually sold on the world market (Jim Rice, pers comm) and thus, most countries need to produce their internal demand.

In Trinidad and Tobago, total rice production has increased from 3 million lb in 1982, to 46 million lbs (wet weight) in 1993. Presently, Trinidad and Tobago produces only 25% of its internal demand for rice, and the rest is imported (mostly from Guyana and Surinam). Up until recently, this locally grown rice was milled only by National Flour Mills, Inc, with some of the profit used to help subsidize rice prices to local growers (Mr Victor, pers comm). Caroni (1975) Limited, a state-owned company, is the largest local rice producer with 1700 acres in dry-land rice and 2,000 acres in irrigated rice just south of Port-of-Spain and to the east of Caroni Swamp. This farm produces 15% of the local internal consumption. The 1995 harvest was severely affected by a drought with yields down by as much as 85%. Normal yields on this large mechanized farm are 3200 kg/ha on the average.

Apparently the rice industry in Trinidad and Tobago is not depressed, and that worldwide demands for rice are skyrocketing. Caroni was recently approached by a European company to buy 30 tons of rice crop. Apparently, Europeans are buying most of the Guyana national production and because of this, Trinidad and Tobago has difficulty importing rice from Guyana, or even Surinam.

Caroni has been laser-levelling parts of the area since 1989, but still has not adopted a water-seeded method and also applies two top-dressings of nitrogen by airplane. Thus, much extension work needs to be done even here on this largest of Trinidad and Tobago rice farms with respect to cultivation improvements to increase yields, lower the costs and reduce negative impacts on the environment (see Appendix I).

The newly established grading system put into place by National Flour Mills to establish the price given to rice brought in by farmers, does not seem to meet with the approval of most farmers. Before September 1994 all rice, no matter its quality, was bought at 89 cents (TT) /lb, the same price as Grade A rice at present. The new system establishes four grades with prices lowered for each lower grade :

- |   |                   |   |                   |
|---|-------------------|---|-------------------|
| - | Grade A = 0.89 TT | - | Grade B = 0.70 TT |
| - | Grade C = 0.45 TT | - | Grade D = 0.30 TT |

Many small farmers have been severely affected by this new system for rice prices. However, to reach Grade A, the rice grains must have 0% chalkiness and this is not possible due to the varieties available at present. The problem is that the available Colombian varieties will only produce 2% chalkiness at best, thus it is impossible to reach Grade A. The Colombian varieties also tend to produce blanks (unfilled grains) which also causes a penalty to farmers. And in addition, farmers are penalized for dockage (straw, etc.) in the rice.

The National Flour Mills seems to be doing really well at the moment because the Government subsidizes the price given to farmers (0.54 for Grade A; 0.38 for Grade B; 0.16 for Grade C; and 0.04 for Grade D). However, since any company can now import rice to Trinidad and Tobago, National Flour Mills will make less money on imports and have less to support the subsidies. The current divestment of National Flour Mills could be beneficial if enough rice growers buy stocks. The Government will retain 49% ownership. It is not clear how this will affect future prices for local farmers.

It would seem that at least on the world market basis, the prospect for rice production is bright. However, since only 2% of world production ever makes it to the world market, it is of great importance to increase the internal production of rice-producing nations. China and other Asian countries operate on only a 30-day reserve (JE Hill, pers comm), so if production drops there owing to climatic or other catastrophes, the resulting demand could make it almost impossible for Trinidad and Tobago to find rice to import.

**Average rice yields in Sector A** usually range from 100 to 165 hundredweights/ha (130 average). This is a comparable figure to Costa Rican small-scale farmers (M McCoy, pers obs). However, agricultural practices in Nariva area are very deficient for rice farming, having an **negative impact on the environment**.

In Nariva rice farming **costs are too high** and many farmers have complete crop failures due to **weeds, shortage of water and/or lack of machinery**. Several very grave problems were noticed in the fields in Nariva directly related to rice farming practices :

- **lack of laser-levelling** resulting in the necessity to use herbicides and other agrochemicals excessively;
- **lack of a good source of rice seed varieties** resulting in needed usage of fungicides and insecticides;
- **sluice gates are non-functioning** allowing much water to escape downstream, thus circumventing the marsh and contributing to its premature drying in summer.

Rice seed is not well controlled in Trinidad and Tobago, and most seeds are contaminated with weeds such as red rice or other wild rice types. Before the Crop Section of the Research Division of the Central Experimental Station in Centeno reduced its activities, most farmers could only obtain 100 lbs per farmer per crop cycle. At present, the rice program is no longer supplying seeds, but a number of farmers from elsewhere in the country are producing, with the help of Centeno, rice seed in three acre plots. The farmers in Nariva need to use part of their commercial harvest as seed for the next crop. Some farmers (even large-scale) have gone up to 12th generation rice for use as seed. The National Flour Mill sells back to the farmers part of their own harvest as seed, and apparently Caroni (1975) Limited sells 6th generation seed to the small farmers (instead of 5th generation certified seed). This is a very detrimental practice, as the rice degenerates with each successive generation and loses its resistance to diseases and insects. The result is negative to both the environment and the farmers since they use more pesticides unnecessarily and production undoubtedly is affected.

We were told by many people we interviewed that the Government of Trinidad and Tobago has pulled out most of its programs to stimulate rice production. New rice varieties from Colombia and Guyana used to be screened by Centeno, but recently this program was terminated. Apparently it is also very difficult trying to get foundation rice seed (3rd generation) or registered (4th generation) and even certified seed (5th generation) from the Centro Internacional de Agricultura Tropical (CIAT, International Centre for Tropical Agriculture) in Colombia.

It was evident the problems small farmers in Plum Mitan Rice Scheme and Kernahan must face because of **lack of harvesters** to harvest their rice. They must rely on the large farmers of Sector B and if they are busy with their own rice, then the small farmer can lose their harvest. If rice grain gets too dry in the field (<18% moisture) it will fracture more easily when harvested or when milled and then the farmer is penalized more at the rice mill and receives less income for his crop.

**Average rice yields in Sector B** are between 6 to 26 hundredweights/ha, considerably less than in Sector A. Agricultural rice practices in Sector B had the same environmental impacts as those in Sector A, plus the very negative effect of heavy machinery use and the fact that it is done where primary forest once grew (western part) and in the marsh (eastern part) where the soils are not favourable for rice cultivation. Account must be taken of the illegal squatting, the unscrupulous destruction of the Nariva Swamp by these farmers, and the socio-economic impact their activities have on the local communities.

Large-scale squatters of Sector B were observed disking two newly claimed sections of the marsh proper, to the east of the currently farmed rice fields in Sector B. The east boundary was less than 100 metres from the palm swamp forest, and therefore nearly cutting the marsh into a N and a S sections. This activity is going beyond the equilibrium between human activities and the conservation of the marsh. The procedure used by these illegal farmers is to dig a one metre deep ditch around a new section of marsh. The ditch spoils are placed on the marsh side of the ditch, and the water in this new section is pumped out into the marsh area. When dried out, the section is burned (which usually escapes into the surrounding marsh and forested areas) to eliminate marsh vegetation and to burn as much of the peat layer as possible. Then the peaty soil is disked and allowed to dry in the sun. Rice does not do well in peaty soils (the grains do not fill out), so this soil usually has to be disked and exposed to sun-drying during two dry seasons before enough of the peat is oxidized and destroyed by microorganisms before rice can be planted. This farmer was also deepening a ditch from the rice fields of Sector B out into the centre of the marsh proper, apparently to be able to drain his fields better in times of high water and to suck back marsh water to his

crops in the dry season.

Farmers in Sector A, at least, currently apply fertilizer using three to four top dressings of nitrogen (urea). Applications are usually done two weeks after planting, during mid-tillering (35 days after planting) and just before panicle initiation (50-60 days). Urea is usually applied to the water sheet. The problem with this method is that the urea dissolves in the water and has a hard time making it down into the soil. Once dissolved in the water, it is oxidized readily to  $\text{NO}_3^-$  and in this form is subject to leaching or drainage loss and can contaminate the swamp. Much is also converted to  $\text{NH}_3$  gas and lost to the atmosphere. Up to 40% of the nitrogen applied in this fashion is lost and not utilized by the rice plants. This increases production costs and potential contamination.

Also, phosphorus and potassium are applied at two weeks after seeding as a top dressing. This practice exacerbates the algae problem (if present).

Pesticides- Rice farmers in Nariva use "traditional" methods to control insect pests. Use of pyrethrin insecticides is common and the trend is to use stronger organophosphate insecticides when insects develop resistance to the less powerful pyrethrin chemicals. This method only leads to increased insect resistance overtime, and the need to use more powerful insecticides in a vicious circle. It is expensive to farmers and dangerous for humans and the environment.

Pests- Farmers at Plum Mitan acknowledged that **waterfowl** do attack recently planted rice seed, especially whistling ducks (*Dendrocygna autumnalis*), which is present in only small numbers. Another species attacking rice is the dickcissel (*Spiza americana*). The draining of the rice fields leaving shallow puddles, and the fact that rice is left on the surface of the soil, creates perfect conditions that whistling ducks seek for feeding. Also the fact that these ducks attack seeds at night makes it more difficult to control the damage. Farmers can lose a significant amount of recently planted seed by such waterfowl attacks. The fact that good seed is scarce, just makes matters worse. Some farmers in Costa Rica traditionally poisoned ducks by the thousands in an effort to control damage, but alternative methods that make poisoning a very unnecessary practice have been found (M McCoy, pers obs). No evidence of deliberate waterfowl poisoning in Nariva was found during the visit of the Ramsar team, and it hopefully should remain that way.

Other agricultural practices- The dry season is used by small farmers to plant cucumbers, squash and watermelons. The irrigation problems mentioned above and the water resource depletion by large squatters in Sector B, make rice farming by farmers in Sector A impossible at present.

It was not until the team saw a young couple out in the middle of the deepest part of the marsh (that was completely dry at the time) trying to produce a cucumber crop before the rains hit and would wipe out the crop, that it was realized how tremendous the need for agricultural land is in the Plum Mitan area. The fact that the marsh was completely dried out due to a severe drought and by the overuse of marsh water by the large farmers of Sector B, allowed this activity to occur in any part of the open marsh. But at least 30% of the marsh area that was still in native grass or shrubby vegetation was under squash or watermelon cultivation. Most of the marsh was being burned, either by these farmers or by the large farmers who were still reclaiming more marshland -for rice cultivation- while dry situations existed.

Apparently, one of the reasons for planting way out in the marsh is the loss of planting possibilities, since the large squatters arrival, in the area that is known as Sector B. Local farmers used to cultivate cucumber, squash and watermelon there, but they were pushed out by the large squatters and had nowhere else to go. Also they needed to plant in this lower area where the water table was close to the soil surface. In Sector B the water table has gone down too far to be able to plant in the dry season.

The major problem encountered by the small farmers growing cucumbers, squash and watermelon was a serious thrips infestation. This was being countered by insecticide usage, mostly pyrethrins, such as Karate. Holes were dug into the marsh floor and the water table appeared at about 50 cm. This water was used to apply insecticide with backpack sprayers and also to water young plants until roots hit the underlying saturated soil layer.

Another worrisome activity was the use of urea fertilizer at a rate of 5 to 7.5 sacks (100lb sacks) per hectare on these plantations directly in the marsh proper. Some farmers were also applying foliar fertilizers to crops in this area.

From our interviews with the small farmers, this activity can bring **substantial profits** and this is why so many were risking these plantings so far out in the marsh. One good rain would have wiped them all out.

It is not possible to assess the **effects of the dry season farming** activities in the marsh without field experience during the rainy season. On the one hand the cutting back of some of the dense shrubby vegetation probably has a beneficial effect when water level rises. Open water probably forms in these areas giving rise to floating vegetation. Such habitat is sorely needed in tropical seasonal marshes. When dry season starts and water levels drop, such areas convert to exposed soil with shallow, open water which is highly sought after habitat by waterfowl and wading waterbirds.

However, the use of urea fertilizer in the marsh proper is alarming and could give rise to a **proliferation of dense emergent vegetation** and ultimately destroy habitat preferred by waterfowl and wading waterbirds. One soil scientist at the University of the West Indies, Dr Gregory Gouveia (pers comm), however, felt that the levels of fertilizer being used were not excessive and that the crops were probably extracting most of that applied. But we believe that if early rains hit and forced abandonment of the crops then the fertilizer would be present to fuel plant succession. The potential damage will depend on the depth of the water over these plots. At 1.5 m or more the damage will be less due to the fact that most emergents do not do well in such deep water. But at shallower depths the fertilizer could fuel intense emergent development. Dense stands of tall emergents are the worst habitats for most waterfowl and wading waterbirds.

One farmer was successfully using a local "handsoap" solution sprayed by backpack sprayers, for example, while other farmers planted directly into cut vegetation, instead of burning it beforehand, to reduce thrips density and subsequent damage. Farmers complained of the **high prices for insecticides** and some had to apply insecticide every week during the crop.

One other problem these farmers have to face is the **price of seed**. Seed is imported from the USA to middlemen in Port-of-Spain. The price charged to local farmers was excessive.

Fires- James (1992) indicates that fires are serious and annual in various wetlands throughout the country, including Nariva. Some fires are set deliberately by squatters to clear

the land for rice or watermelon cultivation. **Fires** affect the feeding habitat for birds, invertebrates and fish, whose populations are devastated by them.

Abundant death and destruction to marsh organisms from these fires was observed. The fires swept into swamp forests around the marsh and caused a lot of damage. Fires would climb vines and burn out the tops of palms used by many species of birds such as the red-bellied macaws.

Fires in open marsh cause damage, mostly to snails, snakes, crabs, and other animals, but vegetation is not that affected. **Fires in wet forests, however, are devastating** to the vegetation and will take centuries to heal. Worse yet, if these forests are allowed to burn over 3-5 consecutive dry seasons, the forest will be virtually eliminated. Wet, swamp forests are very sensitive to fire.

Not all of the burnt forested areas lost all the trees, but openings were observed where most trees had fallen. Severe damage (50% tree loss) to seasonally inundated forest in Palo Verde National Park, Costa Rica by just one floor burn have been recorded (M McCoy, pers obs). The tree species present in this type of forest are not as resistant to fire as are the dry forest types.

The current drought conditions undoubtedly favoured the proliferation of fires observed. It was noticed during the overflight conducted by the team that forest fires in the Nariva area are a major problem. Fires, started in agricultural areas, swept out of control for weeks. Significant damage to forested areas adjacent to the open marsh area of Nariva Swamp was observed. At least 80% of the open marsh had been burned, and at least 30% of the forested areas within the proposed national park were also burned. On 4 May in the early morning, from the Brigand Hill Lighthouse, it was possible to count 10 fires in the area (five in the palm forest east of the open marsh, one near Sand Hill, one in an area east of Block I, and three in the open, deep marsh area). As the day progressed and air warmed up, fires became more active and abundant.

Very little active **fire control** by Forestry or Wildlife employees was noticed at this time and hopefully through training and support (in terms of equipment and institutional/legal support) more will be done in the future.

Other uses- Many of the **other resource use practices** observed, besides rice and vegetable farming, do not have such a negative impact, and some, such as the buffalo herding are quite beneficial. It was estimated from personal observations and by interviews that about 5,000 rural people are dependent on Nariva for their livelihood. After rice and vegetable farming, major uses include **duck hunting**, harvesting of **conch, blue and callaloo crabs, mangrove oysters and cascadura fish**, as well as some **water buffalo grazing**. Since most upland areas are planted to cacao under natural forest and not available for cultivation, a tremendous pressure exists to use the lowlands of Nariva.

Some local residents claimed harvests of 200 lb of conch meat per three-day harvest/acre every week during wet season in the marsh. Conch meat price is about 5-8 TT dollars/lb. Similar economic returns were reported for cascadura fish and blue crabs. There is very strong cultural affinity for cascadura fish in the Nariva area and it is truly treated as a delicacy.

**Forests and mangroves** are also resources for the local communities near Nariva. However, excessive forest felling and excessive mangrove bark extraction for use in the tanning

industry has placed the mature mangrove woodland along the Nariva River under considerable stress (James, 1992). Mangrove trees have been either felled or stripped standing.

Only two persons currently graze **water buffalo** in the area. One is on the sand strip between the Nariva River and the Atlantic Ocean, and the other, in the southern part of the marsh south of Bois Neuf Island, in the area known as the Black Water River.

The second person has grazed buffalo in the marsh for many years. Originally he kept his animals in Sectors A and B areas before they were planted to rice. He currently has 40 buffaloes and 60 holstein cows on about 80 ha (1.25/ha a density similar to that of Costa Rica) and has used this area for 10 years. When he had 65 adult buffaloes, he would produce about 15 calves/year which he sold at 18 months age with a weight of 200 lbs for 1500 TT dollars each. This was his major economic benefit from buffaloes, however he did use some milk for family consumption, but none to produce cheese.

We observed the effect of grazing of these cattle on the marsh as very beneficial. Apparently, ten years ago, there was very dense, heavy vegetation of *Phragmites*, wild tobacco (*Gynerium sp*) and three meter-high sedge, and there were few waterfowl or waterbirds. Buffaloes completely smash and open up the dense vegetation stands, and at present, the marsh vegetation is well open in the grazed area and many more birds are seen during the wet season. While this could not be confirmed by the team (visiting the site in the dry season only), the report coincides with the general pattern found in seasonal, freshwater marshes in the tropics. It should also be noted that there are several Ramsar sites with a history of some form of grazing.

A fire started near where the buffalo were grazing while the team was visiting the site. Some members of the group (Mr B Boodhai and his two assistants, M McCoy and Reynaldo Phillips - of National Parks Division) worked hard trying to get this fire out for over two hours and were able to stop it mostly because of the grazing that had been done before by the buffaloes. Had grazing not occurred in the area it would not have been possible to get this fire out.

There is already a cultural tradition of the raising and care of water buffalo in Trinidad and Tobago. The existing herd in the country is estimated at 5,000 head (Kassie 1995). To the surprise of some, there is no better animal on the planet to create waterfowl and wading waterbird habitat in shallow, seasonal, freshwater tropical marshes.

The use of water buffaloes during centuries at the seasonal marsh at Bharatpur (Keoladeo National Park Ramsar Site), India created an excellent habitat for waterfowl and wading waterbirds. When the marsh was declared a national park in 1980 the buffalo were forcibly removed with the resulted overgrowing of marsh vegetation and the loss of habitat for birds (Ali and Vijayan 1986). A very similar situation occurred at exactly the same time at the Palo Verde Marsh in Guanacaste, Costa Rica, but this time with cows (McCoy 1994, McCoy and Rodríguez 1994).

## V CONCLUSION AND RECOMMENDATIONS

Nariva Swamp and the communities surrounding it present a good opportunity for an exercise in co-management and wise use of natural resources. This area could, if properly handled, and adequately managed, become a showcase for the region, specially the Caribbean.

If the wise use concept is applied throughout, and community participation is encouraged, it will be possible to restore the ecological character of the Nariva Swamp and provide socio-economic development for the communities adjacent to it.

Implementing this option would ensure the conservation of the ecological character of a unique natural resource, and provide the rural communities with much needed social and economic development, education and training opportunities. But for this to happen, research has to be conducted to fill in information gaps; there has to be an integrated strategic planning with the participation of all sectors concerned (Government, NGO's, local communities, universities, private enterprises); a feasible management plan has to be drawn up; and infrastructure, social development and training have to take place. These, in turn, will require national will and cooperation; integrated multi-sector and interdisciplinary work; structures and methodologies that promote participation and will give a sense of pride and ownership, which will be translated into care for the resource; and international support.

### ◆ On institutional, education and community issues

#### Institutional

- It is recommended that the work of the **National Wetland Committee** be strongly supported by all those concerned with water and wetland issues, both at the Government level and by the NGO community.

- It is recommended that the National Wetland Committee should seek the **active participation** of all organisations involved in water and wetland issues still not represented in it (eg. Ministries of Health, Education, and Community Development, the Agriculture Development Bank, the Caribbean Industrial Research Institute -CARIRI, affiliated to the University of the West Indies, UWI-, Caroni (1975) Limited, the Central Experimental Station in Centeno, the Small Business Development Co, among others).

- It is recommended that the National Wetland Committee start becoming more active and **address specific field issues** such as conservation and development in Nariva Swamp Ramsar Site. In this respect a **Nariva Task Force** could be established with representatives from the different sectors involved in the National Wetlands Committee and with a role to play in the development and conservation of Nariva.

- Additionally, and **foremost**, it is recommended that the Nariva Task Force also include **representatives (not just observers) from each of the communities** surrounding the Ramsar site, Plum Mitán, Brigand Hill, Biche, Cocal, Kernahan and Cascadoo, at least.

- It is strongly recommended that the **Forestry Division, have an improved and stronger presence** in the Nariva Swamp Ramsar Site to carry out patrolling, fire control, extension, environmental education, enforcement, etc.

#### Education and training

- It is recommended that the National Wetland Committee with the help of specialised institutions such as the UWI and the IMA, carry out **educational workshops for decision-makers**, lawyers, magistrates, legislators about the worth and the potential of wetlands in general -and Nariva in particular- and about the need for integrated development plans that consider the holistic relationship between the human communities surrounding the wetland and the ecosystem. These workshops should include field trips.

- It is recommended that workshops and seminars are carried out to **promote the wise use of wetlands concept** and the role of the Ramsar Convention in the conservation of wetlands and water resources. These should be done with the full participation of all pertinent institutions, from the government sector, NGO's, University, and others, and addressed to professionals (or future ones) working in the conservation field, such as park rangers, administrators of protected areas, university students -specially at the post-graduate level-.

- It is recommended that **wetland conservation and wise use** in general -and Nariva in particular- be included in the **educational curricula**, through work of the National Wetland Committee in conjunction with the Ministry of Education.

- It is highly recommended that the opportunity for **further training** is given to many young talents with potential to become Trinidad and Tobago's experts in wetland management techniques.

- It is recommended that at least two **MALMR field coordinators** are trained and then assigned for at least five years to Nariva to : (a) promote co-management in the area; (b) identify local persons for training; and (c) facilitate the relationship between the Government institutions, NGO's and local communities. It is considered that potential expertise exists in Trinidad and Tobago for undertaking this role.

- It is recommended that at least **three extension officers** (eg. in rice and vegetables, and in water buffalo) are trained and assigned to Nariva for at least five years to ensure the implementation of the Ramsar recommendations. These persons would have to be special people who can adapt to local conditions, live in the area and work closely with the communities.

- It is recommended that the communities surrounding the Nariva Swamp receive **training in community development, participation and organisation**.

#### Management planning

- It is **highly recommended** that a **detailed management plan**, such as that recently developed for the Tempisque Conservation Area in Guanacaste, Costa Rica (Vaughan *et al*, 1995) should be made for the Nariva Swamp Ramsar site that also includes surrounding state and private lands acting as a buffer zone. This plan should strive to strike a balance on the optimum methods to ensure the existence and prosperity of all wild organisms in the area in

concordance with the wise use and sustainable development by rural communities of both the cultivated and wildland areas involved. The management plan should analyze the needs, opportunities, constraints and limitations of the area in a participatory manner in a participatory exercise including all sectors concerned. And it should examine all existing development proposals for the area, in the light of the current environmental, social and economic situation in Trinidad and Tobago.

- It is highly recommended that an **economic evaluation** of the Nariva Swamp Ramsar Site and surrounding areas be carried out as soon as possible.

- It is recommended that an **environmental impact assessment or an integrated environmental management procedure** be carried out in relation to Sector B, but taking into consideration environmental, social and economic issues, and the entire catchment area of the Nariva Swamp. Special attention should be given to the water resource use (hydrology and hydraulics).

- It is **very strongly recommended that a revision and modification of the conservation status of the Nariva Swamp Ramsar Site and the boundaries** of the areas under different categories of protection/management is carried out as soon as possible. Some suggestions are provided (see Map 3) based on the Ramsar team visit, interviews and analysis of existing documentation. Should the category of National Park allow for some degree of human use, then the marshlands east of Sector A and B could be included inside the proposed park boundaries. Should it not be possible, it would be better to place this area under a category whose objectives are compatible with vegetation manipulation to favour certain species of wildlife and wise use of resources by local inhabitants. Generally speaking, such activities are not allowed inside national parks on a world scale. The establishment and maintenance of waterfowl and wading waterbird habitat generally requires grazing and/or the application of disturbance factors to set back vegetative succession and create open water and exposed soil conditions. Wise use by local inhabitants could include controlled harvest of fish, molluscs, and crustaceans, as well as buffalo grazing. This activity must be done without delay since it is necessary to provide the framework for all the other actions recommended in this report.

### Communities

- It is recommended that a **workshop is held with the communities to present the Ramsar recommendations** of the Monitoring Procedure and ask them for the feedback they are entitled to as main contributors to it.

- It is recommended that a **socio-economic study** of the communities surrounding Nariva is carried out to identify their requirements for support in capacity building and institutional strengthening, the capacity of the land to sustain them all, and other economic possibilities -such as wise use of forest and swamp products, etc. NGO's and UWI are best suited for providing the link and support needed to empower and facilitate the "coming of age" of the communities.

- It is recommended that an **integrated development plan for the communities** needs to be drawn up immediately with their full participation, in order to establish their need for infrastructure, health services, education and training, economic development possibilities, and the value of their environment and how to relate to it in such a way that will guarantee not only their living standards but also their quality of life. Until an integrated development of the communities exists and the participation of the communities in the management of the

site is real, the conservation of the Nariva Swamp will not be possible.

- It is recommended that personnel of government institutions as well as NGO's are **trained to work with local communities**, to learn how to involve the community and facilitate their being part of the conservation effort for the area rather than forbid them to hunt, fish, etc. in an always enforcement style.

- It is recommended that **local persons are identified** and hired by the MALMR to carry out some of the patrolling, conservation and fire control responsibilities. Being residents of the area, they know the problems and the residents better and would be better suited to help solve them. It would also provide some employment.

- It is recommended that **better promotion is made at the communities level of the training centres** available in Trinidad and Tobago, related -for example- to wise use alternatives for agriculture, farming and fishing, community development, management of protected areas and small business. Grants or scholarships should be provided for local people participation in these courses. They would become multiplying agents for these concepts and technologies in their community.

- It is recommended that, since the Government of Trinidad and Tobago is, according to its Strategic Plan 1990-94, committed to the development of eco-tourism as one of the pillars of its economy, and if **eco-tourism** is to be considered for the Nariva area, it **should be done with the full participation and for the benefit of the local communities**. The socio-economic impact of this proposed activity and the local resident's needs in terms of development, training and education should be analyzed and addressed before any actions are undertaken.

◆ **On the exploitation and restoration of Nariva Swamp Ramsar Site**

Land tenure

- It is highly recommended that the **land tenure situation in Sector A of Plum Mitan Rice Scheme, and in Kernahan be resolved immediately** in a manner that recognises and helps those farmers/families that have been in the area for many years and whose farming practices are having a minimal impact on the swamp environment. This is the basis for any type of agricultural development and preference should be given to local inhabitants of the area that have no lands of their own.

- It is recommended that, should the environmental impact assessment of **Sector B** indicate the possibility of farming, this land **should be distributed to local inhabitants** interested in farming and in most need for land/jobs, specially those using the marsh in the summer for growing vegetables.

- It is recommended that, once land regularization has been achieved, **extension work start immediately** on issues such as rice varieties, agrochemicals, biological control of pests. This should be done with the involvement of the many institutions and individuals working in these subjects within the wise use concept (Centeno, UWI, etc).

Water issues

- It is highly recommended that a **hydrologic and hydraulic study is urgently carried out**, in order to establish the impact any type of water management in the catchment area of the Nariva Swamp would have in the conservation of the site, the agriculture and needs of the communities which depend on it.

- It is recommended that in **Sector A, a system of controlled irrigation and drainage** must be put into place. This should be controlled by one person who objectively and fairly distributes (or drains) water, deciding when, where and for how long pumps should be used in any part of Sector A. If a gravity system is ever put into place, then individual sluice gates with padlocks must be put on each entrance of water into every individual farmer's plot. Again, the controller should be the only one who could move the sluice gates.

This is the only way that there is to manage water in a small farmers ag-reform project. From the problems of cooperation that exist in this area (cultural) we do not think individual farmers can objectively open and close off water to their plots. A properly controlled water management system can, on the contrary, help to unify and organize these small-scale farmers, and reduce conflicts.

- It is recommended that **the MALMR's initiative to find a solution for dry season cropping at Plum Mitan** be continued and supported, and that some improvements (as indicated in Appendix I) be explored.

- It is recommended that **all farmers should be charged a fee to help pay for the pumping cost.**

- It is recommended that one or more **reservoirs or micro-dams** be constructed upstream along the rivers that feed into the Nariva Swamp, should the hydrology and hydraulic studies agree. This should help hold back water, that is being lost now, for irrigation purposes when needed. It will also allow for sediment loads to be reduced before this water can enter the Nariva Marsh.

- It is recommended that the entrance to the **Jagroma Cut also be dammed** to allow the water level to reach field level at this uppermost point of Sector A. Then water could be distributed by gravity and not need to be pumped, which is expensive.

- It is recommended that **the possibility of increasing the capacity of the Navet and the Mini Dams** be explored, since (according to the director of water operations of the Navet Dam) the construction of an additional level on top of both dams had been planned for in their original construction plans. This extra water could be used for irrigation.

- It is recommended that **rice farmers in Sector A should use the water-seeded method** of planting which uses the least amount of water since no drainage is allowed. However, any water that is drained should be recycled back up the Mainline Channel.

- It is recommended that in **Sector B all farming activities should be temporarily halted** until the result of the Environmental Impact Assessment is made public and until an appropriate water management program can be developed in Sector A.

- It is recommended that **Sector B should only be planted if excess water exists from Sector A** or if the hydrology and hydraulic studies indicate that a reservoir upstream can be

made that can supply water.

- It is recommended that the **environmental impact assessment for Sector B considers the previous recommendation**, i.e. that the use of water for farming in Sector B can only be approved if it can be shown that there is an excess of water -apart from that needed by Sector A and by the natural marsh-. Priority should be given the marsh, then Sector A and then Sector B.
- It is recommended, as an **alternative**, that in **Sector B** during the **wet season**, permanent water sheets from rainfall -**only for rice cultivation**- could be used.
- It is recommended that if Sector B is to be farmed in the future, it would be better that its drainage **water not run directly into the Nariva Swamp** or down the Jagroma Cut into the marsh. Any water coming down the Jagroma Cut, that will eventually run into the Nariva Marsh should be clean water from the upstream rivers and reservoirs.
- It is recommended that **only a certain amount of marsh water is used**. This will give the marsh an even more important value to farmers and will stimulate their interest in the conservation of this marsh even more than they do now.
- It is recommended that the **boat canal be blocked** at its original initiation point so that both problems can be solved.
- It is highly recommended that the **salt intrusion studies by Prof Peter Bacon** should be continued and this information used to monitor the situation. The results of these studies are extremely important in the light of predicted sea level rise as a result of global warming.

#### Agriculture practices

- It is recommended that the **highly-clay soils** of Sector A and part of B are better suited for rice irrigation, more than for any other type of crop, and could be put into **rice usage** (for map of soils see NEDECO 1983, Fig 4). Highly-clay soils are better for irrigation as less water escapes from this type of soil.
- It is recommended that the **Central Experimental Station in Centeno** provide **new varieties of rice to small legal farmers**. If new varieties were available each year then, less need would exist to use insecticides and fungicides.
- It is recommended that **small legal farmers selected from the Nariva area get training in Centeno as to how to produce good rice seed**.
- It is recommended that methods should be looked into on how to **eliminate the middlemen in the vegetables seed** buying process. Local seed should be produced in the future.
- It is recommended that an **exchange of the most progressive farmers** from Nariva and Guanacaste (Costa Rica) be promoted, specially those using the water-seeded method of rice cultivation.

### Government involvement

- It is recommended that, since this is a land reform project undertaken on State lands, the **Government should take a much more active role** in the proper management of the land and the project. Specially giving more support to the small farmers.
- It is recommended that the government seeks **international loans** to set up this agriculture (including rice) and resource use scheme in the context of the Wise Use principle.
- It is recommended that the present loan system of 12% from **ADB** should be **continued** and expanded.
- It is recommended that the **Government should not discourage rice-growing**. It is imperative that Trinidad and Tobago grow as much rice as environmentally compatible to supply internal demand. This demand will continue to increase.
- It is recommended that the **Government consider entering the rice breeding program of the CIAT** in Colombia.
- It is recommended that the Government of Trinidad and Tobago **support and encourage water buffalo operations by local farmers**.

### Rice Mills

- It is recommended that **more rice mills are set up**. At present all farmers are at the mercy of the only one in existence. It is very important to have several mills available to farmers, to stimulate competition and to assure a more just system.
- It is recommended that **rice should be cleaned of dockage at the mill**, in exchange for a small fee to the farmer, since it would be for the benefit of the farmer and easier for farmers and mill. This would eliminate the penalty charged to farmers currently when they bring in rice with dockage.

### Agrochemicals

- It is recommended that **mechanical means are used to eliminate weeds** in rice fields, instead of chemical. This is accomplished by using at the same time a water-seeded method of rice planting (Hill *et al*, 1992) that was developed in California, USA in the 1970's, which also contributes to many other advantages. See Appendix I.
- It is recommended that, **if rice is grown free of pesticides**, then farmers should tap into the growing market for organically grown rice (in Europe and North America) which gets a much better price than non-organic rice.
- It is recommended that **active research** is applied immediately on a biological control solution for **thrip** insects on vegetables, and insect pests in rice.

### Machinery

- It is recommended that a solution be found for the harvesting of rice on the legal operation of Sector A. Maybe through **loans of harvesters by the Government**, until some local farmers are financially able to acquire some. In Costa Rica, the European Community provides some harvesters and operators to small-scale farmers every harvest. A similar project should be looked into for Plum Mitan.
- It is recommended that the possibility of using the **small-scale harvesters** (cutters and threshers) **developed by CARIRI** a few years ago, be explored. Since some farmers only have one or two hectares, such a harvest method is highly feasible.
- It is recommended that **CARIRI's small-scale, hand-operated cultivators** (for cultivation and soil preparation) be investigated for use in Nariva. Some small scale farmers have tractors and rototillers, but there is still a lack of machinery.
- It is recommended that the **Government stimulates the use of such small-scale machinery** by use of low-interest loans to individuals or organized cooperatives.
- It is recommended that **harvesters used by the illegal farmers in Sector B** should remain in Nariva for sharing by all small legal farmers.
- It is recommended that **small farmers get organised** and obtain equipment as a group since it would be more economically feasible because of the extremely small plots per family in Sector A.

### Restoration and pilot projects

- It is recommended that **the marsh proper should not be farmed**. Summer vegetable farmers using the marsh at present should be given plots (subject to the findings of the EIA) in the east half of Sector B, east of the wide north-south central drain-irrigation canal (see Map 3). Here the water table should still be close enough to the surface to allow for vegetable farming.
- It is strongly recommended that **any farming at the Sector B level eastward, towards the palm forest, be absolutely halted and restored back to marsh**. The ditches must be filled back in, and any area with peaty upper layer should remain as marsh. (See Map 1 for location of the two sections of marsh being claimed by illegal farmers at the Sector B level in May 1995)
- It is recommended that a **restoration project** is started as soon as possible, with the involvement of external consultants and taking into consideration the various recommendation made in this report regarding especially community participation and the Wise Use concepts.
- It is recommended that **small-scale pilot projects be started at Nariva with organic rice and water buffalo** (cheese production). At first small projects, with the most progressive farmers, should be started, and through "show and tell" activities, convince the other farmers of the methods being used.

Water buffalo

- It is recommended that **water buffalo herds** should be kept and/or developed **south of Bois Neuf and in the polder sector just to the east of Sector A** and to the north of Sand Hill. Part of the forest in the southern part of the proposed Nariva National Park and part Sand Hill could be used to hold animals during high water. A dairy should also be developed on Sand Hill. If water levels become too deep during the wet season a section of the eastern part of Sector B (see Map 3) should be used to hold the animals from the Sector A herb. Electric fencing should be used to hold animals in the designated grazing areas. The success of such a project will depend on the presence of a permanent extensionist-social worker to get things organized, funded and going on the ground.
- It is recommended that **a pilot project be initiated** with interested local inhabitants both from the different communities surrounding the Nariva Swamp.
- It is recommended that **at least part of the Nariva Swamp** (see Map 3) should be subjected to grazing by **water buffaloes** to open up the vegetation and to improve habitat for manatee, fish, waterfowl and wading waterbirds. An economic return can be obtained by local inhabitants through meat, milk and cheese production.
- It is recommended that **water buffalo herds be monitored** to identify any modifications, in terms of numbers of heads and grazing sites, that need to be made in order to improve the restoration of the marsh to its original (sustainable use period) ecological character.
- It is recommended that **training on cheese making and marketing** is provided to those water buffalo farmers in the area.

Other uses

- It is recommended that **studies are carried out to determine optimum harvest levels** for natural populations of conch, fish and crab, and aquaculture potential.
- It is recommended that **the use of palm and other forest products** for fuel, food and thatching **be studied and quantified**. The feasibility of starting pilot plantation and reforestation projects with local species should be considered.
- It is recommended that the **unsustainable use** of the Nariva Swamp **be stopped** through financial and personnel empowerment of the Forestry Service (Wildlife Division, National Parks, etc) for efficient control and enforcement. This unsustainable use is referred to fishing and hunting primarily.
- It is recommended that **local residents are trained** and enroled to aid the Forestry Division in the patrolling and enforcement of the protected area.
- It is recommended that the Wildlife Section makes available (through extension and training) to the inhabitants of Nariva Swamp its **program for captive breeding of wildlife species**, in order to reduce hunting pressure and to provide economic development opportunities.

Fires

- It is strongly recommended that **fire must be prevented and completely eliminated from forested parts** of the Nariva Swamp. These areas should be given priority over open marshland.
- It is recommended that rice farmers be shown the **correct methods for burning rice straw** after harvests.
- It is further and highly recommended that the **Forestry's Division Fire Program assists farmers, with the presence of officials**, burn their fields in the correct manner (with firebreaks, burn against the wind and only at early morning, late afternoon or at night).
- It is recommended that much effort be put forth by the **Forestry's Division Fire Program in education of local inhabitants** about fire and how and when to use it as a tool, when fire is bad for the environment, and the risks involved.
- It is recommended that the **Forestry's Division Fire Program improves its fire operations** with more equipment and trained personnel. Use of **local volunteers** has not been taken advantage of yet, either.
- It is very strongly recommended that **more Forestry Division personnel are trained on fire issues** and how to deal with them. Support should be sought for Forestry Division personnel to visit Costa Rica at the Tempisque or the Guanacaste Conservation Areas to learn from their experience with fire control.

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## **VII ACKNOWLEDGEMENTS**

The Ramsar Bureau would like to extend its thanks to the Ministry of Agriculture, Land and Marine Resources, its Forestry Division and Wildlife Section, especially, for coordinating the Monitoring Procedure mission.

The Bureau is also very grateful to the many institutions, organizations and individuals which facilitated and/or participated in the field visit to Nariva Swamp and in the meetings and office interviews, as well as in subsequent correspondence. The Monitoring Procedure team wishes to place on record its appreciation of the efforts made to ensure efficient use of the very limited time available.

It would be impossible not to forget some names (specially since one of our field note-books got lost !), but we are very grateful to all the institutions and people mentioned in our itinerary Appendix H, and apologise for any omission made unwillingly.

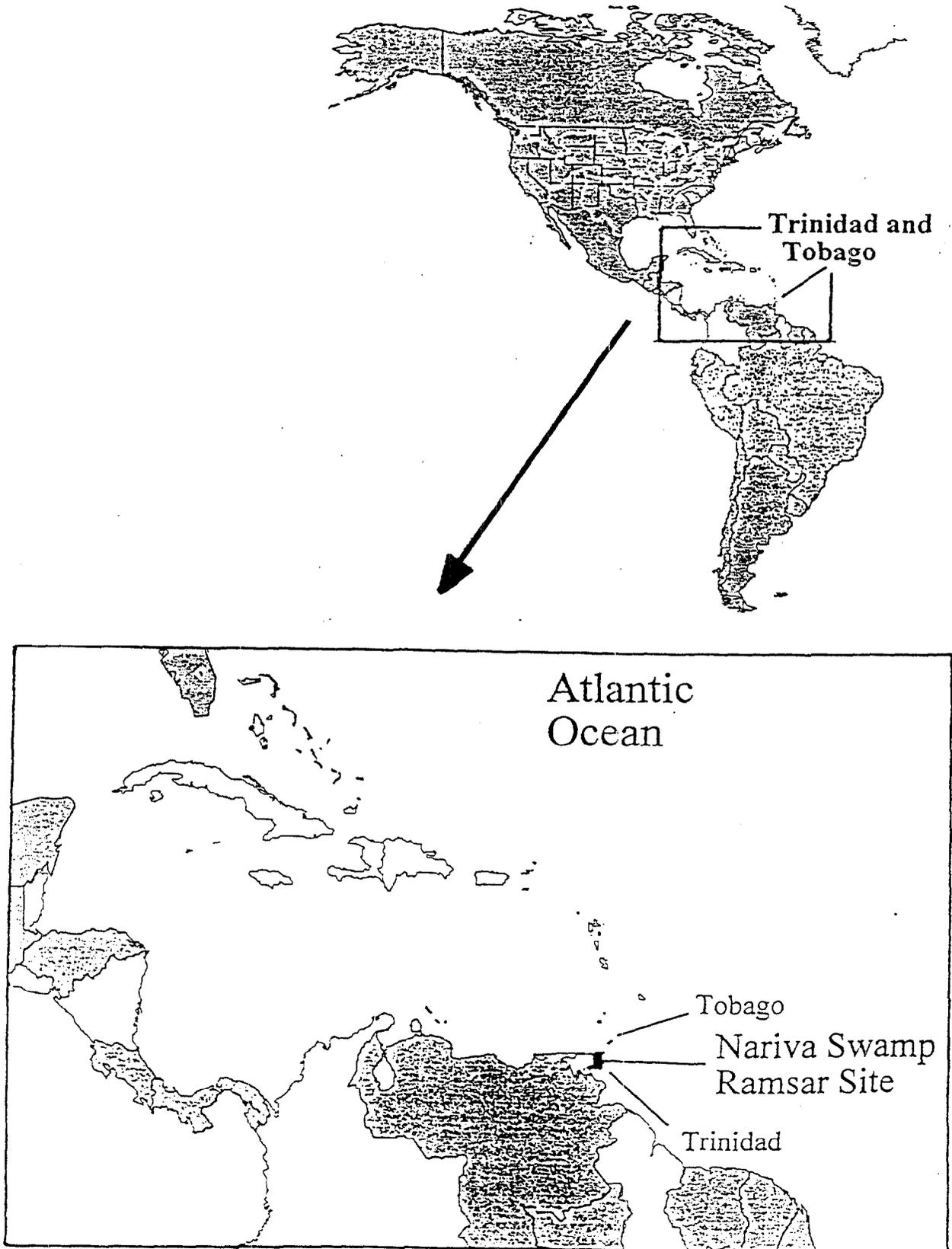
We are specially grateful to the people of Plum Mitan, Brigand Hill, Kernahan and Cocal for their enormous assistance during our field work, their warmth and hospitality.

## VIII MAPS

- ◆ 1 ◆ Neotropical and North American Regions, and location of Nariva Swamp Ramsar Site
- ◆ 2 ◆ Nariva Swamp Ramsar Site, Land Use, December 1995
- ◆ 3 ◆ Nariva Swamp Ramsar Site, Recommended Zonification of Land Use, by Ramsar team, December 1995

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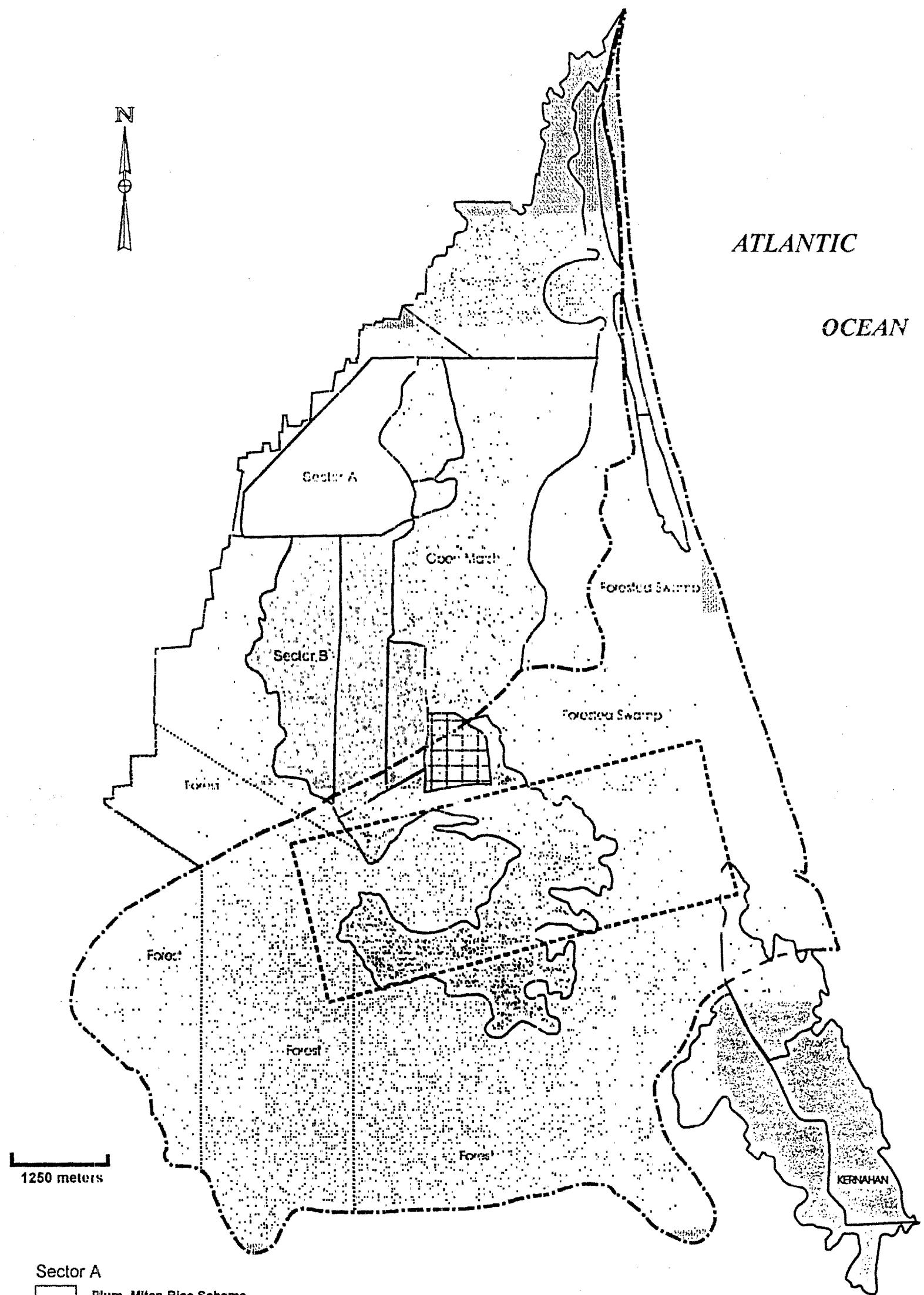
Map 1. Neotropical and North American Regions, and location of Nariva Swamp Ramsar Site



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ATLANTIC  
OCEAN



1250 meters

**Sector A**

-  Plum-Mitan Rice Scheme
-  Rice fields on State Lands adjacent to Sector A

**Sector B**

-  Land currently squatted by large-scale rice farmers

**Marsh**

-  Open marshland with short emergent or floating vegetation
-  Marshland currently burned and disked for future rice cultivation

**Swamp**

**Cocal**

-  State Lands farmed by small-scale vegetable farmers and grazed by cattle

**Kernahan**

-  Small-scale farming community. Rice, vegetables and buffalo grazing

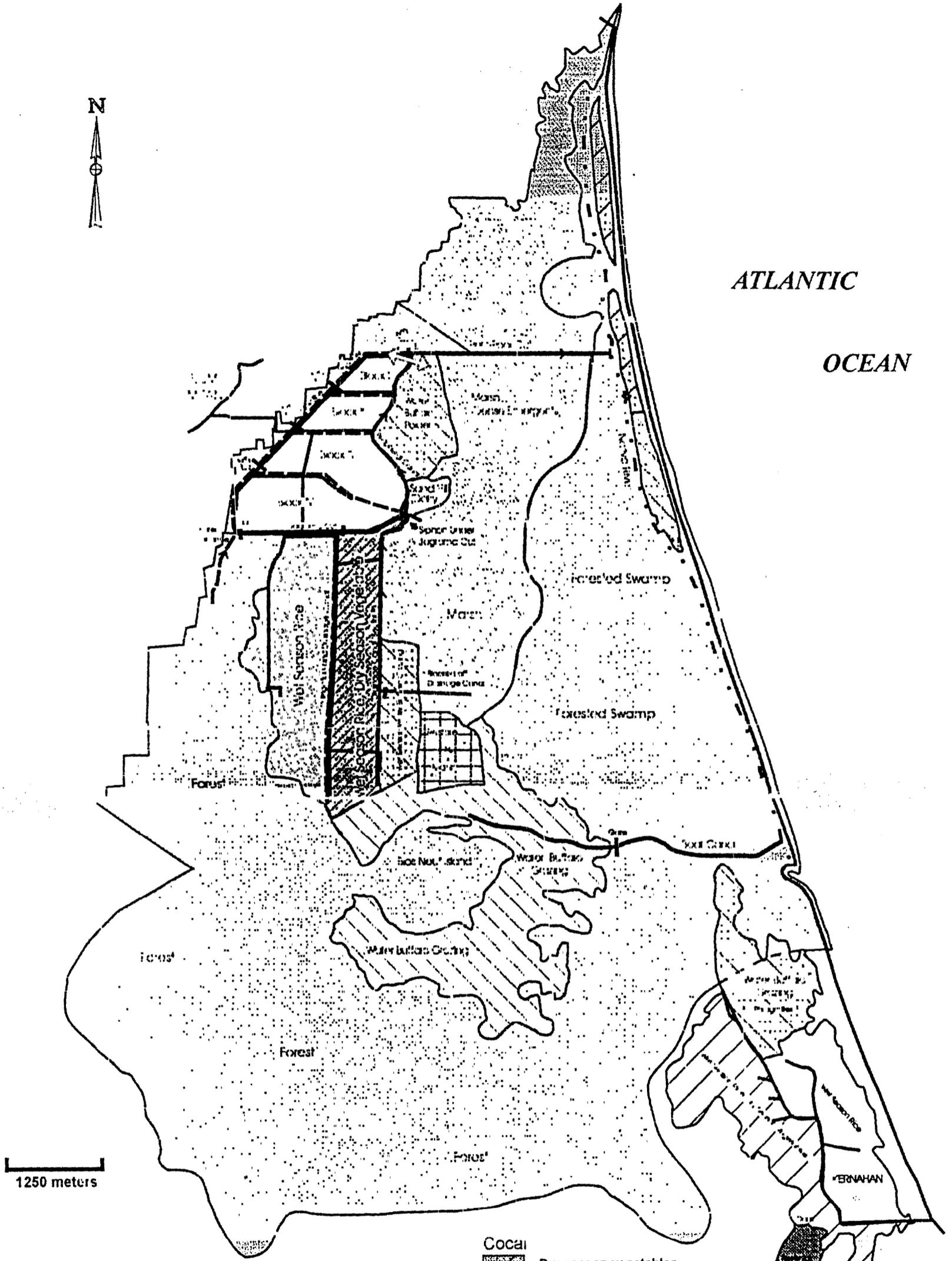
-  Proposed Nariva Swamp National Park

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ATLANTIC

OCEAN



1250 meters

**Sector A**

-  Plum- Mitan Rice Scheme
-  Rice fields on State Lands adjacent to Sector A

**Sector B**

-  Wet season rice (Biche Bois Nuef Area), dry season fallow
-  Wet season rice, dry season vegetables

**Marsh (Proposed Multiple-Use Wildland Area)**

-  Open marsh
-  Water buffalo grazing on open marsh
-  Water buffalo grazing on restored marsh (former rice)

**Cocal**

-  Dry season vegetables
-  Water buffalo grazing

**Kernahan**

-  Wet season rice, dry season fallow
-  Wet season rice, dry season vegetables
-  Water buffalo grazing

-  Large, propeller irrigation pumps
-  Canal gates
-  Irrigation canal
-  Drainage canal
-  Roads

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## **IX APPENDICES**

- ◆ A ◆ Text of the Convention on Wetlands (Ramsar -Iran, 1971)
- ◆ B ◆ Main obligations of Ramsar Contracting Parties
- ◆ C ◆ Montreux Record (Annex to Resolution C.5.4)
- ◆ D ◆ Monitoring Procedure (Recommendation C.4.7, Annex 1)
- ◆ E ◆ Criteria for identifying wetlands of international importance (Recommendation C.4.2, Annex 1)
- ◆ F ◆ Scott & Carbonell (1986) Nariva Swamp data sheet
- ◆ G ◆ Jones (1993) Nariva Swamp data sheet
- ◆ H ◆ Itinerary of Monitoring Procedure Mission
- ◆ I ◆ Sustainable rice farming methods and Wise Use of Nariva Swamp

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**Appendix A**

**Text of the Convention on Wetlands  
Ramsar, Iran -1971**

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**Convention on Wetlands of International Importance  
especially as Waterfowl Habitat**

**Ramsar, 2.2.1971  
as amended by the Protocol of 3.12.1982  
and the Amendments of 28.5.1987**

Certified copy

Paris, 13 July 1994.

Director, Office of International Standards and Legal Affairs  
United Nations Educational, Scientific and Cultural Organization (UNESCO)

*M. Penkoni*



Appendix B

**Main obligations of Ramsar Contracting Parties**

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### Obligations of Contracting Parties

The principal obligations of States which join Ramsar are:

- To designate at least one wetland of international importance for the Ramsar "List of Wetlands of International Importance" (Article 2.1), and to promote the conservation of listed wetlands (Article 3.1).
- To formulate and implement planning so as to make 'wise use' of wetlands, whether or not they are included in the List (Article 3.1); the last Conference of the Contracting Parties approved guidelines on how to achieve wise use.
- To consult with other Contracting Parties about implementation of the Convention, especially as regards transfrontier wetlands, shared water systems, shared species, and development aid for wetland projects.
- To establish wetland reserves and provide for their wardening.

National contributions to the Convention budget are based on the UN scale of assessment. The budget for the current triennium is SFr. 2.3 million per annum.

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Appendix C

**Montreux Record  
Recommendation C.4.8 (Rev) and Resolution C.5.4**

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CONVENTION ON WETLANDS OF INTERNATIONAL IMPORTANCE  
ESPECIALLY AS WATERFOWL HABITAT

Fourth Meeting of the Conference of the Contracting Parties  
27 June to 4 July 1990  
Montreux, Switzerland

RECOMMENDATION ON CHANGE IN ECOLOGICAL CHARACTER OF RAMSAR SITES

RECALLING that Contracting Parties "designate suitable wetlands within their territory for inclusion in a List of Wetlands of International Importance" (Article 2.1), "formulate and implement their planning so as to promote the conservation of the wetlands included in the List" (Article 3.1) and inform the Bureau "if the ecological character of any wetland in (their) territory and included in the List has changed, is changing, or is likely to change as the result of technological developments, pollution or other human interference" (Article 3.2);

EMPHASIZING the fundamental importance of maintaining ecological character of listed sites;

REFERRING to Conference document DOC. C.3.6 of the Third Meeting of the Conference of the Contracting Parties which identifies Ramsar sites that have incurred damage, and Recommendation 3.9 of the Conference of the Contracting Parties which calls upon the Contracting Parties concerned to report to the Bureau on actions taken to safeguard these sites;

NOTING the information on Ramsar sites whose ecological character has changed, is changing or is likely to change, as provided by Contracting Parties to the Fourth Meeting of the Contracting Parties, and summarized in document DOC. C.4.18;

THE CONFERENCE OF THE CONTRACTING PARTIES

REQUESTS that Contracting Parties, in whose territory are located sites which have incurred or are being threatened by change in ecological character, to take swift and effective action to prevent or remedy such changes;

INSTRUCTS the Convention Bureau, in consultation with the Contracting Party concerned, to maintain a record of Ramsar sites where such changes in ecological character have occurred, are occurring or are likely to occur, and to distinguish between sites where preventive or remedial action has not as yet been identified, and those where the Contracting Party has indicated its intention to take preventive or remedial action or has already initiated such action; and

FURTHER INSTRUCTS the Convention Bureau to give priority to application of the Ramsar Monitoring Procedure, within the limits of budgetary constraints, at sites included in this record.

CONVENTION ON WETLANDS OF INTERNATIONAL IMPORTANCE  
ESPECIALLY AS WATERFOWL HABITAT

Fifth Meeting of the Conference of the Contracting Parties  
Kushiro, Japan : 9-16 June 1993

RESOLUTION ON THE RECORD OF RAMSAR SITES WHERE CHANGES  
IN ECOLOGICAL CHARACTER HAVE OCCURRED, ARE OCCURRING,  
OR ARE LIKELY TO OCCUR ('MONTREUX RECORD')

RECALLING that Contracting Parties 'designate suitable wetlands within (their) territory for inclusion in a List of Wetlands of International Importance' (Article 2.1), 'formulate and implement their planning so as to promote the conservation of wetlands included in the List' (Article 3.1), and inform the Convention Bureau 'if the ecological character of any wetland in (their) territory and included in the List has changed, is changing, or is likely to change as the result of technological development, pollution, or other human interference' (Article 3.2);

FURTHER RECALLING that Recommendation 4.8 adopted by the Fourth Meeting of the Conference of the Contracting Parties instructed the Convention Bureau, in consultation with each Contracting Party concerned, 'to maintain a record of Ramsar sites where such changes in ecological character have occurred, are occurring, or are likely to occur';

RECOGNIZING the value of such a record in identifying priorities for the Monitoring Procedure, the Wetland Conservation Fund, and other financial mechanisms;

DRAWING ATTENTION to Resolution RES. C.5.5 ('Establishment of a Scientific and Technical Review Panel');

THE CONFERENCE OF THE CONTRACTING PARTIES

DECIDES that the record established by Recommendation 4.8. should generally be referred to as the 'Montreux Record', although its full title ('Record of Ramsar sites where changes in ecological character have occurred, are occurring, or are likely to occur') should be retained as a subheading for use in formal documents;

DETERMINES that the purpose of the Montreux Record is to identify priority sites for positive national and international conservation attention, to guide implementation of the Monitoring Procedure, and to guide allocation of resources available under financial mechanisms;

INSTRUCTS the Convention Bureau to maintain the Montreux Record as part of the Ramsar database and in accordance with the guidelines appended in the annex to the present Resolution; and

Appendix D

**Monitoring Procedure  
Recommendation C.4.7, Annex 1**

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CONVENTION ON WETLANDS OF INTERNATIONAL IMPORTANCE  
ESPECIALLY AS WATERFOWL HABITAT

Fourth Meeting of the Conference of the Contracting Parties  
27 June to 4 July 1990  
Montreux, Switzerland

MECHANISMS FOR IMPROVED APPLICATION  
OF THE RAMSAR CONVENTION

RECALLING that the Ramsar Monitoring Procedure was established by the Standing Committee at its first meeting after the Regina Conference, in order to give effect to Recommendation 3.9 on Change in ecological character of Ramsar sites;

ACKNOWLEDGING with gratitude the special funding provided for operation of the Monitoring Procedure both by Contracting Parties and by non-governmental organizations, and the many expressions of support for the Monitoring Procedure at the present meeting;

EMPHASIZING the need, as the Ramsar List grows, for the Convention to have a small but effective database, using a standardized data sheet and wetland classification, as provided for in Recommendation 2.3 adopted at the second meeting of the Conference in Groningen;

EXPRESSING its thanks to the Contracting Parties which provided expertise and finance for development and implementation of the database;

THE CONFERENCE OF THE CONTRACTING PARTIES

ENDORSES the measure taken by the Standing Committee to establish a Ramsar Monitoring Procedure (the revised text of which is appended as Annex 1 to the present Recommendation), and instructs the Bureau to continue to operate this procedure when it receives information on adverse, or likely adverse changes in ecological character at Ramsar sites;

DETERMINES that Monitoring Procedure reports shall be public documents once the Contracting Party concerned has had an opportunity to study the reports and comment on them;

RECOMMENDS that the data sheet developed for the description of Ramsar sites (the text of which is appended as Annex 2 Part A to the present Recommendation) be used by Contracting Parties and the Bureau in presenting information for the Ramsar database, and as appropriate in other contexts;

FURTHER RECOMMENDS that the classification system for "wetland type" developed for the description of Ramsar sites (the text of which is appended as Annex 2 Part B to the present Recommendation) be used by Contracting Parties and the Bureau in presenting information for the Ramsar database and as appropriate for other purposes; and

REQUESTS the Standing Committee to oversee the application of the Monitoring Procedure and the use of the database and classification system for "wetland type", and to investigate the need for a Convention Scientific Committee, which would review the above matters and other questions as appropriate.

MONITORING PROCEDURE

1. It comes to the attention of the Bureau that the ecological character of a listed wetland is changing or is likely to change as a result of technological development, pollution or other human interference.
2. Where appropriate, the Bureau shall propose to the Contracting Party or Parties concerned to apply the Monitoring Procedure, requesting, at the same time, additional information on the status of the wetland concerned.
3. Where, as a result of this procedure and other information available to the Bureau, the Bureau is of the opinion that there is evidence of significant change or likely change in the ecological character of a listed wetland, the Bureau shall collaborate with the Contracting Party or Parties concerned to arrive at an acceptable solution and the Bureau may offer advice and assistance to that Party or those Parties, if required. The Bureau shall inform the Standing Committee of any action it has taken in this connection.
4. If it does not appear that an acceptable solution can be readily achieved, the Bureau shall immediately bring the matter to the attention of the Standing Committee. The Standing Committee, acting through the Chairman and Secretary, provided by the Bureau, may pursue the matter, in direct contact with the Contracting Party or Parties concerned and, where appropriate, with other responsible agencies or bodies, with a view to helping to find a solution.
5. In the event of alterations to the List or changes in ecological character in wetlands included therein, the Standing Committee shall arrange for the information to be circulated for discussion at the next Meeting of the Conference of the Contracting Parties in accordance with Article 8 paragraph 2 (d) of the Convention.
6. The Bureau shall periodically review and report progress on the conservation status of sites to which its attention has been drawn under this procedure. To facilitate follow-up, the Bureau shall maintain a register of activities undertaken in this connection.

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Appendix E

**Criteria for identifying wetlands of international importance  
Recommendation C.4.2 (Rev) Annex I**

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CRITERIA FOR IDENTIFYING WETLANDS OF INTERNATIONAL IMPORTANCE

Introduction

Article 2.1 of the Convention states that "Each Contracting Party shall designate suitable wetlands within its territory for inclusion in a "List of Wetlands of International Importance". The guidance provided by the Convention text on identification of "wetlands of international importance" is in Article 2.2, which refers to "international significance in terms of ecology, botany, zoology, limnology or hydrology" and indicates that "In the first instance, wetlands of international importance to waterfowl at any season should be included". The Criteria set out below, which have been approved by the Conference of the Contracting Parties, are for identifying wetlands of international importance.

Criteria

A wetland is identified as being of international importance if it meets at least one of the criteria set out below:

1. Criteria for representative or unique wetlands

A wetland should be considered internationally important if:

- (a) it is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biogeographical region;
- or (b) it is a particularly good representative example of a natural or near-natural wetland, common to more than one biogeographical region;
- or (c) it is a particularly good representative example of a wetland, which plays a substantial hydrological, biological or ecological role in the natural functioning of a major river basin or coastal system, especially where it is located in a trans-border position;
- or (d) it is an example of a specific type of wetland, rare or unusual in the appropriate biogeographical region.

2. General criteria based on plants or animals

A wetland should be considered internationally important if:

- (a) it supports an appreciable assemblage of rare, vulnerable or endangered species or subspecies of plant or animal, or an appreciable number of individuals of any one or more of these species;
- or (b) it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna;

- or (c) it is of special value as the habitat of plants or animals at a critical stage of their biological cycle;
- or (d) it is of special value for one or more endemic plant or animal species or communities.

### 3. Specific Criteria Based on Waterfowl

A wetland should be considered internationally important if:

- (a) it regularly supports 20,000 waterfowl;
- or (b) it regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity or diversity;
- or (c) where data on populations are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.

#### Guidelines for Application of the Criteria

To assist Contracting Parties in assessing the suitability of wetlands for inclusion on the List of Wetlands of International Importance, the Conference of the Contracting Parties has formulated the following guidelines for application of the Criteria:

- (a) A wetland could be considered of international importance under Criterion 1 if, because of its outstanding role in natural, biological, ecological or hydrological systems, it is of substantial value in supporting human communities dependent on the wetland. In this context, such support would include:

- provision of food, fibre or fuel;
- or maintenance of cultural values;
- or support of food chains, water quality, flood control or climatic stability.

The support, in all its aspects, should remain within the framework of sustainable use and habitat conservation, and should not change the ecological character of the wetland.

- or (b) A wetland could be considered of international importance under Criterion 1, 2 or 3 if it conforms to additional guidelines developed at regional (e.g. Scandinavian or West African) or national level. Elaboration of such regional or national guidelines may be especially appropriate:
  - where particular groups of animals (other than waterfowl) or plants are considered more suitable as a basis for evaluation;
  - or where waterfowl and other animals do not occur in large concentrations (particularly in northern latitudes); .

- or where collection of data is difficult (particularly in very large countries).

or (c) The "particular groups of waterfowl, indicative of wetland values, productivity or diversity" in Criterion 3(b) include any of the following:

- loons or divers: Gaviidae;
- grebes: Podicipedidae;
- cormorants: Phalacrocoracidae
- pelicans: Pelecanidae
- herons, bitterns, storks, ibises and spoonbills: Ciconiiformes;
- swans, geese and ducks (wildfowl): Anatidae;
- wetland related raptors: Accipitriformes and Falconiformes
- cranes: Gruidae
- shorebirds or waders: Charadrii; and
- terns: Sternidae.

or (d) The specific criteria based on waterfowl numbers will apply to wetlands of varying size in different Contracting Parties. While it is impossible to give precise guidance on the size of an area in which these numbers may occur, wetlands identified as being of international importance under Criterion 3 should form an ecological unit, and may thus be made up of one big area or a group of smaller wetlands. Consideration may also be given to turnover of waterfowl at migration periods, so that a cumulative total is reached, if such data are available.

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Appendix F

**Nariva Swamp data sheet  
Scott & Carbonell (1986)**

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# **A DIRECTORY OF NEOTROPICAL WETLANDS**

Compiled by

**Derek A. Scott and Montserrat Carbonell**

for the

**Canadian Wildlife Service**

**Ducks Unlimited, Incorporated**

**International Council for Bird Preservation (ICBP)**

**International Union for Conservation of Nature and  
Natural Resources (IUCN)**

**International Waterfowl Research Bureau (IWRB)**

**United States Fish and Wildlife Service**

**Wildfowl Foundation, Incorporated**

**World Wildlife Fund (WWF)**

## Nariva Swamp (6)

**Location:** 10°23'N, 61°04'W; 16 km SSE of Sangre Grande, on the east coast of Trinidad.

**Area:** 6,234 ha.

**Altitude:** 0-10m.

**Province and type:** 8.4.1; 07, 08, 09, 13, 16 & 18.

**Site description:** A permanent brackish lagoon with extensive mangrove swamps, separated from the sea by two parallel sand bars, and a large area of fresh to brackish swamps, swamp forest and seasonally flooded marshes. The level of the lagoon is influenced by the tides by way of river channels and possibly subsurface seepage; salinities range from 4-25 p.p.t. The area includes the largest freshwater herbaceous swamp in Trinidad. The seasonal marshes flood to a depth of 1m between June and November, leaving islands of higher ground with humid tropical forest.

**Principal vegetation:** Beach scrub with *Coccoloba* sp; mangrove swamps with *Rhizophora mangle* and *Avicennia germinans*; permanent herbaceous swamps with *Montrichardia arborescens* and *Cyperus giganteus*; marshes with *Eleocharis mutata*, *Cyperus giganteus*, *C. odoratus* and *Phragmites* sp; swamp forest with *Pterocarpus officinalis*, *Carapa* sp and *Bactris* sp; and islands of humid tropical forest with *Roystonea oleracea*, *Mauritia setigera* and *Euterpe oleracea*.

**Land tenure:** Almost entirely state owned, with 6.1 ha under private ownership.

**Protection:** 1,554 ha of forested high ground jutting out into the swamp are protected in the Bush Bush Game Sanctuary, established in 1968, and 40 ha are included within the Ortoire Nariva Windbelt Forest Reserve. The remainder of the area and thus almost all of the wetland habitat is unprotected.

**Land use:** Agriculture, grazing of livestock, forestry, hunting, fishing, bird trapping for the pet trade, and recreation.

**Waterfowl:** An important area for a variety of waterfowl including *Anhinga anhinga*, several Ardeidae, *Dendrocygna autumnalis*, *Aramus guarauna* and *Jacana jacana*.

**Other fauna:** Over 170 species of birds have been recorded in the swamp. The Blue and Yellow Macaw *Ara ararauna* formerly occurred, but now appears to have been exterminated as a result of excessive trapping for the pet trade. *Ara manilata* is still fairly numerous. Mammals include the manatee *Trichechus manatus*, *Cebus albifrons* and *Alouatta seniculus*; and reptiles include *Caiman crocodilus* and *Eunectes murinus*. The wetland supports a large population of the catfish *Hoplosternum littorale*, which forms the basis of a thriving fishery. Crabs include *Cardisoma guanhumi*, *Ucides cordatus* and *Aratus pisonii*, and the freshwater conch *Pomacea urcens* occurs.

**Threats:** Many threats have been identified including illegal squatting; the reclamation of land for agriculture and clandestine cultivation of cannabis; illegal grazing of domestic livestock in the Game Sanctuary; exploitation of the forests for timber; overfishing; illegal hunting including the use of gun-traps; and excessive trapping of birds for the pet trade.

**Research and conservation:** Because of the uniqueness of the physical conditions, the wetland supports a diverse fauna and flora with many species which are found nowhere else in Trinidad. The swamp has significant potential for research, education and recreation, and some studies have already been made on the biological resources. It has been proposed that the entire area be made into a Wildlife Sanctuary or National Park, and that it be designated a Ramsar Site when the Government ratifies that Convention.

**References:** Bacon *et al* 1979; Ramcharan (1980 & 1984); Thelen & Faizool (1980; IUCN (1982); Lambert (1983); French & Ramcharan (1984).

**Source:** Carol James, Nadra Nathai-Gyan, Geddes Hislop and Eugene K. Ramcharan.

**Criteria for inclusion:** 123.

Appendix G

**Nariva Swamp data sheet  
Jones (1993)**

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CONVENTION ON WETLANDS OF INTERNATIONAL IMPORTANCE  
ESPECIALLY AS WATERFOWL HABITAT (Ramsar, 1971)

## Directory of Wetlands of International Importance

Sites designated for the Ramsar List  
of Wetlands of International Importance

Part Four: Neotropics & North America

Compiler

Tim Jones, Ramsar Liaison Officer  
International Waterfowl & Wetlands Research Bureau

for the  
Fifth Meeting of the Conference of the Contracting Parties to the  
Ramsar Convention  
Kushiro, Japan, June 1993

Ramsar Convention Bureau  
May 1993

## TRINIDAD & TOBAGO

**Area:** 5,128 sq.km

**Population:** 1,240,000 (1988 estimate)

**Date of entry into force of Convention:** 21 April 1993

**Date Paris Protocol accepted:** 21 December 1992

**Date Regina amendments accepted:** 21 December 1992

**Sites designated under the Convention (up to 1 March 1993):**

1. Nariva Swamp

**Total area of Ramsar sites:** 6,234ha

**Administrative Authority responsible for implementing the Convention:**

Ministry of Agriculture, Lands and Marine Resources  
St Clair Circle  
Port of Spain  
TRINIDAD

**Note:** At the time of going to press, the information contained in the site accounts which follow had not received final approval from the Administrative Authority concerned.

## 1. Nariva Swamp

Geographical Coordinates 10°23'N 61°04'W

Area 6,234ha

Location Approximately 50km south-east of the city of Port of Spain, on the east coast of Trinidad.

Date of Ramsar Designation 21 December 1992.

Other International Designations None.

National Designations Forest Reserve<sup>P</sup> (40ha); Wildlife Sanctuary<sup>P</sup> (1,544ha).

**Principal Features** An extensive complex of freshwater swamp forest (*Pterocarpus officinalis*, *Carapa* sp. and *Baccharis* sp.), permanent herbaceous swamp, seasonally flooded marshes and mangrove forest (*Rhizophora mangle*). Nariva supports an important fishery; substantial catches of *Hoplosternum littorale* are taken annually from the swamp, providing a livelihood for many fishermen. The area supports a rich fauna; common or important birds include *Ardea herodias*, *Egretta alba*, *E. thula*, *Bubulcus ibis*, *Butorides striatus*, *Dendrocygna autumnalis*, *Aramus guarauna*, *Gallinula martinica*, *Jacana jacana*, *Milvago chimachima*, *Buteogallus meridionalis*, *Ara ararauna* (at least highly endangered; probably extinct, as a result of loss of food supply and trapping) and *Spiza americana*. Amongst mammals present within the site are *Alouatta seniculus*, *Cebus albifrons*, *Agouti paca* and *Trichechus manatus* (endangered), while reptiles include *Caiman sclerops* and *Iguana iguana*. (1a,2a,2b,3b)

**Conservation Issues** Almost entirely state owned. Management of wetlands in Trinidad and Tobago focuses largely on resource protection under the Forests Act, the Conservation of Wildlife Act and the State Lands Act; offences taken to court are usually related to wildlife poaching. However, this has not been entirely successful and encroachment by squatters has occurred at Nariva. Substantial portions of Nariva Swamp have been clear-felled for rice, water-melon and marijuana production, with consequent destruction of wetland resources. Agriculture is unsustainable in these areas which are constantly abandoned after a few years in favour of newly cleared land. Other problems are the illegal felling of mangroves in order to supply bark to the tanning industry, the killing of manatees *Trichechus manatus* through blocking of water courses for fishing, and unsustainable levels of crab and oyster harvesting. Nariva also receives runoff contaminated with pesticides and herbicides from surrounding agricultural areas.

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Appendix H

**Itinerary of Monitoring Procedure Team**

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Wednesday, 26 April 1995

- Arrival of team

Thursday, 27 April 1995

- Visits to :  
Wildlife Section  
Forestry Division

Friday, 28 April 1995

- Visits to :  
Land and Surveys Division to buy maps and aerial photos.  
National Wetland Committee meeting, to present Ramsar and the Monitoring Procedure and presentations by Lirio Marquez and Mike McCoy about their work in Puerto Rico and Costa Rica, respectively. Present during this meeting, chaired by Mr Selwyn Dardaine, were representatives from the following institutions :
  - o Wildlife Section (Forestry Division, MALMR)
  - o National Parks Section (Forestry Division, MALMR)
  - o Fisheries Division (MALMR)
  - o Town and Country Planning Division (MPD)
  - o Fisheries
  - o University of the West Indies
  - o Point-a-Pierre Wildfowl Trust
  - o Ms Sylvia Kacal (non-government)

Saturday, 29 April 1995

- Field visit to Nariva Swamp to carry out a quick survey of the area to become acquainted with the problems and issues expressed in the Terms of Reference by the government of Trinidad and Tobago. Ramsar team was accompanied by Mr Selwyn Dardaine, Ms Nadra Nathai-Gyan, Ms Karlyn Shephard, Ms Sylvia Kacal, Mr Motilal Lal, Mr Mahadeo Maharaj, Mr Roopnarine Singh, Mr Glenn Seebarsingh, Mr Reynaldo Phillips, Ms Vanessa Ramrattan, Mr Ashook Maharaj, Mr David Boodoo.

Sunday, 30 April 1995

- Aerial survey of Nariva, and establishment of field base in Sangre Grande.

Monday, 1 May 1995 through Sunday, 7 May 1995

- Field work at Nariva Swamp and surroundings, which included :
  - the community of Plum Mitan
  - the community of Kernahan
  - the community of Cocal
  - Plum Mitan Rice Scheme (Sector A)
  - Biche Bois Neuf Area (Sector B)
  - Sand Hill and swamp south of it
  - southern sector of Bush Bush Wildlife Sanctuary
  - the Nariva River
  - the Cocal sand barrier and buffalo farm
  - Brigand Hill

Monday, 8 May 1995

- Visits to :
  - Flour Mill Company (Mr Victor)
  - Caroni (1975) Limited (Mr Horatio Bankay)
  - Planning Section (Ms Jackie Farrell)
  - North Regional Office (MALMR) (Mr R Salandy)
  - Lands Surveys
  - Ministry of Legal Affairs

Tuesday, 9 May 1995

- Visits to :
  - Dr Keith Rowley, Honourable Minister (MALMR)
  - Mr W Ruthven Rudder, Permanent Secretary (MALMR)
  - Institute of Marine Affairs, Chaguaramas (Mr Gerard Alleng)
  - National Wetland Committee meeting, to report on field work done at Nariva Swamp, attended by representatives of :
    - Wildlife Section (Forestry Division, MALMR)
    - National Parks Section (Forestry Division, MALMR)
    - Planning
    - Fisheries
    - University of the West Indies
    - Point-a-Pierre Wildfowl Trust
    - Ms Sylvia Kacal (non-governmental)
  - NGO's meeting, to report on field work at Nariva Swamp, attended by representatives of :
    - University of the West Indies
    - Caribbean Forest Conservation Association
    - UWI Biological Society
    - Dept of Wildlife Ecology, Univ of Wisconsin
    - Field Naturalists Club of Trinidad and Tobago
    - Point-a-Pierre Wildfowl Trust
    - Trinidad and Tobago Biological Society

- Pearl & Dean (Caribbean) Ltd
- Trinidad Guardian

Wednesday, 10 May 1995

- MC leaves Trinidad and Tobago
- LM & MMC visits to :
  - North Regional Office (MALMR) (Mr R Salandy)
  - University of the West Indies (Dr G Gouveia, soil scientist)
  - Caribbean Industrial Research Institute (CARIRI)

Thursday, 11 May 1995

- LM & MMC visits to :
  - Point-a-Pierre Wildfowl Trust
  - Caroni Marsh
  - telephone interview with the Director of the Water Operations of the Navet Dam (WASA)

Friday, 12 May 1995

- MMC leaves Trinidad and Tobago

Saturday, 13 May 1995

- LM leaves Trinidad and Tobago

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Appendix I

**Methods for rice farming with low environmental impact and  
wise use of Nariva Swamp Ramsar Site**

taken from Mike McCoy's report  
to be read with Map 3

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## **Methods for rice farming with low environmental impact and wise use of Nariva Swamp Ramsar Site**

The production of irrigated rice in close proximity to natural marshes can be a very compatible human activity with the natural environment. Irrigated rice culture is probably the one crop that provides more seasonal habitat to wildlife than any other commercial crop. Waterfowl, large wading waterbirds, fish, crustaceans and molluscs can benefit tremendously from this activity if it is done in an environmental friendly way, and following many of the practices described in this document. No doubt the 100 to 165 hundredweights/ha produced by local farmers in Sector A can be improved by almost 40% with better cultivation techniques.

It is possible to grow irrigated rice with no need for pesticide usage. However, in order to do this, fields need to be level, and a permanent water sheet employed which will eliminate, or severely reduce, the need for herbicide usage. The use of the permanent water sheet can also decrease nitrogen application by 40%, a tremendous savings to farmers, and reduce nutrient contamination of the Nariva Swamp. Disease and insect resistance is best solved by a readily available source of new rice varieties. This can only be accomplished by a dedicated government or privately-funded rice research effort, that needs to be developed in-country. Also the presence of an intelligently managed rice project adjacent to a major natural marsh system can ultimately enhance the biodiversity of the area since some waterfowl and waterbirds can benefit from the presence of some disturbed areas that produce exposed soil, open, shallow water and the first stages of plant succession. At the same time a sustainable livelihood can be obtained for the communities nearby.

The main problem of the Nariva Swamp -and of the rice farmers- is the excess of water during the rainy season and the lack of it during the dry season. This problem is strongly accentuated because of the very wrong use of water that has been taking place in the area.

The presence of this large marsh adjacent to the rice project (Sector A specially) and an adequate water management put into place could also guarantee a second rice crop during the dry season through irrigation of the fields.

**PLEASE NOTE :** While most of the methods and recommendations made herewith are referred to the Plum Mitan Rice Scheme, they can also be applied in Kernahan and elsewhere. It must be made very clear that they do not refer to Sector B since the Monitoring Procedure team feels very strongly about the need not only of an **environmental impact assessment** of this area, but also a **management plan** for the entire area of the Nariva Swamp (to be carried out as soon as possible) including a careful analysis of the potential (or not) for farming in Sector B. It is only possible to say -at this moment in time, and with the experience gained during the team's visit- that the environmental impact assessment and the management plan **must take into consideration** the fact that Sector B should only be planted if excess water exists from Sector A or if a reservoir upstream can be made that can supply water. The other alternative, during wet season, is the use of permanent water sheets from rainfall only for rice cultivation in Sector B.

### **Water issues, drainage and irrigation in Sector A**

**Rainy season.** If farmers adopt the water-seeded method of rice planting, almost 100% of water needs during the wet season could be met just by rainfall. Farmers would not be

draining all the water off and therefore, the water sheets can be maintained by rainfall if gates are closed at the lower end of each rice check.

Excess water from additional rainfall can be allowed to overflow the upper surface of each gate to maintain the same level of water permanently during the crop cycle. However, any water that is drained should be recycled back up the Mainline Channel, if possible during low rainfall periods.

This system of using a permanent water sheet, drastically reduces water demands on the irrigation system. Farmers probably would not need to do much pumping from irrigation canals into their fields if rainfall is normal, which could mean significant savings.

**If Sector B is farmed in the future** its drainage water must not run directly into the Nariva Swamp or down the Jagroma Cut into the marsh. Drainage water should be collected into the north-south drain along the eastern perimeter and then go under the Jagroma Cut by siphon and connect to the Periphery Canal. Any water coming down the Jagroma Cut and/or into the Nariva Swamp must be clean water from the upstream rivers and reservoirs.

Dry season. The solution found by the MALMR (Mr R Salandy, pers comm) for dry season cropping at Plum Mitan is the right one, however we would like to add an observation. With four propeller pumps available, it might be possible to get water even up to Block I and enough not only for the water table, but enough to grow irrigated rice with water sheets.

This would involve putting **one pump at the low point** where now planned, but with provisions for being able to also pump water both into and from the Nariva Swamp just east of the Periphery Canal. We believe this scheme is highly feasible since the difference in elevation between high and low points of Sector A is only about 2.5 meters (according to Ministry topo maps).

During the wet season if the marsh is low on water, water should be pumped from this low point of the Mainline Channel out into the marsh. Water should be preferably from the Mainline Channel with little drainage water from rice fields in order to minimize contamination of the marsh with pesticides and nutrients. The marsh should be kept as full as possible to assure a surplus amount of water during dry season for irrigation, and to counteract salt infiltration from the sea.

It is advisable to widen and build higher embankments on each side (specially the south side, and not allowed to have breaks in it) of the **Petit-Pool Cut**, and to build a gate at its outlet. During the onset of the dry season the Petit-Pool Cut should be closed with the objective of holding the cut full of water. This will ensure the highest level of water in the marsh by the onset of the dry season. It is possible that the marsh is lacking in water now because of escape through this south bank of the Petit-Pool Cut during wet season.

Another gate must be constructed at the end of the **Mainline Channel** near the low point pump. Then water from the Petit-Pool Cut can be back-pumped back up the Mainline Channel. The other three pumps should be spaced along the Mainline Channel with the objective of backing up water to the high point of Block I where the Jagroma Cut starts. It will be necessary to construct a series of gates or have the existent ones repaired, in order to allow back-pumping and holding of water. Thus all of Sector A should have access to gravity-fed irrigation water.

The Nariva Marsh should be holding an excess of water at the onset of dry season, from the pumping of water into it during the wet season at the low point pump. So in the dry season

a certain amount of marsh water could also be back-pumped up the Mainline Channel to help meet irrigation needs.

When, during the dry season, the water level of the marsh reaches a certain minimum critical point, then the pumping of marsh water should cease. However, at least 80% of the marsh area should be allowed to dry out by the onset of the rainy season as a measure to set back plant succession and increase the marsh productivity. From interviews with older residents, this is about how much of the marsh normally dries out during the dry season.

In order to help cover the pumping costs, all farmers could be charged a fee.

### Weed control

The most important step, as indicated above is to establish an adequate **water management scheme** that will allow farmers to maintain control and use a permanent water sheet of 8-10 cm over the soil. Followed by a 0° slope **laser levelling** of all plots in order to get rid of all low and high areas in the fields. With the completion of these two phases farmers will need to use virtually no herbicides -if they use the **water-seeding method**, planting into the water sheet and not draining it, and allowing rice to emerge through the water sheet.

Precautions with the water-seeded method. Some precautions must be made for when using this method. Algae may start to develop on the soil surface under the water sheet right after planting, and if not treated, it will grow, start to break apart during the mid-day sun, float to the top of the water, and dislodge seeds and seedlings from the soil surface, diminishing the density of rooted seedlings. To avoid this, an application is needed of 11 to 15 kg/ha of CuSO<sub>4</sub> (medium-sized crystals) into the water sheet, no later than one week after planting. Also one must be careful not to leave too much time between application of the water sheet and planting. If it takes a long time to get the water sheet established (more than two days), due to lack of water for instance, then one should apply the copper sulphate before planting, when the algae are just visible in its formation on the soil surface under the water.

The other major caution would be during dry season water-seeding if trade winds are strong and create a lot of wave action on the water sheet. If waves are excessive, then seeds can be moved underwater and piled up against dikes. Also, young seedlings can be thrashed about and ultimately uprooted. In California, this problem has been solved by use of a roller wrapped with angle iron sections at six-inch spacing and pulled by a tractor. This creates parallel furrows in the soil which are deliberately run perpendicular to the wind direction. When seed is dropped into the permanent water sheet, it accumulates into the bottom of each furrow where the seed cannot be pushed by waves. When seedlings are present any wave action will push a little soil around the base of the seedlings and prevent them from being uprooted.

In March, 1995 in Costa Rica we tested water seeding in a 10 ha plot where wind is usually very strong, but we were not able to first furrow the soil with a roller. Since the soil was a heavy clay, similar to that at Plum Mitán Sector A, the cloddiness of the surface did not allow seeds to be moved by waves. However, a 72-hour windstorm of up to 100 k/hr gusts hit when seedlings were 2-5 cm high. We left the water at its original depth of 8-10 cm and stuck it out. Some seedlings were uprooted but the damage was not bad. We believe that had we lowered the water level during the high wind, the waves would have done more damage. It would seem that to counteract the loss incurred we should plant a bit more seed,

up to 4.5 to five 100 lb sacks/ha rather than the usual four sacks. Harvest yield was not affected by the slightly lowered density of plants in this plot, however. Thus, it is possible to water-seed highly clay soils with wind problems, without use of a roller.

Dry season planting. During the dry season planting, farmers should burn the last crop's rice straw and then disk or rototill the soil. Before the last pass of soil disking, 100% of the total urea needs should be applied by hand or spreader, as well as 100% of the phosphorus and potassium. Then this fertilizer should be incorporated into the upper 10 cm of dry soil with a disk or rototiller on the final pass. Then the 8-10 cm water sheet should be put onto the fields and then pre-germinated rice sown into the water sheet. The water sheet should never be drained off the field. If it is, then five detrimental things will happen :

1. upon exposure of the soil, weed seeds will germinate, including red rice, *Echinochloa*, and other weeds. A 10% infection of red rice weeds in a field will reduce yield by 25%;
2. the nitrogen fertilizer, urea, will be lost as it is oxidized to  $\text{NO}_3^-$  and then ultimately denitrified to  $\text{N}_2$  gas by anaerobic bacteria when the field is reflooded;
3. if shallow puddles are left on the field after draining, then the solar radiation will heat these puddles to extreme temperatures that along with the heat, also drives off oxygen from the water and kills rice seeds and seedlings;
4. upon drainage of the water sheet, much soil and nutrients are lost and are potential contaminants in this case of the Nariva marsh, as well as the fact that much water is lost unduly;
5. when fields are drained and shallow puddles left, conditions are perfect for seed depredation by waterfowl.

Account should also be taken of the fact that only 60-70% of the usual nitrogen level used needs to be applied with the water sheet method. Thus, if 100 k/ha of nitrogen is normally used with the top dressing method, then only 60-70 k/ha need to be used with the water sheet method.

Red rice. Of all weed species, red rice is the most damaging to commercial rice farming. It is by far the most competitive weed with commercial rice. Since rice seed quality is not yet well controlled in Trinidad and Tobago, most seed will be contaminated with red rice or other wild rice types.

Farmers in Costa Rica control these weeds in dry season by wetting fallow fields at intervals, provoking these weeds to germinate, dry the fields and then disking the young seedlings. After four or five diskings at 10 cm of soil column depth, little viable seed remains. This same method is used in wet season with wet cultivation (cage wheels or rototillers), but has the disadvantage of having to take the field out of production for a season.

In both wet and dry seasons, a better procedure to eliminate red rice is to use the water-seeding method. Any viable red rice seeds (or other wild rice types) that are below the soil surface cannot germinate and cannot emerge through both a soil layer and water sheet. Also, if they are on the soil surface and a water layer is placed over them before they germinate, they cannot emerge through a water sheet (unlike commercial rice).

Red rice was eliminated from California by two methods:

- strict control of certified rice seed producers, and
- use of the water-seeded method (Flint *et al*, 1993; Hill *et al*, 1992).

Aquatic weeds. If the water-seeded method is finally adopted by Nariva farmers, with several years application, a shift will occur towards the occurrence of aquatic weeds in rice fields. This problem can be attacked by two methods. One could go back to the old method of seeding and draining for a few cycles to make conditions worse for aquatic weeds. Or one could use commercial herbicides for these types of weeds, such as Londax. These types of herbicides can be applied directly to the water sheet, they break down readily and are much less harmful to the environment than are the dry weed herbicides. They are also very inexpensive compared to terrestrial weed herbicides.

Wet cultivation. This type of cultivation should be used in the interim before fields are laser-levelled enough to be able to use the water-seeding method, and also during the wet season planting.

To reduce the amount of germinating weed seeds, this method crushes the soil under 5-10 cm of water with wide, angle-iron cage wheels used on the rear of regular farm tractors. These wheels are presently used for rototilling in Plum Mitan. One can also rototill the soil in a layer of water, but it should be noted that one can do a good wet cultivation with only the cage wheels, which would probably reduce the costs. Only cage wheels are used in Costa Rica for wet cultivation (McCoy *et al*, 1995).

After cultivation, one should let the sediment settle for at least three or four days before draining and planting. With this method the fine sediment layer that forms on the soil surface inhibits the germination of weed seeds underneath and thus are less of a problem with the crop.

However, if fields are within a certain levelness, of no more than 10 cm difference between low and high spots in a field, or check, then the water-seeded method should be tried. For fields with more elevational differences than this, the wet cultivation method should be employed to reduce herbicide usage and production costs.

Many of the farmers in Plum Mitan cultivate their dry fields in the dry season with a rototiller before the rains hit. If they then plant rice on the moist soil surface and do not inundate the field immediately, a high density of weed seeds will germinate and compete with commercial rice plants.

#### Pests, insects, other invertebrates, birds, mammals

Insects. When young plants are exposed on drained fields, they are more susceptible to insect attack, than when covered with a water sheet. The use of the water-seeded method should help control the damage. Infection of white-leaf virus usually occurs during the first four weeks after planting. The virus is transmitted by the bite of a leaf-hopper insect (*Segatoides spp*) to the young plant stem. Therefore, water should be covering most of the young developing rice seedlings, making it physically more difficult for the leaf hopper insect to actually bite the young stem. Other caterpillars that cut young leaves during the first four weeks would also be inhibited by the presence of the water sheet.

There will be times when commercial insecticides will be needed. Insects (stinkbugs, *Nesara* spp, order Hemiptera) that attack the developing rice grains during the milk stage at about 14 weeks will have to be treated this way, until biological control methods can be developed. The use of pyrethrin-based insecticides (Karate, Cymbush, etc.) should be encouraged. These are less dangerous to the human applier and to vertebrates that may occur in rice fields during application. They also break down rapidly and cause little contamination. If stronger insecticides are used such as organophosphates (Tameron, Malathion, etc.) then precautions should be taken by human appliers. Also if aerial application by aircraft is undertaken, use by helicopters is preferred over fixed-wing aircraft. Helicopters push the product downward onto the crop with less drift over non-target areas. One important practice should be the flying over of "to-be sprayed fields" first without spraying, to scare off any birds that may be in the field, prior to actual application of the insecticide. Most fields in the Plum Mitan scheme are so small that farmers will probably opt for manual application of insecticides with either manual pump applicators or motor-driven ones.

Ducks and waterfowl. Damaged fields are a problem because they must be reseeded which throws off the timing of maturation of the grain come harvest time. Some farmers will also lower water levels for the replant, allowing for weed seed germination and the need to use more herbicide later.

Ducks do not usually frequent fields at night with 8-10 cm of standing water, so if farmers in Nariva could be convinced to use the water-seeded method of rice planting, duck damage would be reduced. The most important management factor, however, no matter what method is used, is not to allow the ducks to find the seed during the first one or two nights. If ducks are kept off such fields during this time, then 80% of the battle is won. However, if the ducks are allowed to find the seed during the first nights, then they will come back to that field every night and it will be difficult to keep them off the field.

Waterfowl seed depredation in Costa Rica is currently being controlled with a combination of propane detonators and weekly spot-lighting with halogen spotlights (400,000 watts). Detonators are expensive to purchase initially (\$350 to \$1,000 depending on the model; recommended contacts for assistance : Mike McCoy and Montserrat Carbonell) but they pay for themselves over two or three crop cycles, if otherwise guards have to be hired to patrol the fields at night. Manual guarding of rice fields can be done with regular flashlights, but the more powerful halogen beams connected to automobile batteries work better. In a situation like Sector A where most fields have roads nearby, the farmers could unite and hire one person to drive around all night and from his/her vehicle spotlight the fields and keep the ducks off newly planted seed in the whole Sector.

Other birds. The other bird pest in rice is the dickcissel (*Spiza americana*) which migrates from North America in fall and can cause major damage to ripening rice throughout the Neotropical Region, from September to December. Some farmers in Costa Rica are controlling damage with propane detonators, but it has also been noted that fields in close proximity to forested areas receive less dickcissel damage. It may be that there is a higher density of predatory birds in these areas which may repel dickcissels. Research to test chemical repellent (methyl anthrilate) use on affected rice fields will be started in Costa Rica in the near future, to determine the feasibility of repellents for dickcissel control. Such repellents should be considered for testing in Nariva also.

Mammals. Small rodents increase their populations at intervals and cause damage to maturing rice by eating the stems, which then causes the drying out of the developing inflorescence. This occurs in Costa Rica about every five years. Information gathered in Nariva from local farmers seems to indicate that they also have periodic damage by small

rodents. A completely satisfactory method of control has not been found. In Costa Rica most farmers use rodenticides (strong insecticides like lannate mixed with some form of bait made from corn kernels, or a mixture of animal fat and ground bone). This practice done at regular intervals may keep rodent populations from peaking, but can be detrimental when baits are thrown out freely along dikes. Dead, poisoned rodents can be later eaten by non-target predators and subsequently also killed, and the poison entering the food chain. Thus, if baits are used they should be placed inside what is called a "bait station", which is usually a section of PVC tubing with a diameter just large enough to let in the target rodent but too small for a predator to enter to consume the poisoned rodent. When each station is periodically re-baited, any dead rodents found inside should be buried.

We have found in Costa Rica that rodent populations are kept lower if dikes are maintained with short vegetation (by cutting) and it seems that when fields are more level (with laser-levelling) rodents are less prone to use these fields for nesting and other activities of their life cycles. They will normally use the higher areas of unlevelled fields where water sheets are absent or very shallow. This same observation has been made in California (Flint *et al*, 1993). Dikes that separate rice checks should also be constructed as low and narrow as possible. Unnecessarily high and wide dikes provide more habitat for rodents, especially when the soil cracks in dry season, since these provide a suitable habitat for them.

We have also been testing the acceptance of raptors to artificial perches placed along dikes and have found that these birds readily accept them in Costa Rica. Rice fields normally don't provide many natural perches for diurnal and nocturnal raptors who use perches to hunt rodents from. The use of such perches seems promising and may help keep rodent populations in check.

### Use of fertilizers

The best alternative so far seems to be that currently used in California, which we are trying in Costa Rica. This method implies that **in the dry season**, 100% of all **nitrogen, phosphorus and potassium** needs are incorporated into the upper 10 cm of soil before seeding. Only Zn fertilizer is applied and left on the soil surface (for use by rice seedlings). The water sheet is then applied and never drained off. By using the permanent water sheet, an anaerobic reduction zone develops in the soil below 1 cm soil depth. The urea is converted to  $\text{NH}_4^+$  cation which bonds tightly to negatively charged soil particles. Thus the  $\text{NH}_4^+$  cannot be lost by leaching as long as the water sheet stays on, the  $\text{NH}_4^+$  stays in the upper 10 cm of soil and is available to the rice plant during the whole crop cycle. However, if the water sheet is drained, then the reduction zone becomes oxidized, and the  $\text{NH}_4^+$  is oxidized to  $\text{NO}_3^-$ . When the field is reflooded and anaerobic conditions resume in the reduction zone, the denitrifying bacteria will convert much of the  $\text{NO}_3^-$  to  $\text{N}_2$  gas, which is then lost to the atmosphere, thus, the importance in not draining the water sheet. Phosphorus and potassium should also be incorporated into the soil to reduce the growth of algae on the soil surface.

If top-dressing of nitrogen is the only alternative, then, at least for the first application, the **urea** should be applied to the dry soil immediately before the water is to be put on. Once the water is being put on, the urea will dissolve in the water and be drawn down into the soil as it absorbs the water.

We have found in two separate tests in Costa Rica, that less nitrogen should be used when incorporated into the soil before planting. Both farmers used 100 to 120 kg/ha of urea, which was the normal rate with top-dressing. However, since losses with the soil incorporation rate are up to 40% lower, this rate was too high for the rice, it grew too much

and lodged (fell over) just before harvest. In one of these tests, however, (on 17 ha), they still were able to dry out the ground enough to be able to harvest and obtained 160 hundredweights/ha, the best harvest ever on that farm. With the soil incorporation method, rice plants seemed to be less stressed, and grew more evenly throughout the crop cycle. Better yet a tremendous savings of up to 40% in nitrogen fertilizer can be obtained by farmers using such a method. Soil incorporation of fertilizer also reduces the amount of nutrients available to aquatic, floating weeds, compared to top-dressing applications.

The same method should also be used during the wet season planting. However, it is more difficult to incorporate fertilizer under wet soil cultivation. Fertilizer incorporation can be accomplished with the tractor rear cage wheels, if they are not penetrating more than 10-15 cm. If the wheels are going deeper than this in the soil, then alternative methods must be developed. A potential system could be the dropping of the fertilizer behind the tractor but in front of a rototiller that is only tilling the upper 10 cm of wet soil, on the last cultivation pass. The rototiller must be as wide as the rear tractor wheels, however. The prior wet cultivation should be done with as little a water sheet as possible, so that the urea is not mixed in water, but in the soil on the last pass. The water sheet should be placed onto the fertilized fields and planting should be done as soon as possible after the cultivation so as not to allow weeds to germinate or algae mats to develop on the soil surface.

Thus in summary, to minimize the run-off of fertilizer to the Nariva Swamp, which could destroy the marsh due to the stimulation of excessive plant growth, it is imperative to incorporate fertilizer into the soil before planting, and the practice of top-dressing must be discontinued. However, to be able to use the soil incorporation method, farmers must first be trained in the method of water seeding. Many will be sceptical of this method, as they were in Costa Rica. Most farmers believe that pre-germinated rice seed cannot root and emerge through a water sheet. Progressive farmers must be identified, convinced of the method and then try it on their plots with the objective of convincing the other farmers. Most fields will probably need to be laser-levelled also in order to use the water-seeding method.

#### **New rice varieties**

A better method to reduce insecticide and fungicide usage is the continual development of new rice varieties resistant to insects and disease. This also brings an added benefit of crop improvement such as increased yields, better seedling vigor, resistance to lodging, and improvements to grain quality.

The CIAT in Colombia, has started a new policy, under which, any country that pays a yearly fee of US\$ 40,000 to its new irrigated rice branch, will receive the visit of rice breeders to develop new varieties within that country. Such a program could be funded by a tax levied per sack of rice harvested by each farmer (such as in California, USA).

#### **Government involvement**

Several factors exist that should stimulate the Trinidad and Tobago Government to reconsider its support to national rice production:

- a) world market rice prices are rising, thus making importation of rice more difficult;
- b) it is estimated that world rice production must be increased by 60% over the next 35 years (Jim Hill, pers comm) just to keep up with world demand (Trinidad should contribute to this

increase in production);

c) Guyana cannot continue to meet the import rice demand for Trinidad (Mr Victor, National Flour Mills, pers comm) and already experiences shortages of rice for local consumption;

d) small farmers need to be stimulated into legal farming activities; and

e) a serious unemployment situation exists in rural areas that needs to be addressed -rice farming could help alleviate this problem and reduce the pressure to deforest hilly areas with resultant erosion, and other associated environmental problems.

With the production of new varieties, over time, rice will be freer of insect and disease problems, yields can be increased, and farmers will need to use less pesticides.

#### Other uses of rice fields

The cultural importance that residents of Trinidad place on the fish, cascadoo and the large conch snail opens up the possibility of even greater economic returns to irrigated rice farmers. As done by at least one farmer, a long ditch can be built in the field to hold permanent water, which in the dry season will hold young cascadoo fish. When the rice field floods, the rice is planted and the fish swim out of the ditch living in the rice field during the crop cycle. There they also mate and reproduce. When the field is drained for harvest the fish move back to the ditch on their own since this is the only water left in the field. The farmer can then seine the fish in the ditch, keep the larger ones for sale and put back the younger fish for the next cycle. Such a scheme could be repeated by many farmers, which now do not take advantage of this possibility. Such a system also dictates the use of the less harmful pesticides in the rice field while the fish are there.

#### The situation in Kernahan

The number one problem in Kernahan is a serious excess of water during wet season and a total lack of such water during dry season. A reservoir is sorely needed to help alleviate this problem. We identified a potential site for a reservoir nearby (see Map 3).

If high water levels continue to plague rice farmers here, then use of floating rice varieties should be investigated. These do well in deep water and although less productive than medium dwarf varieties used now, would give more economic gain if total crop failure of dwarf varieties continues to be a problem due to high water levels. Again, this will not happen unless help is given to the community by extensionists or social workers.

Most of the recommendations made for rice farming in Plum Mitan can also be applied here, where we found a stronger tradition of water buffalo raising and a large extension of *Phragmites sp* vegetation, to the north of their cropland area which should readily receive heavy grazing. A great potential exists to expand water buffalo activity and especially cheese production in this community.

#### On water buffalo, restoration of the marsh and cheese production

If the high biomass production common in such marshes is not extracted by grazing, the marsh habitat preferred by waterfowl and waterbirds is overtaken. Birds shun ungrazed,

overgrown areas and are highly attracted to grazed areas. Grazing opens up the vegetation, and creates conditions for the formation of open water when rain restores the water levels. Floating vegetation develops in the open water. As the dry season commences, the floating vegetation dies back, and as water levels drop, exposed soil forms around the open water areas. This type of habitat is attractive to waterfowl and wading waterbirds. We have much experience with this in Costa Rica (McCoy 1994; McCoy and Rodríguez 1994) and cannot stress enough the importance of grazing toward providing the necessary habitat for waterbirds. Possibly, the least damaging to the marsh, **restoration method**, the cheapest, and most productive -in terms of economic help for the local communities, is the grazing of aquatic vegetation by water buffalo.

Additionally it is important to remember that some of the finest **cheeses** are produced from water buffalo milk (mozzarella and riccota). We believe that an even greater economic return can be made from this operation if ranchers with water buffalo produced cheese. Cheese is not produced much in Trinidad and Tobago, where it is mostly imported from New Zealand at a very high price.

In the case of the Black River Water buffalo operation, it is a good three hour walk from the closest town (Biche) also points to the feasibility, since cheese is much easier to transport out than the equivalent amount of milk used to produce such cheese. The people running this operation knew nothing on how to produce cheese. But in reality it is a very inexpensive and easy process. Recent work by Roshni Maharaj at the Food Technology Unit, Department of Chemical Engineering, University of the West Indies, St Augustine, has shown the feasibility to produce cheese from buffalo milk (Kassie 1995). This technology should be extended to future buffalo ranchers and projects in the Nariva Marsh.

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