

Fishing Versus Farming in a Fresh Water Swamp in Trinidad in the Caribbean

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Abstract. This paper compares the status of fishing to farming in the Nariva Swamp, on the eastern coast of the island of Trinidad, in the country of Trinidad and Tobago. This swamp is one of international significance, since it is a home to the endangered animal, the manatee (*Trichechus manatee*). Also the swamp has a large population of two aquatic species of economic importance in Trinidad and Tobago - the armored cat-fish or cascadura (*Hoplosternum littorale*) and the ampulariid snail or black conch (*Pomacea urceus*). Residents of the area include in their diet the consumption of these species, as well as exploit them commercially. The paper is based on two surveys in the swamp, one was of 99 occupiers of plots, to determine their economic activities and the other survey was of 33 households, to determine the importance of fish from the swamp in their diets. The analysis in the paper showed that farming was now the dominant economic activity in the swamp, both in terms of income received as well as the amount of labor utilized. The residents did consume fish from the swamp, but this fish was not the major source of protein. Poultry and poultry products, especially chicken were the preferred protein sources. Farming was seen as a threat not only to fishing, but also to the native flora and fauna of the swamp and the paper called for urgent studies of the impact of such extensive farming on the ecology of the swamp.

Keywords. Nariva swamp, fishing versus farming, wetlands.

1. INTRODUCTION

1.1 Location

The Nariva Swamp is the largest and most diverse wetland in Trinidad and Tobago. It is located on the east coast of Trinidad between 10° 30' N and 10° 22' N latitude and 61° 01' W and 61° 06' W longitude, covering an area of approximately 6234 hectares.

The Nariva Swamp is largely a fresh water wet-land, which provides habitats for numerous species of flora and fauna, some of which are endangered, contributing to a rich biodiversity, that is significant, both locally and internationally (Bacon et al, 1979). Such international significance has been underscored by the formal designation in 1993 of Nariva Swamp as a "Wetland of International Importance, Especially as Waterfowl Habitat" under the Ramsar Convention. The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 122 Contracting Parties to the Convention, with 1029 wetland sites, totaling 78.2 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance (Ramsar website).

The Nariva Swamp in particular has a small population of manatee (*Trichechus manatus*) in ponds on its eastern side near the mouth of the Nariva River. The manatee is endangered

both locally and internationally (IUCN, 1996).

1.2 Human Settlement

Human activity in the Nariva Swamp has led to the direct consumption of its resources. Two major settlements have been established in the Swamp: Plum Mitan and Kernahan/Cascadoo.

Plum Mitan lies at the northwestern end of the Swamp. It was established as a settlement approximately 70 years ago. However, during the Second World War, it appears that rice production was promoted there by the lease of State Lands to farmers, in an effort to expand domestic production of food, to combat war-time scarcities. After the Second World War, in 1957, a formal project - the Plum Mitan Rice Scheme was established. Also, more land was allocated to farmers, and an area officially declared for rice production, designated as Block A. In Block A, infrastructure was established for rice production including drainage channels and sluice gates.

It is estimated that there are about 2100 persons who live in Plum Mitan. They are served by community facilities in Plum Mitan and in Biche, a neighboring village. These facilities include three schools, a health center and two community centers. The area is well served by electricity and running water.

Kernahan /Cascadoo was established in the extreme south-eastern part of the Swamp. Kernahan is the larger of the two

villages and is located at more or less sea level in the Swamp, while Cascadoo is in a nearby more southerly and hillier area. This settlement was established from around 1960, by individuals from a village called Penal in south Trinidad, who started squatting on these lands during the dry season to plant crops and to fish. There is a theory that the construction of the Navet Dam, a major source of domestic water for Trinidad, permanently lowered the water levels in the Swamp, making areas like Kernahan/Cascadoo accessible for farming. Gradually the squatters in this area have set up permanent lodgings and now a village can be said to exist.

It is estimated that approximately 100 households live in Kernahan/Cascadoo, with the majority, approximately 60, living in Kernahan. While there is a community center and a pre-school, the area is not served by a public school. Electricity has recently been introduced to the area (March, 2000), but the area does not have running water or any health facility.

1.3 State Ownership

Nariva Swamp is state lands, in the sense that the land is property of the Government of the Republic of Trinidad and Tobago. The State may grant leases for the use of its resources, or can convey title to the land to individuals or organizations by outright sale.

Management of its land resources however, has been very problematic for the Government of Trinidad and Tobago. So despite its declaration of the Nariva Swamp as a National Park and certain areas of the Swamp as "Restricted Areas", the State has exhibited in general, a clear inability to enforce its authority and control over the resources of the Swamp including land. Thus access to the Swamp has been fairly open, with little or no restriction, especially to fishing.

1.4 Approach to the Study

This paper will describe the nature of fishing enterprises carried out in the Nariva Swamp and compare these enterprises to agricultural enterprises also carried out in the Swamp. The contribution of fishing to the nutrition of the households in the Swamp will also be assessed.

What the paper will argue is that despite the importance of fishing to the residents that agriculture is a far more lucrative occupation to the residents. Therefore it could be expected that there will be the continued conversion of land to facilitate agricultural production, which will eventually limit or exclude fishing and also cause irreparable damage to the ecology of the Swamp.

The data utilized in this study were obtained from two surveys, which were conducted there. The first was a survey of 99 individuals occupying parcels of land at the Swamp, recognized by the Ministry of Agriculture Land and Marine

Resources. This survey will be referred to as the "Farmers Survey". This survey was carried out as part of an Environmental Impact Assessment of large scale rice farming, which took place in the Nariva Swamp between 1985 and 1996 (Institute of Marine Affairs, 1998). This survey provided information on commercial fishing and farming enterprises by residents of the Swamp.

The second survey was a survey of residents of the Kernahan to determine their eating patterns and the contribution of fish to their diet. This survey was conducted for this paper in May/June 2000. In this survey, an attempt is being made to interview all the households in Kernahan. Interviews done with 33 households were analyzed and the preliminary results of this analysis are presented in this paper.

2. FARMERS SURVEY

2.1 Sampling Design and Conduct of Survey

A simple random sample was taken from a sample frame of individuals occupying plots of land as listed on the register of the Ministry of Agriculture, Land and Marine Affairs' Offices at the Rio Claro (Nariva/Mayaro) County Extension Office and the El Reposo (St Andrew/St David) County Extension Office. These individuals occupied plots in Plum Mitan, Kernahan, as well as Biche. The survey was carried out in January 1998 and the information collected was for the calendar year 1997.

Information in the survey was collected by personal interview by a team of interviewers, who were Extension Officers of the Ministry of Agriculture, Land and Marine Affairs, who were familiar with the area, and with the conduct of such interviewing. A total of 99 individuals were interviewed.

2.2 General Characteristics of Respondents

94% of the respondents were male and 6% female. The average age of the respondents in the survey was 42. The average number of people living in each household was five. The average number of years the respondents spent in school was six.

84% of the respondents received news about the country and the world from either the television or the radio. 7% obtained their news from the newspaper while 8% talked to their neighbors and other people in order to get their news.

24.2% of the respondents belonged to groups such as cooperatives, farmers' and village councils and tenants associations. The range of services offered by these groups however was very limited. Respondents were asked what was the best job they thought they could get. 27% thought that

being a manual laborer was the best option, while 18% said farming and 7% said tractor or heavy vehicle operator. With respect to what the respondents thought was the best job for the male children of the household, 17% believed that agriculture was the best option, 16% said teaching, 12% said the public service, while 11% said any type office work. The responses with respect to the female children of the household were slightly different, 23% said that teaching was the best option, 9% said sewing, 4% said housewife, while 3% said nurse.

92% of the respondents felt that they could handle jobs in tourism and that there was scope for tourism in the area. This is because they felt that there were attractions in the area that tourists would like to see. These attractions include the Nariva Swamp itself, the Brigand Hill lighthouse, and wildlife such as the monkeys, birds/ducks and the manatee.

83% of the respondents were interested in jobs to show these attractions to tourists and felt that other members of their households would also be interested in such jobs. 69% of the respondents felt that they could run a business geared toward tourism. These businesses included, guest houses, restaurants and cafes, or tour guiding. Currently those residents who do sell items to visitors to the Nariva Swamp area, sell brooms, baskets, produce from farming, or conchs and cascadura.

With respect to the tenure of land holdings, 63% of the respondents said they were squatting on the land, while 18% claimed to have leases for their plots. Ten percent claimed to own the land and the rest (approximately 9%) of the respondents had some arrangement to use the land from the official tenant of the land.

All but one of the respondents believed that the loss of wildlife in the Nariva Swamp was a serious issue. 72% of the respondents felt that certain animals (such as the manatee, birds/ducks, agouti and the alligator/caiman) were in danger of disappearing. 89% of them also stated that destruction of the forests was also a serious issue. Again, all but one of them believed that it was important to have forests.

83% of the respondents felt that special programs and funding were the best ways to help reverse the decline in the condition of the natural environment in the Nariva Swamp.

The respondents said that their worries and fears for the future include un-employment, insecure tenancy, natural disasters, crime and destruction of crops. The major problems in the area, they reported were unemployment, lack of potable water, bad roads, and poor irrigation. The respondents felt that the best way to develop the area was to have a regular supply of water and to improve the employment situation, as well as the infrastructure and irrigation. They felt that the government should pay for development of the area, if it was to take place.

2.3 Occupations of Respondents

From the survey in Table 1, it is seen that 83% of the respondents considered that their occupation was farming. Thus it is calculated that of the 400 persons comprising the population of occupiers of plots in the Nariva Swamp, 332 were farming full-time. Other respondents were engaged in a wide range of other activities, including fishing. In fact 94% of the respondents stated that they fished in the Nariva Swamp.

Table 1. Occupation of Respondents in the Farmers Survey: Nariva Swamp - 1997

Occupation	Frequency	Percent
Farming	82	82.8
Laborer	4	4.1
Taxi Driver	3	3.0
Tractor Operator	3	3.0
Fishing	2	2.0
Other	5	5.1

65% of the respondents reported that they had spouses. Of the spouses 23% were reported to have an occupation of farming, while 69% of them reported that they were housewives. As far as children were concerned 56% were reported to be students while 29% were reported to be farming and 11% un-employed.

The total number of people employed in farming in the Swamp was estimated at 598, with 546 persons being family labor employed and 52 being hired laborers.

3. COMPARISON OF FISHING AND AGRICULTURAL ENTERPRISES

3.1 Importance of Enterprises

In defining their most important enterprise, 68% of respondents said that their most important enterprise was the one that gave them the most profit, while 7.4 % said that the returns were "faster", with their most important enterprise.

With regard to fishing, (Table 2), four percent of the respondents stated that cascadura fishing was their most important enterprise. Three percent stated that conch gathering was their most important enterprise. Additionally, six percent of the respondents stated that cascadura fishing was their second most important enterprise and two percent conch gathering. Only one respondent each stated cascadura fishing and conch gathering was their third most important enterprise.

The picture was much different for the cropping enterprises which were definitely more important to the respondents. Watermelon was identified by 36% of the respondents as their most important enterprise. 12% stated that rice was their most important enterprise, 6% said bodie (an edible legume), and 4.2% cabbage (Table 2).

Table 2: Most Important Enterprise for the Respondent: Nariva Swamp – 1997

Enterprise	Frequency	Percent of Respondents
Melon	34	35.8
Rice	11	11.6
Bodie	6	6.3
Cabbage	4	4.2
Cucumber	4	4.2
Cascadura Fishing	4	4.2
Conch Harvesting	3	3.2
Total	66	69.5

15% of the respondents reported that watermelon was their second most important enterprise and 14% cucumber (Table_3). 20% had no other enterprise that they would rank as their second most important. 63.4% of the respondents had no enterprise that they would rank as third most important. 6.5% had cucumber as their third most important enterprise. 75% of the respondents stated that their most important enterprise occupied 1 hectare, while 10 % stated that their most important enterprise occupied 2 hectares.

3.2 Returns from Fishing Enterprises

The figures for fishing show that virtually all the respondents reported acquiring fish from the Swamp. As was just discussed, 17% of the respondents reported fishing (including conch gathering) as one of their major enterprises. Given a population size of 400 this suggests that about 68 occupiers of plots had fishing as a major activity. It was estimated that the

68 persons fishing represented the total commercial fishing effort in the Swamp, with 44 fishermen involved in cascadura fishing and 24 in conch gathering (Table 4).

The information in Table 4 also shows the Total Revenue (sales) and the Total Net Revenue for these fishermen. The Total Net Revenue is calculated by deducting both operational (variable) costs and the imputed cost of family labor from the Total Revenue. Family labor is costed at the going market labor wage rate of TT\$40/day (approximately US\$6.35/day at current exchange rate US\$1 = TT\$6.30).

The Total Revenue (sales) from cascadura was \$377,520 and Total Revenue (sales) from conch was \$163,800, giving a Total Revenue from all fishing enterprises of \$541,320. The Total Net Revenue from all fishing enterprises was \$353,820 (Table 4).

Table 3: 2nd Most Important Enterprise for the Respondent: Nariva Swamp - 1997

Enterprise	Frequency	Percent of Respondents
Water-melon	14	14.9
Cucumber	13	13.8
Rice	7	7.4
Cascadura Fishing	6	6.4
Bodie	5	5.3
Pumpkin	3	3.2
Hot Pepper	3	3.2
Banana	3	3.2
Livestock	3	3.2
Nil	19	20.2
Other	17	17.2

Table 4: Returns from Fishing Enterprises in the Nariva Swamp - 1997

Enterprise	No. Of Fishermen*	Mean Revenue per Fisherman	Total Revenue	Mean Net Revenue per Fisherman	Total Net Revenue
Cascadura	44	8580	377,520	5355	235,620
Conch	24	6825	163,800	4925	118,200
Total	68	15,405	541,320	10,280	353,820

*Estimated number of persons who fished commercially.
Exchange Rate US\$1 = TT\$ 6.30

3.3 Returns from Crop Enterprises

The mean sizes of the plots used in the survey are given in Table 5. A weighted mean plot size was calculated from Table 5 as 2.66 ha. Thus, given that the total number of occupiers of plots in the Nariva Swamp derived from the sample frame and non-response in the survey was estimated at 400, the total farm acreage in Block A and Kernahan of the Nariva Swamp was estimated at 1063.73 ha.

Table 5: Plots of Land of Respondents in the Nariva Swamp (Block A and Kernahan) - 1997

Plot	Mean Size (Hectares)	% of Respondents *
1st	2.12	100.0
2nd	4.16	37.1
3rd	2.85	7.2
4th	1.66	3.1

*% of respondents having 1 plot, 2 plots etc.

The major crops of respondents in the survey were given earlier in Table 2. For the analysis in this paper, the three major crops chosen were water-melon, rice and cucumber, since the most reliable data were obtained for these commodities in the survey. For each of these crop enterprises, Table 6 gives the mean size and an estimate of the total area of the crop in the Nariva Swamp (Block A and Kernahan) in 1997. The total area of these crops is estimated at 993 hectares, which is about 93% of the estimated total farm acreage.

Table 6 shows that watermelon not only was the most popular crop among the farmers but also had the largest acreage. Rice production was the second most important crop enterprise, but in 1997 was only about 66% of the acreage of watermelon, reflecting the increased importance and profitability of watermelon production in the Nariva Swamp.

Table 6: Major Crop Enterprises in the Nariva Swamp- 1997

Crop	Mean Hectares/ Farmer (Growing the Crop)	Estimated Area (Hectares)*
Water-melon	0.85	560
Rice	1.72	367
Cucumber	0.85	66
Total		993

*Estimated Area in Block A and Kernahan.

Table 7 gives the returns for the three major crop enterprises. In this table it is seen that the Swamp produced about \$11 million in Total Revenue from water-melon. Rice production provided Total Revenue of \$1.8 million, while cucumber produced a Total Revenue of just over \$400,000. The Total Revenue from these three crops was about \$13.4 million.

Because of the high labor input in its production, cucumber had a negative Net Revenue. However the Net Revenue of water-melon was very high at almost \$6.5 million. This no doubt explains the importance of the crop to the farmers.

Table 8 shows that fishing was a very minor economic activity compared to farming although the study area being examined was indeed a swamp or wetland. In fact the Total Revenue from fishing (cascadura and conch) was only 4.1% of the Total Revenue from the three major crop enterprises analysed in Table 7. Also the Total Net Revenue from fishing was only 5.4% of the Total Net Revenue from the three crop enterprises.

3.4 Comparison of Labor use in Fishing and Crop Enterprises

As seen in Table 9, a total of 4,539 man-days were estimated to have been used in fishing in Nariva Swamp in 1997. This labor consisted solely of family labor, as no hired labor was used in fishing.

As seen in Table 10, there was much greater labor input in the three major crop enterprises, with a combined hired and family labor input of 65,658 man-days in 1997. This means that the fishing labor input was only 6.9% of the labor input in the three main crop enterprises. In fact the fishing labor input was just less than that of cucumber, which was the least important of the three crops considered in this analysis.

4. THE RESIDENTS SURVEY

4.1 Survey Design and Conduct

In the absence of a sample frame, a census of the residents of Kernahan was attempted in the residents' survey. This survey was carried out by personal visit to the households in the village. The interview was conducted with the individual who could best provide information on the food consumption of the household. This individual was invariably the woman (wife) of the household. The interviews were conducted by a graduate student of the University of the West Indies who has been trained in statistical and survey methods.

Table 7: Returns from Major Crop Enterprises in the Nariva Swamp - 1997

Crop Enterprise	Mean Total Revenue /ha	Total Revenue	Mean Net Revenue/ha	Total Net Revenue
Water-melon	19934	11,163,040	11590	6,490,467
Rice	4817	1,767,839	365	133955
Cucumber	6312	416592	-651	-42966
Total		13,372,192		6,581,456

Table 8: Comparison of Returns from Fishing and Crop Farming: Nariva Swamp - 1997

Fishing Enterprise	Total Revenue as % of Total Revenue from Crops	Net Revenue as % of Total Net Revenue from Crops
Cascadura	2.82	3.58
Conch	1.23	1.80
Total	4.05	5.38

Table 9: Labor used in Fishing: Nariva Swamp - 1997

Specie	Hired Labor	Family Labor/Fisherman	Total Family Labor
Cascadura	0	77.25	3399
Conch	0	47.50	1140
Total	0		4539

Table 10: Labor Used in Major Crop Enterprises: Nariva Swamp - 1997

Crop	Hired Labor/Hectare	Total Hired Labor	Family Labor/Hectare	Total Family Labor
Water-melon	23.1	12936.0	82.17	46,015.2
Rice	23.6	8861.2	39.58	14525.8
Cucumber	44.3	2923.8	76.17	5027.2
Total		24721		65568.2

4.2 General Results of the Residents' Survey

As seen in Table 11, the average age of the respondent in the residents' survey was 41.2 and the average household size was 6.7. The average monthly income was TT\$ 1377.8 (US\$ 218.70). With respect to the monthly food bill of the residents, an average of TT\$ 503 (US\$ 79.84) was spent per month. The mean percentage income that was spent on food monthly by the residents was 36.5%

Table 11: General Characteristics of Residents of Kernahan - 2000

Variable	Mean
Age of respondent	41.2
Family size	6.7
Monthly Income	\$1377.8
Amount of money spent on food per month	\$503.03
Amount of money spent on 'snacks' per month	\$32.2
% of monthly income spent on food	36.5

4.3 Fish and Food Consumption of Residents

The residents of Kernahan consumed a wide variety of both fresh water and salt water fish. The fish consumed from the Nariva Swamp included:

- cascadura (*Hoplosternum littorale*)(all residents consumed this fish),
- coscurob (*Cichlasoma taenia*),
- sardine (*Astyanx bimaculata*),
- guabine (*Hoplias malabricus*) and
- tetra (*Odontostilbe pulcher*).

The average number of times per week that the residents consumed fish was 1.6.

The main sources of fish from the Swamp were from nearby water and the Bush-Bush Wildlife Reserve. Residents also reported buying salt water fish from fishermen. When asked what they would consume in lieu of fish, if in fact fish was unavailable, most of the residents said that they would consume more vegetables and ground provisions

Conch (*Pomacea urceus*) did not contribute greatly to the diet of the respondents. It was consumed on average once per month. The conch consumed by the respondents was mainly obtained from the Bush-Bush Wildlife Reserve.

The survey of residents revealed that the diet of the residents was quite varied. The main sources of animal protein were chicken, and other poultry and poultry products, rather than fish. The main sources of carbohydrates were rice and starchy vegetables (ground provisions) and vegetables. These food items were consumed almost on a daily basis by the residents and were usually obtained from home gardens. There was some supplementation of home supplies of carbohydrates and protein by purchases.

Snacks and 'luxury food' items such as fast foods, and processed foods did not make up a major part of the diet of the residents.

5. CONCLUSIONS

The results of this study have shown an interesting pattern for a wetland. In recent years, farming had infiltrated into the wetland ecosystem and is now a dominant economic activity. So even though the Nariva Swamp is a wetland, with vast areas of standing water, the environment of the Swamp is being altered to allow farming on any raised or hilly areas. Farming is now of far greater economic importance, than the more traditional fishing activities generally associated with wetlands in Trinidad and Tobago.

The greater importance of farming is reflected in not only the income received from farming by residents, but also the amount of labor utilized, as the figures in this paper clearly indicate.

The residents of the area do consume fish from the Swamp mainly, and fish from the nearby sea as major protein sources, but even here at an average consumption of fish of 1.6 times per week, it appears that fish is only contributing about 23% of the supply of protein and that most of the protein supply is coming from chicken and other poultry products. Thus the consumption pattern of the residents in this regard is no different from the general situation in the rest of Trinidad and Tobago, where overwhelmingly, the major source of animal protein is chicken.

The open access nature of the fishing conducted has appeared to be fairly sustainable in that the residents appear to be able to obtain a reasonable amount of their fish supply from water in the swamp in close proximity to their homes. However this is not the case with the conch, which all residents reported to be in much scarcer supply and now only available in large enough quantities for harvesting, in the Bush-Bush Wildlife Reserve.

Again the fact that the residents could so easily identify and name this Reserved Area as a source of supply of conch and fish attests to the laxity of control of the swamp resources by the state authorities. Thus one can expect that there will be a gradual depletion of the stocks of the more important commercial species, which will threaten their existence. Studies need to be conducted urgently on the levels of these stocks and the sustainable yields that may be harvested from these stocks.

It would seem however that the greatest threat to the fish stocks and to native flora and fauna of the swamp is farming. It is not know the extent of damage to the eco-system that is being created by the use of chemicals in farming, or indeed the effect of the conversion of such extensive areas of the swamp from the natural vegetation to agriculture. Urgent action is necessary to mandate that studies be undertaken to investigate these matters if the Nariva Swamp is not to die an un-natural death.

6. REFERENCES

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