

# **Potential Impacts of Industrial Development on Coastal Fisheries in the Gulf of Paria, Trinidad**

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## **ABSTRACT**

Four fish landing sites on the west coast of Trinidad lie within the area for proposed expansion of an industrial complex. This would increase the complement of industries such as ammonia, methanol, urea, iron, and steel production plants. Such development has the potential to change the present fishery related activities of the four sites. In Trinidad and Tobago tourism, industrial development, conservation, recreational and traditional uses including fishing, all compete for access to the coastal zone often leading to user conflicts. The importance of the fisheries sector needs to be better represented in the broader context of coastal area management.

The fishery related activities at these landing sites were characterised through the use of interviews, trawl surveys, and secondary data from the Fisheries Division and a fishing association. Potential impacts of the proposed development on fishing activities were evaluated based on a programmatic environmental impact assessment conducted by the Institute of Marine Affairs (IMA). Two hundred and forty four fisherfolk using seventy-seven fishing boats operate from these landing sites exploiting fish resources mainly in the nearshore and offshore areas of the coastal zone of the Gulf of Paria. Changes in the terrestrial and nearshore areas of the coastal zone will result in changes of varying degrees to fishing activities at all landing sites. A major perception by the fisherfolk is the negative impact of increased pollution by this industrial complex on their livelihoods. It is recommended that prior to development any resultant changes, particularly those that cannot be mitigated, be discussed with fisherfolk through consultative workshops and meetings. The final design of the expansion of the industrial estate should accommodate fishery related activities resulting in the least disruption to the landing sites.

**KEYWORDS:** Coastal area management, fisheries, Trinidad

## **INTRODUCTION**

In Trinidad and Tobago industrial development, tourism, conservation, recreational and traditional uses including fishing, all compete for access to the coastal area often leading to user conflicts. This coastal area is a transitional region where land meets the sea – a region encompassing watershed, floodplains, shorelands, beaches, mangroves, estuaries, bays, offshore waters, and the continental

shelf. In Small Island Developing States (SIDS) such as Trinidad and Tobago, the whole island can be considered a coastal area for land use control purposes (McShine 1996). The fisheries sector depends on the coastal area both directly in terms of resources and space and indirectly by factors affecting biological productivity (FAO 1998). This makes the sector particularly susceptible to land- and sea-based activities that have an impact on coastal environment.

The economy of Trinidad and Tobago is dependent on the energy sector, which is the most significant contributor to foreign exchange earnings of the country. Export data for 1994 listed crude oil and refined products as accounting for about 45% (TT\$ 5.6 B; US\$ 1= TT\$6.0) of total export earnings while petrochemical exports account for around 30% of export earnings. Fish and fish products exported in 1994 rank twentieth (TT\$ 53M) (Trade Point, 2001). The relative importance of the industrial sector is a significant factor for prioritising access to the coast area of Trinidad. This is often to the detriment of the fisheries sector, and the current legislative framework cannot facilitate changes to the fisheries sector that result from this demand for use of the coastal area.

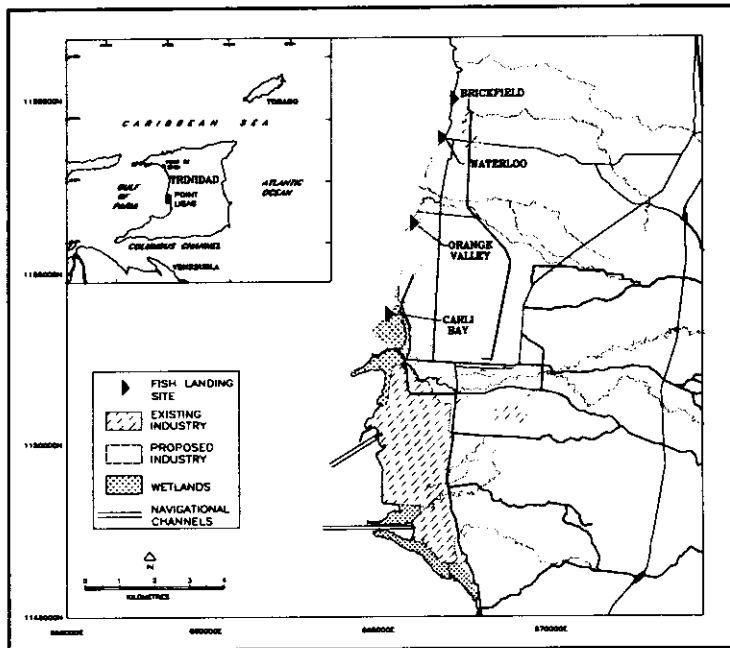
The Fisheries Division of Trinidad and Tobago in conjunction with the Food and Agricultural Organisation of the United Nations (FAO) developed a draft formal policy for the fisheries sector (Fisheries Division 1997). However, the fisheries sector is still governed by the Fisheries Act (1916) and the Archipelagic Waters and Exclusive Economic Zone (EEZ) Act (1986) which regulate fishing activities in Trinidad and Tobago (IMA 1999a). The Fisheries Act regulates the size of mesh, form, and dimensions of nets or appliances for fishing.

An expansion of an industrial estate and port facilities at Point Lisas on the west coast of Trinidad is earmarked for development, Figure 1. This estate, established in the 1960s, now occupies an area of approximately 900 ha and accommodates about 90 companies including three ammonia/nitrogen plants, five methanol plants, three iron and steel plants, power generation plant and downstream industries (IMA 1998a). The port facilities have docking bays, navigational channels and turning basins and dedicated facilities for steel, ammonia, urea, base oil, methanol and additives for lube oil manufacturers. It also handles general cargo and minor dry bulk operations. The area proposed for expansion consists of approximately 400ha of sugarcane cultivation, wetlands and residential communities. Included in the Estate developmental plans is the reclamation of 200 ha extending from the western portion of the proposed expansion.

Four fish landing sites at Carli Bay, Orange Valley, Waterloo and Brickfield are located within this expansion Figure 1. Carli Bay has a history of impacts on its fishing activities, in the 1980's the main river, which received much of the effluents from the estate, was earmarked to be diverted into Carli Bay and the subsequent dredge spoil was dumped on a herbaceous swamp. The diversion was to accommodate large volumes of hot water entering the river, to increase the circulation path into Carli Bay and the adjacent bay, and to increase land space for a housing complex associated with the estate (McShine-Mutunhu 1985). In anticipation, fishing facilities with slipways and vending facilities were constructed

for the fisherfolk on the banks of this channel. Although the diversion was never completed, the fisherfolk still used the channel for a few years before it silted up and the fishing facilities was later abandoned. The fisherfolk now operate from the beach with no facilities.

This paper describes the baseline conditions of the fishing activities of four fish landing sites at Carli Bay, Orange Valley, Waterloo and Brickfield on the west coast of Trinidad and examines the potential impacts such an expansion might have on the fishing activities.



**Figure 1.** Location of fish landing sites adjacent to industrial estate, Pt. Lisas, Trinidad

### METHODOLOGY

Trawl surveys were used to determine the demersal species composition of the nearshore environment. The nearshore marine area was defined as the region extending to approximately five (5) metre water depth. Six trawl surveys were undertaken between May and July 1998 at 1.5 – 2.0 m, 3.0 - 3.5 m and 4.0 - 5.75 m using a Type II trawler. This trawler was a 9.4 m wooden/fibreglass pirogue with an inboard engine. It was equipped with a single otter trawl with a headrope length of 8.96m and a cod end stretched mesh size of 4cm. Entire catches were sorted and

species identified using (Fischer 1978, Cervigón et al. 1993). Species diversity was calculated using the Shannon-Wiener Index.

A Frame Survey was conducted in September 1998 to characterize the fishing activities at each of the landing sites using a questionnaire and maps to identify fishing areas. The survey was administered over one week and targeted vessel owners and captains. The data was incorporated into a Microsoft Access database and analyzed to yield information on fishing units by home port, fishing gear by home port, fishers involved in primary gear fisheries, species caught by primary gear, catches by primary gear and problems and impacts that the fisherfolk held regarding the proposed expansion.

Responses on problems in the fishing industry were grouped into the following categories; conflict with other fishers, damage to vessel/gear, dumping of garbage, fishery economic factors, lack of facilities, loss of fishing grounds, pollution by the industrial estate, safety hazards, siltation and others. Perceptions of impacts of the proposed expansion were grouped into the following categories; relocation/compensation, pollution, loss of fishing grounds, improved facilities, safety hazard, unemployment and other. Potential impacts from the proposed Industrial Estate expansion were adapted from a matrix developed from a programmatic environmental impact assessment conducted by the Institute of Marine Affairs (1999a).

The resulting impacts on the fisheries were categorised into terrestrial, nearshore and offshore environments of the coastal area. The impacts were further classified based on effects on the fisheries ecosystem and social and economic benefits of the fisherfolk. The linkages as well as causal relationships between the different groups of potential impacts were identified and expressed in the form of primary, secondary and tertiary potential impacts.

## RESULTS

### **Fish Resources of the Nearshore Area**

The species composition of the nearshore area in the region of the proposed expansion is diverse comprising 100 species from 56 families. The fish group consists of 68 species from 34 families. It was dominated by clupeoids, scianids, haemulids, carangids and plueronectids. There were five penaeid shrimp species; white shrimp *Penaeus schmitti*, pink shrimp *Penaeus notialis*, brown schrimp *Penaeus subtilis*, red-spotted shrimp, *Penaeus brasiliensis*, and sea-bob *Xyphopenaeus kroyeri*, and four species of portunid crab. The Shannon-Weiner diversity indices for the six trawls ranged from 2.02 – 2.67, indicating a high diversity. Juveniles of many species of fish, shrimp and crabs were present (IMA 1998b) as well as gravid females of the white shrimp and portunid crabs.

### **Fishing Facilities**

Orange Valley is the largest landing site of the four sites with two slipways, two net and boat repair sheds, an engine repair area and an 80-locker building. The adjacent wholesale market consists of a tiled building with aluminum tables. Cold storage facilities in the market are no longer operational and are used for general storage. This market is one of the three largest fish markets in Trinidad. At Brickfield there is a slipway, locker building with storage for approximately 45 lockers, and a net and boat repair shed. There are no useable facilities for fisherfolk at Carli Bay, and the fish are landed on the beach and the boats are anchored in the Bay. At Waterloo, the fisherfolk have constructed makeshift storage areas for their engines and gear, and to repair nets. More permanent concrete storage buildings are replacing some of these temporary structures and a slipway is presently under construction by the fisherfolk. There are a few stalls for selling catches, and there is neither electricity nor pipe-borne water supply. With the exception of Carli Bay, all the sites are easily accessible by roads.

### **Fishing Methods**

The fish resources are exploited by a variety of fishing methods and the resulting fisheries are categorised by gear type (Table 1). There are the gillnet, line, trawl and Italian seine or tuck seine fisheries. The trawl fishery comprises four fleets based on the size of vessel and degree of mechanisation (Kuruville et al. 2000). Type I and Type II fleets are artisanal with a single otter trawl, the Type III is semi-industrial with a larger stern trawl and the Type IV are the industrial gulf of Mexico design vessels. The trawl fishery is restricted to Orange Valley and Waterloo (Table 1). At Waterloo however all the trawlers are Type II whereas at Orange Valley the entire Type III semi-industrial fleet is based. The gillnet fishery comprise both braided cotton multifilament and nylon monofilament nets. This is the dominant fishery at Carli Bay (Table 1). In the line fishery the primary fishing method is the bottom-set long-line locally called "palangue" which has about 2000 – 5000 hooks per line. A boat may have 1 to 3 palangues. Other secondary methods used by the line fishery include banking, towing, and "a-la-vive". Found only at Carli Bay, the Italian seine or Tuck seine is made of a much heavier braided cotton and use like a purse to catch schooling pelagics.

### **Fishing Areas**

The fisherfolk from the four landing sites exploit fishing areas throughout the Gulf of Paria, the south coast and north coast of Trinidad. The fishing areas are dependent on the type of vessel, engine size and time of year. They predominantly fish in the Gulf of Paria, but industrial trawlers extend to the north and south coast. Artisanal Type I and II trawlers concentrate their fishing around Point Lisas.

**Table 1.** Summary of fishing methods, boats and fishermen at four landing sites on the west coast of Trinidad

Landing Site		Fishing Methods	No. of Boats	No. of fishermen
Carli Bay	Gillnet	Monofilament (P)	9	26
		Multifilament (P)	2	8
		Multi/monofilament (P)	2	2
	Line fishing	Banking (P)	1	1
		Italian Seine (P)	4	32
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Orange Valley	Gillnet	Multifilament (P)	1	3
		Monofilament (P)	4	11
	Line fishing	Bottom set long-line (S)		
		Banking (S)		
	Trawling	Type I (P)	1	2
		Type II (P)	5	22
		Type III (P)	10	15
	Type IV (P)	5	22	
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Waterloo	Gillnet	Monofilament (P)	1	2
	Line fishing	Bottom set long-line (P)	4	11
		Banking (S)		
	Trawling	Type II (P)	8	27
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Brickfield	Gillnet	Monofilament (P)	3	9
		Line fishing	17	51
		Banking (S)		
		A-la-vive (S)		
		Towing (S)		
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<b>TOTAL</b>			<b>77</b>	<b>244</b>

(P) - Primary fishing method

Type I - Artisanal otter trawl

Type III - (semi-industrial) Stern trawl

(S) - Secondary fishing method

Type II - Artisanal otter trawl

Type IV - (industrial) Gulf-of-Mexico trawl

### Catch Data

Monofilament gillnets are usually bottom-set for demersal species mainly sciaenids and lutjanids. At Carli Bay the target species is the yellow mouth croaker, *Micropogonias furnieri*. The multifilament nets are generally set at the surface for pelagics mainly scombrids such the Spanish mackerel *Scomberomorus brasiliensis*

and the kingfish, *S. cavalla* and carangids. Daily records from the Carli Bay Fishing Co-operative Society Limited showed that 260 metric tons (mt) of fish were landed valued. This was locally valued at TT\$ 1.45 million. This value is the ex-vessel value and does not take into account the added value of the catch. Of this landed catch, *M. furnieri* accounted for 213 mt locally valued at TT\$ 1.07 million. Estimates from the Frame Survey suggest that for Orange Valley, Waterloo and Brickfield, this fishery landed approximately 82 mt, 8 mt and 49 mt, respectively. Trawling is the most important fishery both in terms of landed weight and value. The target species for the trawl fishery are five penaeid shrimp species. Important fish species caught include *M. furnieri*, and *Cynoscion* spp. The artisanal trawl fishery for Orange Valley and Waterloo were estimated to have landed 138mt and 141mt annually. No estimates for the Type III trawlers were available from the Frame Survey. Estimates from the Frame Survey suggested that 282mt for the Type IV trawlers were landed annually. The line fishery targets both pelagic and demersal species depending on the gear type employed. Species include *S. brasiliensis*, *S. cavalla*, *Caranx hippos*, crevalle jack, *Cynoscion* spp. lutjanids, and carcharhinid sharks. Based on the Frame Survey 588mt of fish were landed for Brickfield. The Italian seine targets schooling pelagics such as *S. brasiliensis* and *S. cavalla* and herrings. No verifiable catch data were available for this fishery.

### **Markets**

The three wholesale markets are located on the west coast of Trinidad, including the Orange Valley fish market. Despite this, most of the catch is landed at the homeports of vessels. Catch is purchased by wholesale vendors and retailed to processing plants, smaller buyers, restaurants and supermarkets. Fish is also sold in the communities by other vendors. The fish from the gillnet fishery landed at Carli Bay is exported to Canada, the United States and occasionally the United Kingdom. The Type IV vessels are the only exception in landing their catch at all the major wholesale markets, predominantly at Port of Spain and Orange Valley. Most of the shrimp from the semi-industrial and industrial fleets are exported to the United States and other Caribbean countries.

### **Socio-economic Profiles**

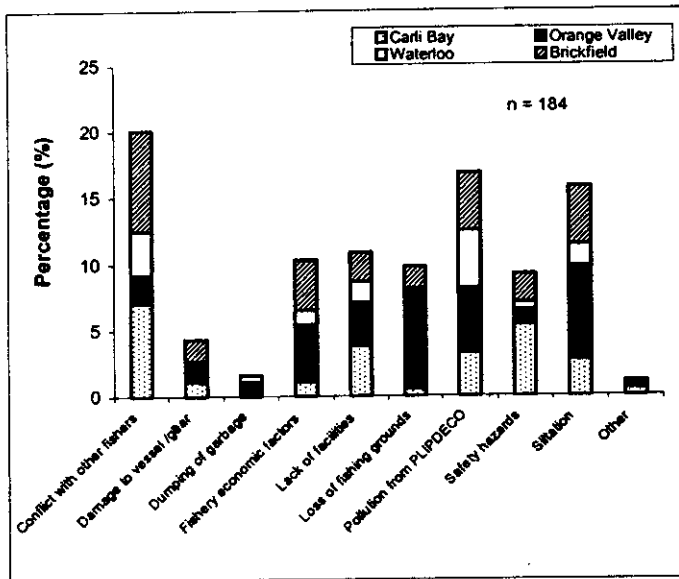
Fishing is an all-male occupation providing employment for fisherfolk in Carli Bay, Brickfield, and Waterloo. More than 75% of the boat owners and captains are engaged full-time in the fishing industry. Other occupations include, truckers, masons, and workers in the sugarcane industry. Most of the boat owners and captains fall within the 30-59 age group. The most common primary reason for choosing fishing as an occupation was family tradition and a lack of an alternative employment option.

### **Problems in the Fishing Industry as Identified by the Fisherfolk**

The major problems identified by the boat owners and captains at the four landing sites were conflict with other fisherfolk (20.1 %), perceived pollution from

the Point Lisas Industrial Complex (16.5%) and siltation (15.8%) (Figure 2). Other problems include lack of facilities (11.4%), fishery economic factors (10.8%) and damage to vessel or gear (9.1%). Conflict among the fisherfolk is largely related to the trawlers, with fishers from the line and gillnets fisheries at Brickfield and Carli Bay having the highest percentage of conflict with them.

Some problems are specific to a landing site. For example, siltation was highest for Orange Valley and Brickfield. At these sites, the mudflats can be completely exposed for about 200-300 m from the shoreline at low tide. Loss of fishing grounds is closely related to the trawlers who indicated that areas outside of the existing Point Lisas Industrial Estate was once prime trawling grounds. The close proximity of Carli Bay to the Industrial Estate is also related to the loss of fishing grounds. Safety hazards mainly related to theft and piracy has affected the Carli Bay fisherfolk and their practice of operating at night makes them particularly vulnerable.



**Figure 2.** Perceived problems in the fishing industry by fisherfolk at four landing sites on the west coast of Trinidad

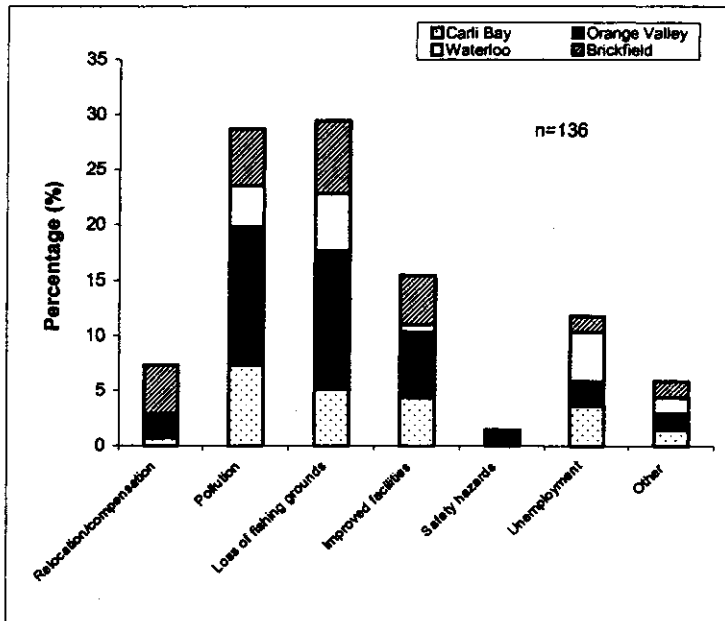
### Perceived Impacts of the Industrial Expansion

The major concerns expressed by fisherfolk are increased loss of fishing grounds (29.4%) and pollution (28.7%) (Figure 3). About 50% of the responses for these two issues were from trawlers who concentrate their fishing effort for shrimp in the vicinity of the Point Lisas area. Unemployment (11.8%) was considered by some



to impact negatively on them as result of the expected decrease in catch associated with pollution and loss of fishing grounds.

Only 7% of the fisherfolk perceived the issue of relocation of their fish landing site and the possibility of compensation. Most of these responses were from fisherfolk in Brickfield which is outside of the industrial expansion area. One positive impact that the expansion was perceived as bringing was improved facilities for the fisherfolk.



**Figure 3.** Perceived impacts to the fishing industry by an expansion of an industrial estate at four landing sites on the west coast of Trinidad

### Potential Impacts

The potential impacts of the proposed expansion inclusive of the port facilities are summarised in Figure 4. The negative effect on the fisheries ecosystem has the potential to reduce the livelihood of the fisherfolk and disrupt the social cohesion of the communities. In the terrestrial region of the coastal area where the fishing facilities are located and the point from which fishing activities are launched, the main issues revolve around the possible physical loss of the landing site. This is a greater threat at Carli Bay and Orange Valley since both sites are well within the proposed expansion. The presence of a fueling facility at Orange Valley may pose a hazard to the industrial development.

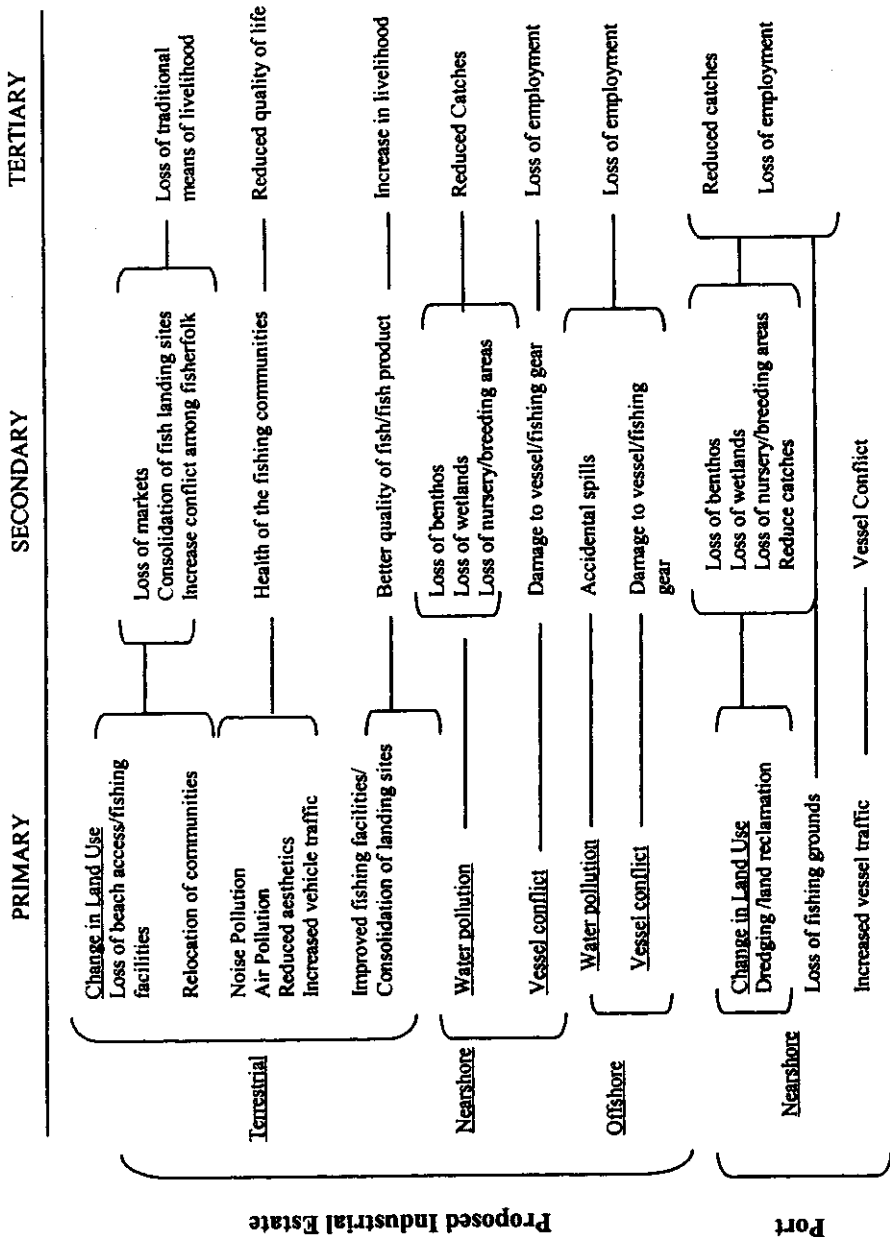


Figure 4. Potential impacts of the proposed industrial estate and port development on the fishing activities at Carli Bay, Orange Valley, Waterloo, and Brickfield, Trinidad

The possibility of a consolidation of all the landing sites will most likely cause problems because of the existing conflicts among the fisherfolk. However interviews with fisherfolk suggest that these conflicts may be mitigated if the expansion accommodated sufficient berthing facilities and increased marketing facilities. Since Orange Valley is also the third largest wholesale market on the west coast, disruption to its activities or existence will affect not only local distribution but also shrimp exports.

The environmental quality of the habitats in which the fish resources are exploited are of prime concern because of the threats of heavy metal, inorganic and organic pollution from effluents discharges into the environment. The most important environmental problem in the coastal areas of the Gulf of Paria is the nutrient load to coastal waters (UNEP 1999). Levels of petroleum hydrocarbons in marine sediments in the Gulf is also high (Ibid.). This pollution threat was one of the major concerns of the fisherfolk. Additionally, the loss of wetlands concomitant with reclamation of land for port and estate development will reduce the size as well as the productivity of the nearshore area. This area acts as nursery and breeding grounds for the exploited penaeid shrimps and some crabs and fish species. While most shrimp larvae may arrive in the plankton from the South American shelf, the local abundance of adult shrimp stocks is dependent upon the quantity of juveniles inhabiting the nearshore area (Morton and Talbot 1996). The availability of suitable habitat is an important factor affecting the local abundance of shrimp. This may affect both the artisanal trawl, the semi-industrial and industrial trawl fisheries. One shrimp species, *Xiphopenaeus kroyeri*, because of its absence in catches from semi-industrial vessels in the Gulf of Paria is thought to complete its entire life cycle within the nearshore area (Amos 1990).

Loss of fishing grounds of non-trawlers was considered as a potential impact due to the possibility of increased vessel traffic and restricted access by companies in the expanded industrial estate. Loss of fishing grounds by trawlers in the nearshore areas was not considered an impact of the proposed expansion because of the Fisheries Regulation (1998), which created a no trawl zone in the Gulf of Paria extending one nautical mile from the coastline. Although this Regulation was in effect at the time of the Frame Survey, the fisherfolk continued to fish in these waters, their previous fishing grounds, because of a lack of enforcement.

Decrease in catches as a result of environmental degradation, loss of the landing site, or marketing of their product will lead to loss of income and loss of livelihood to the fisherfolk. For those with fishing as their only source of employment, it would be difficult to find alternative jobs. Capital-intensive developments demand relatively small amounts of skilled labour, which is not available in the communities (IMA 1998a). Statistics for 1990, showed that only 409 jobs or 7% of the work force at the existing industrial estate came from within the communities (Manwaring and McShine 1991). Many of the fisherfolk chose fishing because of family tradition and several of them at a landing site are related, therefore loss of earnings and jobs can also affect the social structure of the communities. While 244 fisherfolk directly

fished, this does not include the retail and wholesale vendors, processors and their employers, net repairers and boat builders, marine equipment suppliers and exporters, who may also be affected in varying degrees depending on the severity of the impacts, affecting the social cohesion of a much wider community.

#### DISCUSSION

The fish landing sites at Carli Bay, Orange Valley, Waterloo and Orange Valley land more than 1,500 mt of fish and shrimp, but no accurate value of these resources is available. This value is an approximation based on results from the Frame Survey and secondary data from the Fisheries Division and the Carli Bay Fishing Co-Corporative Society Limited. The quality and quantity of the fish resources exploited is dependent on the quality of the natural environment. The described fishing activities of the landing sites show that if these activities are presented as a system representing the fisheries ecosystem, the social and economic considerations as well as the fisheries management regimes as components then the likelihood of predicting impacts are clearer when the linkages between these components are highlighted. The numerous concerns expressed by the fisherfolk indicated that this group of stakeholders has concerns about the proposed expansion, which has the potential to affect their livelihood. When these potential impacts are taken into consideration with the changes already taking place within the fisheries sector, it demonstrates a differential vulnerability of the landing sites and a similar ability to cope with such changes. The concerns and needs expressed by the fisherfolk need to be taken into consideration into any developmental plans of the estate. There must be continuous dialogue between the developer and the fisherfolk, possibly through consultative workshops and meetings with representatives from government fisheries agencies also in attendance. One such example is the consolidation of landing sites, because of the siltation problem on the west coast and the need to provide cost effective facilities to meet export standards (Kishore et al. 1999). Dialogue between the fisheries sector and the energy sector should be encouraged so that the final design of the expansion of the industrial estate can accommodate fishery related activities resulting in least disruption to the landing sites.

The issues of resource allocation and conflict resolution among the multiple users of the coastal area can be dealt with in the context of coastal area management (FAO 1998). However, after a thirty year history of such initiatives towards this goal (McShine 1996), there is no legislative framework for coastal area management. Many of the issues are dealt by existing planning, research and administrative machinery (Clark 1998). The establishment of an Environmental Management Authority in 1995 and the development of a national environmental policy to regulate pollution provide some means of consolidating and addressing issues from a fisheries perspective. Of particular importance is the environmental impact assessment (EIA) process that is now mandatory for certain types of development including industrial development, in obtaining certificate of clearance approval. However, perusal of available environmental impact assessments reveals

that the fishing activities of the targeted area is poorly characterized and the linkages between the environmental quality of the habitat fished, fish resources, gear used, and their contribution to the economy both at community and nationally levels is weakly articulated. In addition, the creation of jobs and the traditions of the fisherfolk should also be reviewed for their contribution to social cohesion of these coastal communities. A large part of this under-representation is due to the low contribution of the fisheries sector to the economy. Statistics for fisheries generally never reflect a true economic value of the fisheries, as the added value is not evaluated. This is one of the weaknesses in the fisheries sector that is reflected in the EIA.

The fisheries sector needs to take the responsibility for being recognised and included in coastal area planning. As part of the consultative process and to correct existing inadequacies, the fisheries sector can take the initiative in the development of standards for the manner in which the sector is represented in environmental impact assessments. This scenario presented in this study is not isolated and is taking place in other locations in Trinidad and Tobago. One output of such standards for the fisheries sector can be a vulnerability index of the fish landing sites to potential impacting activities due the multiple uses of the coastal areas.

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