

# Developing a Shrimp Bycatch Utilization Program

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## RESUMEN

En un mundo plagado por la amenaza de escasez de alimentos, puede ser real el rayo de esperanza que ofrece el programa de utilización de la fauna acompañante del camarón. El programa ha encontrado usos aceptables para especies subutilizadas o no utilizadas. Ha abierto una brecha revolucionaria al proveer materia prima barata—pescado desmenuzado para conversión a materiales básicos para toda una gama de productos. Las posibilidades del programa son tan grandes que preponderan sobre los problemas asociados con la pesca tradicional del camarón. El recoger el pescado, el desarrollo de procesos para nuevos productos y el romper barreras tradicionales para la introducción y aceptación de los productos por el consumidor, son aspectos estimulantes.

El creciente costo de los alimentos y el alto valor nutritivo del pescado han ayudado al desarrollo de este programa, para provecho de todas las estratas de la sociedad. Esto es posible por el hecho que el pescado desmenuzado es, de tal modo, factible y razonablemente estable como material base, que puede elaborarse en productos de bajo costo al igual que en productos más sofisticados.

El temor a alterar el sistema ecológico, prácticamente ha desaparecido porque el nivel de recolección es actualmente más bajo que las cantidades provenientes de los barcos de arrastre.

La ponencia traza el desarrollo de un programa en un país costero de Sur América y destaca los problemas, éxitos y esperanzas de esta acometida revolucionaria.

Como resultado de estos adelantos, se espera ver en el futuro más y más estados costeros desarrollando programas de aprovechamiento de estos recursos en concomitancia con sus empresas camaroneras.

## RESOURCE POTENTIAL

The name "Guyana" means land of many waters. This is manifest in its three large rivers, the Essequibo, Demerara and Berbice. The largest of these, the Essequibo, flows for 600 km from its source to the sea. The fishery productivity zone receives a large volume of nutrient rich and sediment bearing water from the Orinoco (Venezuela) and the Amazon (Brazil) as well. These large volumes of non-polluted fresh water support the growth of phytoplankton off the mouths of these rivers and the westward flowing south equatorial currents distribute the phytoplankton and nutrients along the coastal areas resulting in extremely productive waters.

Various studies and surveys have confirmed that there are large fish and shrimp resources along the Guyana Coast, part of a continuous continental shelf extending along the north coast of South America. The UN/FAO Report (F. Millerd and L. Videaus) dated July 1969 records catches of 244 kg/h of fish caught in depths of 8 to 24 fathoms. This average marketable fish catch was made up as follows: sea trout (*Cynoscion virescenes*), 60%; croaker (*Mi-*

*cropongon furnieri*), 16%; banga mary (*Macrodon ancylodon*); 18%; mixed fish (Stromaeidae, *Nebris microps*), 6%. Surveys also indicate seasonal variations from a low in November to February to its highest rate in June to August.

This and other regional reports indicate the high volume of fin-fish in the areas and in depths in which the shrimp trawlers operated. These facts prompted observations which led to the realization that large fin-fish discards were made by shrimp trawlers. Studies by the R.V. OREGON II in the early 1970's along the north and north-east coast were mainly in connection with the composition of the catch of commercial shrimp—brown shrimp (*Penaeus aztecus subtilis*), pink shrimp (*P. duorarum notialis*), pink spotted or hopper (*P. brasiliensis*) and white shrimp (*P. schmitti*) but these surveys also were interested in the composition of the fish biomass in the shrimp vessel operational areas. The total live catch was recorded in these cruise reports as total fish, total crustaceans and all remaining organisms. These reports show fish (85% plus) to be the major portion of the biomass caught in these shrimp trawl investigations. Based on this, it was calculated that approximately 200,000 tons of fin-fish were discarded in this area as the incidental catch of the shrimp trawl industry. Of this amount about 60 to 80,000 tons could be said to be in the coastal area adjacent to Guyana.

Fish caught in these investigatory cruises fell into three main categories: (1) edible fish presently being used for human consumption, (2) edible fish not acceptable traditionally for human consumption, and (3) non-edible fish for pet or animal food. The edible high preference species were the snappers, *Lutjanus purpureas* and *L. synagris*; groupers *Epinephalus* spp.; Sciaenids, *Cynoscion acoupa*, *C. jamaicensis* and *Nebris microps*. In this group there were some from categories (1) and (2) depending on the geographic area of the country and traditional eating habits.

Incidental fish catches varied by area and depth zone off Guyana and ranged between 50 to 500 lb/h. The highest catch rates were between 5 to 10 fathoms (520–1680 lb) and the lowest 16 to 40 fathoms (77 to 203 lb).

#### Awakening of Interest

The common practice of discarding fish by the shrimp trawlers has been a problem from the inception of the industry in Guyana. The availability of the investigatory figures and the awareness of the volume of this waste added to the consciousness of the problems. The government therefore in its program to secure an economic source of protein for a fast growing young population began to look to the sea for this source. Early in the 70's the opportunity presented itself. The shrimp industry had its first major setback. After years of almost unhindered operations jolted by the first major price in fuel, the owners saw their operations going under as a result of higher operational costs.

The Government was quick to appreciate the situation and made a "gentlemen's" agreement with the owners in an effort to stabilize their operations. The agreement in short was "that every commercial shrimp trawler shall bring in not less than 2,000 lb fresh edible fish per vessel per trip." In conse-

quence of this agreement, the Government would waive the export tax of 2.5¢ (US) per lb of shrimp. (These mandatory fish landings have been raised to not less than 4000 lb per vessel per trip). In return, the government set a price of 5¢ (US) per lb for fish delivered. (This price has been revised upwards many times—it is something like 15¢ to 20¢ (US) per lb.). This national program for marketing of inexpensive fresh fish has been of great advantage in the nation and to the owners. The meteoric rise in production is indicated in Table 1.

At the present time, most trawlers land much more than the agreed amount as it provides extra income for owners, captains and crew. There are still great restraints and it is obvious that still only a small percentage is brought in. The average annual species mix is approximately: sea trout, 25%; croakers, 10%; banga mary, 45%; sharks, 12%; mixed species, 8%. The figures are approximate and subject to seasonal variations.

### Early Problems

Some of the early problems remain with us today. The major one is to increase the quantity of fish brought in without decreasing the quality of the shrimp caught. On the other hand, we have been able to overcome some of the early problems like storage, handling on-board, unloading and a major breakthrough in acceptability of lesser known and used species is imminent.

The first and most basic problem, of course, was to persuade owners and captains to agree to store large quantities of fish with their valuable shrimp catch. There were logistic and scientific arguments against this, and I venture to say that the greatest success in the program was the physical agreement by owners and captains to bring in the fish.

The present operation as mentioned before will retain some of these early problems. For example, some of the fleets operate between 20 to 40 fathoms and do not find fishing for fin-fish very productive and almost impossible to store over the trip period. These vessels must therefore come to shallower water and carry out special efforts.

Table 1. Fish landings in Guyana (1975 to 1979)

Year	Artisanal Fishery Quantity (lb)	Fishery % Total Production	Industrial Fishery Quantity (lb)	Fishery % Total Production	Total Productivity
1975	30,444,300	87	4,677,700	13%	35,122,000
1976	30,905,000	88	4,095,000	12%	35,000,000
1977	43,960,000	88	6,243,000	12%	50,203,000
1978	34,648,000	86	5,788,000	14%	40,436,000
1979	34,480,000	81	8,252,000	19%	42,732,000

Source: Fisheries Division, Ministry of Agriculture, Georgetown, Guyana (1979).

These problems have produced many ideas for solutions: (1) A method of collecting a larger quantity of this incidental catch. (a) Shall we use collector vessels or is this operation too expensive? (b) Can we use radio identifiable rubber dinghies to store the fish in chilled sea water and tow these to shore later, or will this attract pirates? (c) Can we fit chilled sea water tanks on the rear deck of existing trawlers? (2) Design a vessel with a multiple temperature hold to store fin-fish and shrimp in separate compartments. (3) In order to further the process of acceptability of some species, to continue work in the minced fish production and stabilization.

The handling of small banga mary has and will continue to be a problem but much time and effort is being exerted in this area.

It is estimated that at least 80% of the catch by shrimp trawls is fish and this was formerly discarded into the sea. However, in 1979 of an estimated 17.5 million tons harvested as bycatch only approximately 4.3 million tons was landed. Fears were expressed earlier that the landings of this resource would in some way affect the ecological system, but these fears have so far not been justified.

### Handling and Storage

The captains and crews had to devise a new method of handling and storing both shrimp and fish. When the catch was made, the shrimp were picked out, frozen, and then packed in special polythene bags for storage in the hold. Selected fish were washed and air-freeze dried in the passage way of the hold. When these were stiff, they were stored in bins to be brought in. Because of inexperience in the early days, fish arrived in port frozen in a solid block and had to be thawed before unloading. Later, with experience and experimentation, it became possible to bring in good quality fish that could be easily unloaded.

The program received a great fillip when the fisherman became aware of public appreciation, because for the first time the industry was making an impact on society. Justification also came in the form of monetary returns to owners and captains engaged in a tight economic operation. With this plus, on the side of production, there was a corresponding minus in the problem of marketing some of the species, and the additional large quantities over and above the artisanal fish production. New, acceptable and exciting processes had to be found in order not to frustrate the fisherman.

### Pricing, Policy, Unloading, Checking

All of these were new areas and in the beginning improvised arrangements were made. There were occasions when fish received were not of top quality and some were of such poor quality that they had to be dumped. Thus the problem would arise who was to be blamed and who would suffer loss. These problems made it necessary to consider alternative methods for handling, storage, utilization and the education of captains, crews and processing plant staff.

## Organizing the Program

Having tackled the initial problems and awakened an awareness of the potential of the resource, it was possible to receive some interest in return. It was felt very early that this resource should be used to implement an export program because of an impending foreign exchange constraint. If this was to be done, the policy would naturally be to process this fish into the traditional imports of dry salted, smoked and canned products.

This policy, however, hinged on securing foreign capital investment to implement the program. Work was initially started in the area of dry salting and smoking; areas that required very little foreign capital. The establishment of technology with the attendant constraints was time consuming since the basic technology had evolved in some of the developed industrial areas where sun drying has ceased to exist as a hygienic and economic method of drying. To develop alternative techniques and also good hygienic quality and an economic standard of production, local efforts had to be exerted. This also applied to smoked fish. Having established some systems and standards, the facilities to transform these experiments into pilot plant equipment and pilot plant operation had to be found.

*Salting.*—The equipment and methods used were simple but effective. In the case of dry salting, we built sloping salting floors, with old stainless steel plates from a plate freezer. The fish were salted and piled in mounds which were broken and rebuilt with the top becoming the bottom of the pile.

The fish were piled for 4 days, then broken and left for a further 3 days. On the 4th day the pile was again broken and the fish passed lightly through water. The fish were then spread on racks made of fishing nets, in the sun, and covered with thin plastic.

*Smoking.*—Smokers were made from 45-gallon drums with one end removed and made into a cover. A door was cut in the side at the bottom in order to accommodate the heat or smoke chamber. A chimney was fixed to the cover. This simple equipment and method took us to the stage of our first consumer test and established the capability to produce. The unknown factor now was the ability to build up these systems, as well as to produce quantities of a level to satisfy at least the domestic market.

## THE RESEARCH AND DEVELOPMENT PROGRAM

The work thus far had not gone un-noticed and had attracted the attention of the International Development Research Center (IDRC). The Associate Director (Fisheries) had for some time drawn attention to the potential of this resource in a world situation of diminishing new protein sources and it was this organization's intervention in 1973 that made it possible to start an in-depth development program.

The work program between IDRC and the Government of Guyana had the following objectives: (1) To develop top quality edible protein food from under-utilized resources and to assess the fish resources as to the abundance of various available secondary species and as to the chemical composition and biological value of groups of related species, (2) To study marketing and

Table 2. Species of fish most preferred distributed according to age group of respondents

Species	Age Group (yrs.)				Not Stated	Total (%)
	≤35+ (%)	36-45 (%)	46-65 (%)	>65 (%)		
	(N=220)	(N=103)	(N=103)	(N=18)	(N=2)	(N=466)
Red snapper	43.6	46.6	43.7	44.4	50.0	44.4
Trout	10.0	11.6	13.6	5.6	50.0	11.2
Shark/Fish*	4.1	1.9	1.9	-	-	2.9
Cavalli	4.1	-	1.0	-	-	0.5
Bonito	0.5	-	-	-	-	0.2
Flying fish	0.5	-	-	-	-	0.2
Other (mainly banga mary and croaker)	36.3	35.0	36.9	38.9	-	36.1
Salt fish	-	-	-	-	-	-
No favorite No specific type	4.1	4.9	2.9	11.1	-	4.3
No response	0.5	-	-	-	-	0.2

\* Naturally scaleless or fish possessing very tiny scales.

† Rounded.

consumption patterns that exist with present imported fish and to evaluate the acceptance of new products by the consumer, (3) To develop low cost products such as salted, smoked and minced fish, (4) To develop higher value products such as fresh and frozen and canned fish products, (5) To develop miscellaneous products such as ready-cooked and boiled and dried fish, canned anchovy types, fried fish and vegetable products and soup mixtures, (6) To develop recipes and publications for the promotion of the new products, and to (7) develop standards and techniques of quality control.

These objectives were so successfully achieved in the first phase that a second phase was approved in 1979.

In addition to the traditional items (salted, smoked, pickled etc.) the greatest breakthrough was in the adoption of the "minced fish" technology. Extensive consumer acceptability and taste panel tests were carried out in Guyana including all sections of the society. Needless to say there were problems of superstitions and the common problems of likes and dislikes (Table 2). However simple these may have appeared, they all had to be taken into consideration.

Another program problem was the species composition of banga mary, croaker and species of shark. Special attention had to be paid to these, particularly in the "minced fish" production to utilize the low interest species.

Table 3. Preference for meat type by reason

Reason	Commodity Preferred							Total <sup>†</sup> (%)
	Chicken (%) (N=181)	Fish (%) (N=176)	Beef (%)* (N=52)	Pork (%) (N=9)	Mutton (%) (N=4)	Other (%) (N=5)	No Specific Meat/Fish (%) (N=18)	
Economical	12.1	11.4	3.9	-	-	-	11.1	10.3
Taste	18.8	26.7	19.2	33.3	-	20.0	-	21.3
Nutritional value/ Health reasons	7.2	21.0	25.0	-	25.0	-	-	14.4
Availability	5.5	3.4	1.9	22.2	-	20.0	5.6	4.7
Personal/Family likes	39.8	27.3	40.4	33.3	75.0	60.0	27.8	34.8
Easier/Quick preparation	13.3	9.6	-	-	-	-	-	9.2
Other	-	-	1.9	-	-	-	5.6	0.4
No reason	2.2	-	7.7	11.1	-	-	22.2	2.9
No response	1.1	0.6	-	-	-	-	27.8	20.0

\* Rounded.

† Includes one no response to any preference.

Source: Systems Group of Companies, Caricom Secretariat Report, 1980.

### Market Survey and Study

Organized market study and survey has disclosed the high economic value of the program, not only to Guyana but to the Caricom Region.

Food preferences as determined by surveys are reported in Table 3.

### SUMMARY

Two major concerns have surfaced as a result of in-depth investigations into bycatch utilization: (1) the quantum of this resource and the urgent need to increase and improve the landings, and (2) the need to make greater use of under-utilized species for human consumption.

Under (1), serious consideration is being given to: (a) The use of collector vessels. The study of the economics of this operation seems to rule it out except for some primary processing done on this vessel. (b) An ODM recommendation based on a study in the area seems to suggest the use of radio identifiable rubber dinghies. The trawlers would deliver periodically their catches to the dinghies which would later be towed to the shore factory. (c) Experiments with chilled sea water tanks have been both promising and economic. Most gulf-type trawlers can accommodate a 4-5 ton tank on the rear deck. (d) Careful studies are now being undertaken to use multi-temperature

hold vessels. The entire hold of the vessel is to be redesigned to accommodate fish and shrimp.

Consideration under (2) center around the development, stabilization and use of minced fish. There are many hurdles to be crossed in this new product, and some of these surfaced in the program under review. The main ones are: tradition, religion, folklore, appearance, taste, and smell. When these have been successfully tackled and overcome, we have a product of tremendous potential. The product is so flexible that it is capable of being a base material for low priced as well as sophisticated processed products.

This product was also used in two experimental programs: (1) School feeding to children who did not particularly like fish (results 85% acceptance). (2) Malnutrition child cases. The material fed had a 28% protein content and resulted in an 18-20% improvement in the condition of those treated on a twice daily intake over a 30-day period.

The limits to the bycatch utilization program seem endless, with special emphasis for those young coastal states with population explosions. With very few sources of cheap protein available, it would seem that the sea is the only logical answer.