A long range program to establish a tuna fishing industry requires planning and services similar to those of the Pacific Coast, including:

1. Training program for local fishermen.
2. Adequate baiting facilities.
3. Accurate plotting of fishing banks and recording of seasonal variation in abundance and locality.
4. Studies of ocean currents as an aid for fishing and navigation.
5. Establishment of reciprocal customs port entry requirements, regulations, etc., between participating governments for the fishing vessels.
6. Forming a control organization for collecting and disseminating information.
7. Installing adequate freezers for collection and distribution of fish.

The pioneering aspect of this project may seem complex, but the comparatively close association with the Pacific fishery and world interest in tuna should be an excellent source of information and assistance for its initiation.

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Haiti's Fisheries and Their Potential Development

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IN 1954, following the missions of two FAO fish culture experts to Haiti, during which much was done to establish fish culture in the country, the Haitian Government requested FAO's assistance to survey her existing fisheries, potential fisheries resources, and to advise and assist her in formulating and implementing a fisheries development program. In May, 1955, the writer arrived in Haiti to carry out this assignment.

The basic economic reasons for this request are clear. Haiti imports each year some 15,000,000 pounds of salted and smoked herring and cod, mostly

from Canada, worth nearly $1,500,000 CIF, which she can ill afford. At the same time her existing fisheries are in a very primitive state, and those employed in them operate at subsistence level. Any development in her indigenous fisheries would thus have the merits of reducing the flow of money from the country, improving the economic position of the country's fishermen, and, as the standard of living rose, of increasing the consumption of animal protein among the peasant population.

The first months in Haiti were spent travelling around the coasts, visiting the fishermen's villages. These journeys were made either by truck, by boat, on foot or on horseback. Besides making a census of the fishermen, their boats and gear, an appreciation was gained first hand of some of the physical factors, such as the prevailing wind and sea condition, and the coastal geography which controls what operations are possible. Some parts of the coast, for instance, are fringed by impassable reefs, others are bounded by continuous cliffs; in other places there are excellent harbors, and many open, sandy beaches are to be found. Sea conditions off the north and south coasts are generally worse than in the Gulf of La Gonave to the west of the island, since they are open to swells which reach them after uninterrupted passages across wide stretches of ocean. The sea conditions all around the island are influenced by the normal on-shore, off-shore cycle of winds caused by the daytime heating and night time cooling of the air over the land. The fishermen use the off-shore morning breezes to sail to their fishing grounds, and the on-shore afternoon breezes to return.

Internal communications in Haiti are slow. Few surfaced roads exist, and rains frequently temporarily cut off one from another. This, combined with the low purchasing power of the peasant farmer and his taste for salted fish, point to improved salting methods and perhaps the introduction of smoking as the most suitable preservation methods at this time, except in the very few towns where ice making plants exist. At present, a high proportion of fishermen fish primarily for their own needs and those of their families. Any surplus is bought by travelling saleswomen, known locally as Madam Sarahs, who salt it lightly with impure locally produced salt, partly dry it, and carry it a few miles inland, usually on donkeys, for resale. This fish normally keeps for about three weeks. Sometimes a load is carried to a market center like Port-au-Prince, where it sells for about 10 per cent more than it will bring in the country. The high prices paid by the very poor peasants for imported salt-fish are surprising ...herring 22c-25c per pound, and cod 25c-35c per pound... until it is realized that these fish are used not so much as an article of nourishment, but as a condiment with the salty or smoky flavor being imparted to the whole family's dish of rice.

The Haitian fisherman's gear is extremely simple. His boats range from "pri pris" through dugout canoes and flat bottomed "corallains," to twenty foot sailing boats. The pri pri is a simple wooden raft, sometimes made of bamboos lashed together, sometimes of more substantial logs, sometimes paddled, sometimes sailed with the aid of an old flour sack. It is almost certainly a direct descendant of the original Indians' rafts which were called pipirites, the word having now become corrupted into pri pri in the north and piri piri in the south. The typical sailing boat is carvel built, and is normally of very rough construction. This is due more to the quality of the materials which are available and the limited purchasing power of their clients than to lack of skill

in the shipwrights. Some of them make a very creditable boat considering the tools at their disposal, but this is not to say that there is not considerable room for improvement in the over-all standard.

Of the various fishing methods employed, hand lining is the most common. Longlines are also known, but although very effective, they are not very widely used owing to the risk of losing a considerable sum of money at any one time. Independently floated lines up to about one foot in length are also used for taking needlefish (*Ablennes hians*) at the surface. Lines are also trolled by fishermen on their way to and from their grounds but this is not regarded as a very profitable method of fishing and is only carried out incidentally. Trap fishing is the second most important fishing method. The typical trap is Z-shaped, is made of woven split bamboo and has two entrances. This type of fishing, of course, is popular since it does not demand a high expenditure of energy and leaves the fisherman with the maximum time for other pursuits such as tilling his plot of land. Most fishermen are, in fact, part-time farmers who go to sea to add a bit of variety to their menu. Traps may be baited or not, depending on the whim of the owner; the bait ranges from sour oranges to fish, and sometimes crawfish. The latter are not much prized by the fishermen who prefer scale-fish, and when crawfish are taken, as sometimes happens, they may well come to this ignominious end. Shore seining is also an important fishing method, but it is limited in application. It is often carried out by nomadic groups of fishermen who erect temporary huts on the beaches and salt the major part of their catch. Shore seines are made of cotton, which is only rarely treated against rotting. Tar is the only preservative in general use. Under these conditions the webbing lasts on the average only about three months. Since shore seines may cost up to $200 when new, and the catches are small, there is small wonder that the price of fish to the consumer is high and the fisherman's profit low. The only other type of net in use is the cast net, which is widely used in shallow waters. While many fishermen know how to make a net, it is of interest that very few can repair one correctly. The only other type of fishing gear which is remotely important is the spear. Harpoons are used for taking sharks off the entrance to the Artibonite River, and crawfish are sometimes speared after being attracted to a torch at night.

In summary, there exists a very simple, badly equipped, fishery around the coasts of Haiti, operating at peasant level from sailing and rowing boats. It is prosecuted by between 7,000 and 8,000 fishermen, two-thirds of whom perhaps are part-time. Their equipment is limited in type and expensive, especially in the country districts where fish hooks may cost up to fifty times their f.o.b. price. This is due partly to bad communications and partly to high taxes. Fish preservation methods are bad. These considerations taken together spell small profits for the fishermen and high prices for the consumer.

How should the problem of developing these fisheries be tackled? It seemed that dual approach was needed; on the one side to encourage private enterprises, using as high a proportion of local fishermen as possible to undertake the comparatively large scale operations, involving powered boats which are necessary to tap high seas resources at present untouched by the peasant fishermen; on the other side to improve the fishing techniques and equipment of the indigenous fishermen, and to improve their fish curing and marketing facilities.

During the initial survey, on many occasions shoals of bonito or skipjack

(*Katsuwonus pelamis*) and albacore (*Thunnus atlanticus*) were noticed feeding at the surface. Although the local fishermen do not catch these fish, they form the basis of a prosperous industry in Cuba, where some 12,000,000 pounds are landed annually by a fleet of between thirty and forty boats using the pole and line method. There seemed, *a priori*, no reason why such an industry could not be established in Haiti, using partly Haitian and partly foreign crews. Since, from a nutritional point of view, the establishment of such an industry would be likely to give quicker returns than extension work among the local fishermen, it was decided to concentrate on this at the start.

In order to encourage potential investors in such an industry, it is necessary first to demonstrate that the fish can be caught, second that they can be caught, prepared and sold on a commercial basis. In order to test if this could be done, the Haitian Government, at FAO's suggestion, chartered the Cuban bonito boat *Santonia* in the spring of 1956 from Messrs. Mariscos del Caribe, with a skeleton crew of three. For three months she worked around the coast of Haiti and the distribution of tuna, and their proximity to available live bait at that time was plotted. Considerable concentrations were found off the northwest tip of Haiti, off Jérémie at the tip of the southern peninsula, and off the southwest coast from Aquin to Coteaux. In view of the lack of good harbors on the south coast, east of Aquin, and the fact that large concentrations had already been found, the remainder of the south coast was not investigated although there are strong reasons to believe that tuna would be found all along it, particularly in the area east of Saltrou, behind Beata Point. Minor concentrations were also found regularly off Miragoane, halfway along the north coast of the southern peninsula, and off the west end of Ile de la Tortue. The local fishermen claim that bonito occur at these places throughout the year, and experience confirmed that they could be found for at least eight months, from the start of our operations in February to their end in September.

The initial findings were encouraging, especially in view of the subjective opinion of the Cuban fishermen that there were as many, or more fish in these areas than on their home grounds. It was therefore decided to continue the charter of the boat for a second period so that commercial trials could be carried out. The base chosen for these was Môle St. Nicolas, a magnificent natural deep water harbor at the northwest tip of Haiti. Bait fish are plentiful in the bay which is situated in an arid area excellent for salting and drying, and so close to the fishing grounds that bonito could often be seen from our anchorage leaping in the bay itself. Unfortunately, these trials did not start until mid-August, near the end of the high season as experienced in Cuba. In spite of this, and the fact that there was a skeleton crew of only four Cubans aboard, supplemented by inexperienced Haitians, (who, incidentally, made considerable progress as time went on) the *Santonia* still took an average of nearly half a ton of fish a day during the month under trial. This is about the same as she averages at the height of the season on her home grounds with a full Cuban crew, a remarkable achievement due largely to the proximity of the grounds to the base of operations. A simple open-sided drying shed was built, and local women were taught to prepare and salt these fish with high grade fisheries salt imported from the Turks Islands. The results turned out very well, some samples being eaten more than six months later. The sales trials showed that, although it was a new product, it was well received.

At the end of the trials, a prospectus was drawn up showing the approximate

returns to be expected on an investment in a fishery of this sort, based on local sales of dried salted fish. The use of foreign technicians was envisaged in the key positions aboard, at least at the start, coupled with Haitian labor. The prospects seemed good even when contemplating starting operations with a fleet of only three boats. It should be remarked that the fishing boat design section of FAO's fisheries division has designed a boat specially for near water pole and line fishing out of Haiti, based on our experience. It should, of course, be borne in mind that the local market is not the only one available. There is now a tuna cannery in Puerto Rico which would probably be glad to take the higher grades of tuna, so a dual outlet might well be anticipated.

During our trials, the albacore (*Thunnus atlanticus*), which is a light meat tuna, was by far the commonest species taken, with skipjack (*Katsuwonus pelamis*) second, and yellowfin tuna (*Thunnus argentivitatus*), Atlantic little tunny (*Euthynnus alleteratus*), and frigate mackerel (*Auxia thazard*) also taken.

Unfortunately, the year following these trials proved to be one of great political instability in Haiti and this has discouraged investors. There are hopes now that an industry of this type will soon be established, but there is certainly room for more than one operator, and the prospects merit close attention.

The Haitian Government has only recently been able to turn its attention to the other potential line of development, that of improving the techniques of its indigenous small fishermen. In this respect it was first necessary to set up a mechanism through which this could be done and to deal with some fundamental problems. It has recently passed legislation establishing, for the first time in Haiti's history, a Fishery Service responsible for both inland and marine fisheries development. It has the right to operate a revolving fund for the purchase of high quality fishing gear for resale at minimum prices to fishermen through shops to be opened in coastal districts. These shops will be able to sell gear on a supervised credit basis. The Service thus has powers with which to face the basic problem of getting better equipment into the hands of fishermen who live far from shops and whose cash resources are meager. A certain amount of gear has already been ordered, so a start has been made. Again, the government is taking measures to eliminate taxes on fishing gear, an essential preliminary to the introduction, for example, of nylon, which up to now has carried a tax of 40 per cent ad valorem.

It is intended to train extension agents who will work for the Fishery Service, operating from centers to which these stores will be attached. Their main work will be the training of local fishermen, but they will also carry out some exploratory and experimental fishing. The Service also intends to teach better salting methods and to organize better distribution facilities.

What are the main unfished or under-fished resources, and what new types of gear is hoped to introduce to tap them? A complete answer, of course, is not possible, but work carried out so far points to some possibilities. After the tuna, the next most important group are perhaps the semi-pelagic shoaling fish, and of these the blue striped cavalla (*Caranx ruber*) known locally as the "carengue fine" is perhaps the most important. Dense shoals of these fish are frequently seen near shore throughout most of the year, and especially in the summer. They have been taken in trammel nets and would be likely to be taken in surface set gill nets. They have also been attracted to lampara nets at night and might be susceptible to being taken with encircling nets or lift nets. The yellowtail (*Ocyurus chrysurus*), another shoaling fish, is taken by hand

lines at night. The introduction of monofil nylon lines, and of wire lines in conjunction with hand reels, would improve the rate of fishing for these fish and for snappers which are taken at great depths by day. Deep water handlining results in the capture of some fine fish, but cotton lines are often lost to large fish and sharks. It is believed that the introduction of wire will greatly reduce this loss. Bottom and surface set longline gear will also be tried. Nylon trammel nets have proved very efficient for a wide variety of species, and local fishermen to whom some were loaned soon learned to use and appreciate them, making, for them, unprecedented catches. Gill nets are also likely to be effective for many species and will certainly be tried both at the surface and the bottom. Trammel nets are one answer to the problem of reef fishing. Set around the reefs they have taken a wide range of scale fish at night, when many fish apparently leave the shelter of the reefs. They are also effective for crawfish. Trials are also envisaged with traps woven from wire rather than the weak bamboo traps presently in use, and it is hoped that improvements will result.

These are, of course, only some of the main types of gear that it is hoped to popularize, but even so, their introduction among the small fishermen will take time and patience. Hence, the new Fishery Service has much to do to encourage and assist the development of Haiti's fisheries both on a comparatively large scale and among the peasant fishermen. There is still a long way to go before it can be said that Haiti's marine resources are being fully exploited, but there is no doubt that the seas around Haiti can produce much more than at present to feed her population. A start has now been made on this work—let us hope that it will be energetically and successfully followed up.

Experimental Trawling for Red Snapper

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THE COMMERCIAL FISHERY for red snapper in the Gulf of Mexico is carried on almost exclusively by handline operations. In many instances during recent years the fishery has taken advantage of electronic devices such as loran and depth recording equipment. The use of mechanical reels is now widespread in the red snapper fishery. The basic approach to the production of red snapper, however, has remained essentially the same during the past century, in that the hook and line method of fishing accounts for practically all of the present catch.

There have been numerous attempts to develop methods other than the handline by which red snapper could be taken in quantity. It has been recognized that the use of other types of gear in the fishery might be desirable.

Attempts by various workers have dealt with the experimental use of traps and trawl lines (Jarvis, 1935); hoop nets and mechanical reels have also received attention (Smith, 1948; Siebenaler and Brady, 1952). In some cases, the results of these experiments have stimulated further consideration regarding use of gear other than the handline in the fishery. Experimental fishing with