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CONTAINS

- 1.- Technical Conference on Fishery Products.
Tokyo, 2-9 Oct. 1973.

Theme: R-12: The present and future role of bilateral and multilateral agencies in establishing fishery product industries.

Paper: Research in investigations of some tropical fish products being supported by the International Development Research Centre of Canada.

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no. 1

TECHNICAL CONFERENCE ON FISHERY PRODUCTS

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Theme R 12: The present and future role of bilateral and multilateral agencies in establishing fishery product industries.

Paper: Research investigations of some tropical fish products being supported by the International Development Research Centre of Canada.

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I. Introductory

Fishery research and development project activities fall within the Division of Agriculture, Food and Nutrition Sciences of IDRC. Since the Centre is relatively new, it is perhaps best first to describe its purpose which is

to initiate, encourage, support and conduct research into the problems of the developing regions of the world and into the means for applying and adapting scientific, technical and other knowledge to the economic and social advancement of those regions, and, in carrying out those objects

- (a) to enlist the talents of natural and social scientists and technologists of Canada and other countries;
- (b) to assist the developing regions to build up the research capabilities, the innovative skills and the institutions required to solve their problems;
- (c) to encourage generally the co-ordination of international development research; and
- (d) to foster co-operation in research on development problems between the developed and developing regions for their mutual benefit.

It is therefore not to be confused with CIDA (Canadian International Development Agency), CUSO (Canadian University Services Overseas), FRB (Fisheries Research Board), university institutions or other agencies in Canada with which close cooperation may be developed when relevant for the execution of any specific project being supported by the Centre. It is also noteworthy that in endeavouring to foster cooperation between the institutions of developed and developing regions, the selection of expertise for consultancy advice is not restricted to any national source. Similarly, the purchase of required equipment for any project is not confined to any monetary area.

With regard to areas of activity the Centre has given greater emphasis to needs of the semi-arid tropics. In Fisheries, the focus has been on the pragmatic problems associated with increased profitability of rural fishing activities. Such a focus, however, endeavours to deal with the problems in as comprehensive a way as possible with realistic objectives but taking account of related factors and liaison with other institutions. This is particularly important in respect of fish product improvement in less developed countries since all sectors of the industry are closely integrated and interdependent.

II. Some significant factors in semi-arid tropics

In the countries which are within this broad area, the needs for protein for human consumption can generally be best provided in the cheapest form by fish supplies. Where there is a tradition of fish consumption, the problems are those of price and regularity of supplies of the cheap fish required. In many cases also, there are quantities of fish available which are not readily accepted. In both cases, the desirable levels of protein intake are not met and consequently the net requirements of protein are far below that for adequate nutrition, particularly in the youngest age groups. As it applies to fish consumption, this protein gap is further complicated by losses due to processing, packaging or insect infestation as well as in storage and transport to remoter areas.

Consumption increase can readily result by greater supplies of traditional products, assuming prices suit the purchasing capacity of the needy populations. However, there is need for an improvement of the traditional products so as to provide a wholesome and palatable product without much change in its appearance or presentation, while improving its food value and keeping it as cheap as possible (maximize nutritive value and minimize costs). Secondly, there is need for the development of new but acceptable products which are less wasteful of protein and can be prepared in greater bulk for economy and to cope with the quantities available at seasonal glut. This naturally involves questions of the feasibility of investment when acceptable products are developed and find markets. All these factors which tend to help stimulate the efforts from the primary sector of the industry by stabilizing the market for the fish produced can thus enable a profitable diversification of the catching systems and more rational cropping of available fish resources.

In the rural fishing enterprise, the vertical integration is such that fishing stops when the small smoking ovens and storage bins are filled. Efficient processing systems, coupled with adequate storage and effective distribution to markets, are collectively therefore the pivotal factors on which the improvement of small scale rural fishing activity depends. This is particularly the case where there are no wholesale markets and nearby industrial depots of canneries etc. The socio-economic effect on the primary and secondary sectors of the fishing industry is thus greater in the rural or artisanal fisheries with

low capital investment but labour intensive and thus the greater^{the} need for efforts to optimize the conditions as far as possible from the governmental viewpoint.

In less developed countries, processing losses between landing and consumption may be as much as 30% by weight and often 60% in food value. Losses are due to protein denaturing (as in charred fish in the hot-smoking systems in West Africa) or mould damage in storage. Insect infestation by beetles and fly-maggots as well as breakage damage through rough handling in transportation also account for considerable losses. The pattern is of processing at the beach or at river bank production centres and the transport of the bulk-packaged, brittle, light weight but bulky product to distant markets. The changing pattern in coastal areas is of transport of frozen marine fish to remote centres where it is then processed for localized distribution and thus the finished product is subject to less handling. In practice, the profitability of the later system is greater apart from the constancy and greater bulk of base-supply. The 5-ton transport trucks, when over-loaded to their tray capacity, carry 8 tons of frozen fish in cartons but only 3 to 4 tons of smoked or dried fish in baskets. The former arrives in perfect condition as a thawing-out block and is easily handled for smoke processing as a better product. The latter is partly broken and damaged and thus less attractive for market. The former supply comes from industrial enterprise and factory ships, the latter from rural enterprise which can only decline under such severe competition unless there is some adjustment to the system.

The purchasing power of the rural consumer is much less than in the cities. In general, the remoter the rural community, the less is their ability to pay. The exception to this generalization occurs at industrial centres such as mines, mills, plantations, etc. Their fish needs are thus met by supplies of cheaper types of fish products. Once the traditional consumption pattern is established over generations of users, it becomes much more difficult to change it. Not only are such communities very conservative to change in habits but the demand for fish types changes perhaps may only alter as their purchasing power increases.

In other tropical areas such as the Caribbean, the consumption of fresh fish has been so established that markets for chilled or frozen fish are only very gradually being established in cities where adequate storage permits sales of acceptable products. Very often the fish is exposed for sale in the fresh state and when unsold later held in cold storage (about -5°C) for sale subsequently. Such storage causes a slow freezing of the water in the fish muscle and results in burst fibres and mushy fish when unthawed or cooked. This often happens in areas where cold storage is available but where the fresh fish is not quick frozen or held at constant low temperatures (say 2 to 5°C). This practice is deterrent to widespread consumption where the consumer is accustomed to eating fish prepared from the fresh state (and not after it is smoked before being included in the meal preparation). Such difficulties have occurred in some countries where frozen storage depots have been introduced and are used jointly for meat and fish products at the same temperature.

In most countries of the broad group of interest to IDRC projects, the fish products consumed are prepared for eating from either fresh, smoked, salted or canned preparations. The consumption of the frozen domestic pack preparations when present in such countries are consumed by higher income groups and are not the focus of our projects. It has been found that the low-income consumer wants a small quantity of fish per meal for his family use. The purchaser thus buys individual fish which weigh no more than 4 to 6 oz. or say a 2 oz. can of sardines or pilchards for the family meal. This small sized fish is thus in demand not only as a convenient unit to be added to the meal but because it is cheap. In some areas however, even this is too costly. The need for the cheapest hygienic packaging for small unit packs thus exists and is likely to be satisfied by plastic packaging of some traditional products in somewhat dehydrated condition.

Rural fish consumption in remote inland areas is made more difficult owing to the seasonality of supplies, the variable climatic conditions and the problems of adequate storage of the traditional fish products. The periods of heavy rain and intense dry heat alternately favour the growth of moulds on the moister smoked products or the multiplication of dermestid beetles and fly maggots in the dried and smoked products. When the fish is treated both by salting and smoking, the losses due to moulds and insects are less in general terms. Such salted/smoked products are contrary to traditional food preparations. The habit of consumption would require much publicity (in difficult and expensive circumstances) to permit acceptance of any slightly or unusually varied product like a salted/smoked fish which would entail preparatory treatment such as de-salting by overnight soaking or boiling and discarding the water. The adoption of such a system will alleviate storage losses considerably and may be the easiest procedure. However, the total cost of and time involved in having to change the food preparation system and having a product that is totally acceptable to the consumer has prevented its widespread application after experimental demonstrations in Mali, N. Nigeria and Togo. The problem of effective processing and the packaging of small units for direct consumption still persists. The objective may be realized through economies of scale in bulk processing of the traditional product, individual consumer packs in cheap material that conserves fish in mould-free and insect-free condition, and bulk packaging for rough overland transport. A flexible combination of these circumstances may be the solution in different parts of Africa.

Meanwhile, the bulk landings of frozen fish have tended to smoothe out fluctuating supplies of normal seasons and to create more dispersed processing centres around each interior township where the frozen cartons are distributed. This offers a better opportunity for innovative change by introducing slightly modified products for these areas even though the consumer tastes will not have changed.

III. Current IDRC Projects

1. West African Rural Fisheries

This project has been conducted since July 1972 in Ghana by the Ghanaian Government's Ministry of Agriculture which coordinates the inputs of different departments and research institutes for the study of the interrelated factors for rural fishery improvement of which the processing system constitutes one of four sectors. The research objectives are as follows:

(a) Production Systems:

To increase the total landings of fish and improve net earnings of artisanal fishermen particularly in the off-season (October to May) by:

- 1) extending operational range and capacity of smaller craft, 2) developing a beach-landing craft, 3) increasing efficiency of fishing techniques used, 4) developing further the fishery extension/education system, 5) improving the support service facilities for supply of gear, parts and maintenance essential to the industry.

(b) Processing Systems:

- 1) Establish the processing parameters which significantly influence the chemical/physical and nutritional properties of smoked and dried fish products with particular regard to present and future consumer acceptance.
- 2) Determine the degree of protein loss from the time of landing to reaching the interior consumer, 3) Devise techniques to reduce or eliminate the wastage assessed, 4) Evaluate the efficiency of traditional techniques and innovations and test new processing equipment design in order to select systems acceptable in rural fishing communities.

(c) Marketing and Economic Component:

The present systems of marketing and distributing fish by and among the fishing and other rural communities will be studied, and the various conditions of the areas under research (i.e. harvesting, processing and distribution) will be examined, together with the potential cost benefit structure of each of the innovations proposed.

The impact of increased protein sources upon the health of the rural peoples will also be studied.

(d) Extension Services Component:

Extension activities are implied in each of the above components. Research and testing of suitable extension techniques to be undertaken in the pilot area will facilitate the utilization of results of technical research in the rural communities.

Studies are determining the nutritive losses in processing and in storage under normal conditions with the commonly available fish types. The parameters involved in smoking the fish and the entire mechanics of the system as regards fish, ovens, fuels, handling costs, storage and flow of supplies have permitted an appreciation of the factors responsible for quality reduction. Since the traditional oven design does not allow much variation of process control, investigations are being carried out on the effect of varying the smoking parameters on processing efficiency, product acceptability with a view to oven design improvement.

At the same time a system has been adopted for standardizing quality assessment of smoked products (in appearance, organoleptic condition and chemical content). The determination of total volatile base nitrogen (TVBN) has been used as an overall index for assessing the spoilage of fish while simple organoleptic standards are used for acceptability traits of all products. Work is also in progress on the development of a sealed-pack storage procedure for use with smoked sardinella of low moisture content. Because the final product must be within the means of the lowest income group, the product must be cheap, economies of scale must be adapted for coping with the major production season of three months and the bulk of the products must be storable without food-value loss for 8 months at least.

It is hoped that this work, when completed, can make a significant impact towards stabilizing the production of artisanal fisheries not only in Ghana but in the wider region where conditions are similar and circumstances applicable.

The work is being undertaken by the Food Research Institute of the CSIR of Ghana and the Food Science and Nutrition Department of the University of Ghana Legon. The duration of the study up to the pilot plant stage should be up to 1975. The principal investigators are J.E.M. Bartels, D.R. McGregor, G. Okraku-Offei, P. Fleku, G. Hall. The services were engaged of R. Peters, a processing engineer of Memorial University Newfoundland, to formulate the activities of the project.

2. Processing of Cultured Oysters (West Africa)

This project is essentially concerned with oysterculture but will be also involved in the depuration for live oyster sales and particularly with the improvement in the traditional smoke-processing and with packaging of the oysters as a hygienic and storable product for regional markets.

The project is likely to be based in Gambia with the collaboration of other West African countries in various aspects of the research study.

3. Fisheries By-Products (Caribbean)

The utilization of fisheries by-products and species caught which are at present of uneconomic value is developing as a potential area of emphasis for IDRC support. Discussions are in progress with a number of fisheries research stations, in particular one in British Honduras, where it is proposed to develop marketable products from the discarded heads and legs of the spiny lobsters of which at present only the tails are of economic importance, and a variety of other fish caught in the Caribbean waters by the shrimp trawlers fishing the Guyana banks.

This research study is to be done in collaboration with various institutions in the area for specific objectives and organization arrangements are being currently formulated.

IV. Areas of Special Potential

Some areas of the tropics have a particularly large unsatisfied demand for fish and while imports have traditionally supplied partial need, the national objective is self-sufficiency in fish supplies. Some have experimented with the large-scale importation of fresh cod fish to be processed as dry salted cod (Jamaica), while others have tried replacing stock fish by local processed products (Nigeria, Cameroon). An essential feature for a profitable process is the combination of cheap fuel for drying and bulk quantities. In the Niger delta area of Nigeria, the fish production sector has been reduced by the attraction of employment in the petroleum industry. However, flaming jets of natural gas are burnt off in this oil prospection zone, while frozen fish supplies are imported and distributed in bulk to compensate for the reduced production and increasing demand. This situation seems particularly favourable for the experimental bulk processing with natural gas for dehydrating the product to a form similar to stock fish which is so in demand in the current market. The projected demand for fish in Nigeria is stated to be 1,200,000 tons by 1985. Considerable investment is to be undertaken in vessels, crew-training, harbours, and cold chain infrastructure to supply this. The abundant supply for natural gas on site needs only the initial experimentation and subsequent standardization of a processing system for the efficient processing of the type of products that are widely accepted while better and perhaps more desirable products are being developed and popularized in the country.

In areas where shrimp trawlers operate for exportation of large shrimp or prawns to the U.S. market all the fish that is caught is jettisoned because of its much lower market value. This is generally a great bulk of mixed species

which include many that are readily eaten in the area. The bulk aboard the vessel and the problems of handling and storage afloat coupled with transport to port are almost intractable. However, in the case of the trawlers fishing off the Guyanas it is estimated that more than 100,000 tons of edible fish are jettisoned annually by the 400 trawlers operating there. Despite this, the Caribbean area is a net importer of fish. Many countries of the region are planning to use this fish.

It is understood that national shrimp trawler fleets of some Caribbean countries are now bringing in part of the edible fish caught for experimental marketing. The main problem seems to be one of logistics, of bulk handling, storage and sale where the shore facilities have to be equipped to handle such fish supplies and adequate markets have to be found for the fish without harm to the traditional inshore producers.

The conversion of these quantities of fish to suitable products in all the major shrimp fisheries may probably be facilitated by the use of the flesh and bone separator machines. These can produce minced flesh from which comestible products such as sausages, hams, fishburgers, fish pastes etc. can be made. This seems to be a system that can allow for a great range of products to cater for varied tastes in the more sophisticated consumer markets. It permits the recovery of flesh for human use as well as bones, skin etc. for stock feeds. It may make all the difference to the profitability of some enterprises where the quantities of shrimp caught are small. It enables a more rational cropping of available demersal species and not a selective-cropping-and-throw-back operation. In general, these products may require some consumer market promotion and special packaging if they are to be sold at normal temperatures to rural communities. This source of supplies, however, offers a great opportunity for satisfying the region's market for fish.

V. Conclusions

The main motive in this area of activity of IDRC is to make available more food products by reduction of waste of traditional fish products as well as the development of innovated processes for fish or by-products not currently used. While the current scale of the projects is small, it is hoped that their impact, once demonstrated at the pilot plant scale, will have an increasing outreach influence in the country of operation and, where relevant, in the geographic region.

The importance of effectively conserving fish products is considered to be a limiting factor to profitability of tropical fishing enterprises as well as being the eventual basis on which diversification of fishing techniques, prolongation of the season by fishing for other types, and the more effective rational cropping of available fish resources can be realized.