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THE TRANSFER, ADOPTION AND COMMERCIALIZATION OF CHORKOR
SMOKER: THE SUCCESS STORY OF EFFECTIVE LINKAGE PRACTICES BY
THE FOOD RESEARCH INSTITUTE

BY

Gladys Nerquaye - Tetteh

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INTRODUCTION

In Ghana and many other African countries, fish constitute over 70 per cent of the total animal protein in take (FAO/World Bank Report, 1979-81). The fisheries sub-sector is one of the most important Divisions of the Ministry of Food and Agriculture playing an important role in contributing to the country's food security. Another important contribution of the fishing industry is that of employment. It is estimated that 500,000 fishermen, traders, processors, boat builders and mechanics are employed by the fisheries industry. It also supports twice as many dependants, (Asafo, 1995). Ghana's total fish production figures for the period 1993 to 1996 as given by the Fisheries Department are 383,650; 327,904; 374,798; and 484,889 metric tonnes respectively.

In general fish is made up of 70-84 per cent water; 15-24 per cent protein; 0.1-22 per cent fat and 1-2 per cent minerals. The high moisture content of fish renders it highly perishable. It is estimated that in the high ambient temperatures of the tropics, fish spoils within 12-20 hours depending on the species and the method of catch (Clucas et al, 1981, 1996).

Various traditional methods are employed in processing fish for consumption and also to prolong its shelf life for storage. These methods include smoking, drying, salting, frying and fermentation (Okraku-Offei, 1970; Nerquaye-Tetteh, 1979; Kordylas et al, 1982). Among these smoking is the most widely applied method in Ghana. About 70-80 per cent of the total fish landed is smoked (Resource Development Consultants, 1987; Fisheries Department, 1998). Various studies undertaken on fish consumption patterns in Ghana indicate that, to a large extent, fish is consumed more in the smoked form since the traditional flavour, taste and colour obtained by smoking are preferred (Orraca-Tetteh et al, 1971; Plahar et al, 1995, 1996, 1997).

FISH SMOKING

The art of smoking is said to be as old as civilization. It is done by combining three main effects.

- a. Preservative value of smoke - the smoke is produced by burning wood which contains a number of compounds some of which will kill bacteria.

- b. Drying - the fire which produces the smoke also generates heat to dry the fish.
- c. Cooking - since the smoking is done at high temperatures, usually above 80°C, the flesh of the fish is cooked and the heat also destroys or kills bacteria on and in the fish (Clucas, 1981).

Depending on the type of fish to be smoked, what it would be used for, and the length of time it may have to be stored, the smoking process can take the form of “wet” hot smoking or “dry” hot smoking. Both processes are carried out at temperatures high enough to cook the fish. The smoke drying method is the most widely used.

The reasons for smoking fish are varied, but the notable ones as far as Ghana is concerned, are:

- a. To prolong shelf life.
- b. To enhance flavour and increase utilization in soups and sauces.
- c. To reduce waste at times of bumper catches and store for the lean season.
- d. To increase protein availability to all people throughout the year and
- e. To make fish easier to pack, transport and market.

Before the introduction of the CHORKOR SMOKER to the fish smoking industry in Ghana, four main types of traditional smoking ovens were used. These were:

- a. Cylindrical (round) mud - sometimes referred to as the “Fanti oven”.
- b. Cylindrical metal or Oil drum oven.

- c. Rectangular mud
- d. Rectangular/square metal oven.

CYLINDRICAL MUD OVEN

This oven, as the name implies, is round and constructed from mud. It is widely used in the Central and Western regions of the country hence the name “Fanti” oven. The oven exists in various sizes, but typically, it has an external diameter of about 132cm: internal diameter of about 105cm and a height of about 80cm. A ledge is made in the wall at about 50cm up the full height of the oven, on which sticks can rest to support the layers of fish to be smoked. The layers of fish are then separated by sticks.

A stock hole of about 42-48cm is cut at the bottom of the wall for feeding firewood into the oven. Pieces of wire mesh can also be used to hold the fish for smoking instead of the sticks.

CYLINDRICAL METAL OVEN

The cylindrical metal oven is usually constructed by joining two opened steel, 44-gallon oil drums together and cutting a stock hole at the base. Pieces of iron rods are fitted about two-thirds above the base of the drum to serve as a support for the layers of fish. The average diameter of the metal oven is about 114cm with a height of about 88cm and a

stock hole of approximately 41cm by 41cm. This type of oven is used throughout the country.

RECTANGULAR MUD OVEN

This oven is rectangular in shape and constructed from mud. Pieces of thick iron bars are placed across the top of the ~~base~~^{wall} to support the layers of fish to be smoked. A stoke hole is cut along one of the longer sides of the oven. The fish is arranged on pieces of wire mesh and placed on the supporting iron rods. Where more than one layer of fish is smoked, the layers are separated by sticks. Pieces of jute bag are used to cover the fish whilst the fish is being smoked. This oven was widely used in the Greater Accra and Volta regions.

RECTANGULAR/SQUARE METAL OVEN

This oven is normally constructed from 44-gallon steel oil drums which are opened and joined to give the rectangular/square shape. Sometimes, battens of wood are used for reinforcement. Thick pieces of iron rod are placed on top of the base to support the fish arranged on pieces of wire mesh. A large stoke hole is cut at the base of the side wall.

DISADVANTAGES ASSOCIATED WITH THE USE OF TRADITIONAL OVENS

Many disadvantages have been reported (Kagan 1969; Nerquaye-Tetteh 1979; Clucas 1982; Bostock et al, 1987):

- a. Constant attention is required to control the fire and turn the fish. This may involve smoking through the night.
- b. The operation is both health and fire hazard.
- c. They are inefficient in their use of fuel and ventilation system.
- d. There is little or no control over the temperature of the fire and the density of the smoke produced.
- e. In some cases, the construction materials used limit the durability of the ovens.
- f. The open construction of the ovens leaves the fish susceptible to climatic conditions and animal attack.
- g. The smoked product is usually of poor quality due to non-uniform smoking, burning and charring on the outside.

Since the early 1950's, the awareness of the shortcomings of the traditional fish smoking ovens boosted work on the development of new and improved smoking oven models in Ghana and other African countries. Examples are: "Adjetey" oven (1962); Altona oven Anon,(1971); Ivory Coast oven (Maembe 1982); and Nyegesi Fish Smoking Kiln (Wood et al 1990).

The "Adjetey" oven was not accepted because of its high cost and the inconvenience in its operation. It was also observed that the smoked fish produced using the "Adjetey" oven, could not come out as that from the traditional ovens.

When loading fish for smoking on the Altona oven, the fish is skewed through the eyes using metal rods and hung in ~~an~~^{the} enclosed chamber. The skewing process resulted in removing the eyes of the smoked fish and this was unacceptable to the consumers. Hanging of the fish for smoking was also a complete departure from the smoking techniques to which the smokers were used. In addition, the high cost of the Altona oven made it unaffordable to the processors.

The Ivory Coast oven was also expensive and cumbersome to use. The poor colour of the smoked product and the high variability of the oven temperature also mitigated against its use.

The Nyegesi kiln which was designed by Natural Resources Institute of the United Kingdom as a fuel-efficient oven which could smoke fish that could keep for several weeks, did not offer any great advantages over the Chorkor Smoker when tested ~~with~~^{at} the Food Research Institute.

THE CHORKOR SMOKER

With the constraints and disadvantages associated with the traditional ovens and the bad experiences associated with the new ovens which were introduced earlier, in mind, the Chorkor Smoker was developed as an improvement on the traditional rectangular mud oven used in some fishing communities.

Before the development of the Chorkor Smoker, a thorough study was carried out throughout the country to assess the methods and equipment used in fish processing, types of smoked products, the people involved in the smoking business, as well as the marketing of the product. The fish processors were then involved in the development process of the Chorkor Smoker. This was necessary because from their experience they had a better understanding of which modifications will work better. The technology was based on the already existing system which was familiar to the users. In addition it was simple, easily adaptable and easy to construct and use.

At the Chorkor community in particular, round and rectangular mud ovens were in use. The rectangular ovens were used for the initial smoking process of cooking the fish. Then the cooked fish was transferred manually into the round mud oven for further smoking till the fish was very dry. When the Chorkor Smoker was being designed, these two processes were taken into consideration, so as to enable the entire smoking process to be done on one oven which is the Chorkor Smoker.

The Chorkor Smoker, an improved traditional fish smoking oven consists of a combustion chamber and a smoking unit of a set of trays. The combustion chamber is originally rectangular, twice as long as wide with two stoke holes in front. There is a middle wall dividing the combustion chamber. The recommended average standard measurements of the combustion chamber is: length - 90ins (225cm); width - 45ins (112.5cm); height - 24ins (60cm); thickness of wall - 5ins (12.5cm); width and height of stoke hole - 15ins (37.5cm); and depth of fire pit - 6ins (15cm).

The combustion chamber forms the base of the Smoker. It is generally constructed from mud, but burnt bricks and cement blocks may be used. The latter two are more expensive than mud. The use of cement blocks is not recommended since it cannot withstand the high smoking temperatures. The top of the wall is flat so that the trays fit flush to avoid loss of heat and smoke. The oven is designed so that the wooden frame of the tray which rests along the mid-line of the base wall is firmly supported and not easily burnt.

The smoking unit consists of a set of 5-15 smoking trays depending on the size and quantity of fish smoked. On average, however, 10 trays are used per oven for small to medium-sized fish species such as Anchovies, Mackerels and Sardines. For large species such as Tunas, Grouper and Snapper, 5 trays are used. Wawa (*Sterculiaceae triplochiton*) has proved over the years to be ideal for the construction of the trays. The average depth of the smoking tray is 2.5ins (6.25cm). Wire net of half an inch to one inch mesh and 18 to 20 gauge is recommended.

The following list highlights some key features of the design.

- a. The top of the oven wall is level and flat so that the trays rest flush upon the wall leaving a 2-inch space from the frame wall to the inner space of the base.
- b. The stock holes are in the middle of the width of each of the half sections of the base and are arched to provide a greater structural strength. It is large enough for easy stoking and removal of firewood, but not so large as to permit heat and smoke escape.
- c. The height of the smoking chamber is low for ease of stacking up to 10 or more trays, but the fire is at least 20 inches from the lowest tray. 4 to 6-inch fire pit is dug for each stoke hole.
- d. The trays fit flush together in order to form a "chimney".
- e. The wire mesh is stretched in both directions across the bottom of the frames, in order to support about 20kg of fresh fish per tray without the tray sagging.
- f. The wooden frames of the tray can last three or more years and the wire mesh one to two or more years if properly constructed and maintained.
- g. Deeper trays of about 6ins in height have been developed in some fishing communities and used for storage of smoked fish.
- h. Each oven has a sheet of plywood used as a cover and also for regulating smoke and heat in the smoking unit.

EFFECTIVE LINKAGE PRACTICES IN THE TRANSFER, ADOPTION AND COMMERCIALIZATION

In 1969, the first set of the Chorkor Smoker designed in collaboration with fish smokers at Chorkor, a suburb of Accra West, was presented to two fish smokers who were operating their smoking business together and also indicated their willingness to accept and use the Smoker and give their findings and comments to the Food Research Institute.

The Smoker was located in a place where other fish smokers were operating. This was done so that as the two fish smokers used the introduced technology their colleagues around them would observe how it operated. The intention was to get them interested in the new idea.

Six months later, the following general views were given by the fish smokers themselves:

- a. The smoking process became less tedious with the use of the trays.
- b. More fish could be smoked. This was because by framing the pieces of wire mesh, the fish could be arranged up to the corners and up to 10 trays could be placed on one oven.
- c. The trays formed a chimney to trap the smoke and heat resulting in a more efficient fuel wood usage due to improved heat and smoke circulation. Thus more fish could be smoked over a shorter period.

- d. With the use of the sheet of plywood as a cover, the heat and smoke required during the smoking process could be regulated to some extent. Therefore a uniformly smoked product of a better quality in terms of colour, shape and taste was produced.
- e. Handling of the fish during the smoking process was greatly reduced.
- f. Charring of the fish was reduced considerably.
- g. And above all, the product had a higher market value.

From 1969 to 1971, with a small grant from Freedom From Hunger Campaign (FFHC), more Chorkor Smokers were constructed and sold at subsidized cost to interested smokers at Chorkor.

Gradually, the use of the technology, spread within the Chorkor Community as more smokers realizing its obvious advantages were prepared to adopt it. The smokers started making their own arrangements for the construction of the "Smoker".

Following the ready acceptance of the technology by the Chorkor community, various means were used to extend it to other fishing communities using effective linkage practices. Examples are the following:

From 1982 to 1986, UNICEF (Ghana), ILO, UNDP, UNESCO and FAO financed various collaborative projects aimed at promoting the transfer and adoption of the Chorkor Smoker in the Greater Accra, Volta, Central and Western Regions of Ghana. The strategy used in the transfer of the smoker in most cases was the participatory technique.

The construction was carried out in the communities with the participation of the users. Local masons and carpenters were taught the skills of construction of the "Smoker".

The "Smoker" was owned by individual fish smokers who contributed to the cost of its construction by providing mud, water and labour.

A manual on the Chorkor Smoker entitled, " A Practical Guide To Improved Fish Smoking in West Africa" was published in English and French as part of the extension activities funded by UNICEF (Ghana) in 1982/83.

A video cassette on " Improved Fish Smoking in the Tropics", an educational programme for fish smokers, extension officers as well as students was also produced in Ghana in 1986 by FAO in collaboration with the Food Research Institute and the National Council for Women and Development.

An FAO Technical Cooperation Programme (TCP) project carried out at the Food Research Institute in 1986 assessed the technical performance of different types of traditional and improved smoking ovens including the Chorkor Smoker. The study showed that some variations in temperature distribution occurred within all the oven types. It also showed that control of the smoking and drying rates could only be achieved by re-arranging the layers of fish or taking fuel wood away from the fire. However, the oven that performed well in terms of cost, capacity, ease of operation, product quality and fuel efficiency was the Chorkor type (Stroud,1986).

From 1988 to 1998, as part of the activities of the Ghana/Netherlands Regional Training and Applied Research Project For Artisanal Fish Processing in Africa, a six week regional training course was organized each year on artisanal fish processing and extension methods for middle level extension officers by the Food Research Institute, University of Ghana, National Council on Women and Development and the Ministry of Food and Agriculture for Extension Officers. The main objective of the project was to contribute to the reduction of post harvest losses of fish and to enhance the availability of quality of fish and fish products for the rural population. During these courses the Chorkor Smoker featured prominently. A grand total of 204 key extension personnel from 12 African countries have participated in the 11 training courses. Participants came from Ghana, Nigeria, Sierra Leone, The Gambia, Camaroun, Kenya, Tanzania, Uganda, Zambia, Ethiopia, Eritrea and Lesotho were taught how to construct and use the technology. In the fourteen fishing communities used for the field demonstrations, 202 fish smokers have received a total of 202 Chorkor Smokers with 1010 trays.

Information received from some of the participants who came from other African countries show that the Chorkor Smoker has been successfully transferred and adopted in their various countries. From Zambia the construction of 143 ovens was reported by ex-course participants.

A study undertaken in Ghana by Nti et al, 1999, in some selected Project pilot fishing communities established that the adoption rate of the Chorkor Smoker was 100 per cent.

Majority (72.5 per cent) of them were among those who were introduced to the technology under the Ghana/Netherlands fish project. The rest obtained the information on the improved technology through observation (13.7 per cent), friends and relatives (11.8 per cent). Assessment of the scale of adoption showed 88 per cent full adoption.

The Food Research Institute was established in 1963 to carry out a coordinated programme of applied research in storage, processing, preservation and marketing of foods with the aim of contributing towards the development of the food industries in the country.

The Chorkor Smoker was developed in 1969 with the above mandate in mind. Also most of the programmes undertaken for the development, transfer and adoption of the Chorkor Smoker were funded by external organizations with specific objectives and terms of reference which did not include commercialization. So not much has been done by the Food Research Institute on the commercialization of the Chorkor Smoker.

In line with the change in the policy of CSIR, in recent times, making commercialization one of the key objectives in the operation of the Institutes, commercialization of the Chorkor Smoker may now be undertaken.

LESSONS LEARNT

The Chorkor Smoker has completely replaced the old smoking ovens in many fishing communities in Ghana. Its adoption is enhanced by the better quality of smoked fish which attracts premium price on the market.

The Chorkor Smoker which was developed for use in Ghana has received acceptance in Western, Central, and Eastern African countries.

Since the fish processors were involved from the beginning of the development of the oven, its acceptance and adoption rate was high from the initial stage.

Construction materials for the Chorkor Smoker are locally available.

The possibility of constructing the oven in the community in the presence of the users also facilitated its acceptance.

The construction is easy.

The Chorkor Smoker has a capacity of 200-250kg. per batch compared to 30-50kg. per batch for the traditional oven. There is 60 per cent saving in fuel consumption, 50 per cent reduction in labour force and 60 per cent saving in smoking time.

Impact studies undertaken by the Ghana/Netherlands Fish Project in 1990 and 1994 showed that, the adoption of the Chorkor Smoker resulted in the following:

- a. More fish was smoked resulting in the reduction of fish wastage.
- b. Higher income was earned due to the smoking and selling of greater amounts of fish.
Along the east coast of lake Tanganyika small herring-like fish “daga” is smoked during the bumper season and sold across the lake in Zaire where is scarce.
- c. There is reduction in expenses due to reduced use of fuel wood.
- d. More money is available for feeding the family, pay school fees, support economic activities of their husbands, to invest in additional economic activities such as animal husbandry and also contribute to the construction of better houses.

The “ Smoker” is easy to operate and time saving so that it alleviates drudgery and is user - friendly. This has contributed positively in encouraging younger women to take up fish smoking as a profession.

Before the introduction of the Chorkor Smoker, the bulk of Anchovies landed was sun-dried on the ground, producing a product of poor quality and unsafe for consumption. With the availability of the Chorkor Smoker, smoking of Anchovies is widely practiced producing a product of better quality and safer for both human consumption and animal feed production. It also has a higher market value.

The Smoker has proved a useful innovation in both the marine and freshwater fishery because it is easily adjusted by the processors themselves to suit their local needs and conditions. For example, the clay base has been replaced by refractive bricks in Tema U Compound where the bricks are available. The height of the oven base and the trays are increased in areas where bigger and fatty fish is smoked. In some areas deeper trays are used for storage of the smoked fish. Half and even quarter sizes of the normal Chorkor Smoker are used where smaller quantities of fish are smoked.

Nti et al, 1999, reported of improvement in economic activities which has resulted in positive impact on house hold income and food consumption patterns of the processors.

Group formation is another important factor to be considered in technology transfer. The adopters are assisted to form groups which are introduced to banking at the rural level. This has helped some of them in acquisition of loans from the banks.

The key factors limiting effective adoption of the Chorkor Smoker are high cost of inputs and lack of credit.

In recognition of the important contribution of the Chorkor Smoker to the reduction of post-harvest losses in the fish processing industry, postage stamps depicting various activities on the Chorkor Smoker have been issued in Ghana. This further helped in the transfer of the technology.

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