Evaluation of determinants for effective adoption of an improved fish-processing technology in Ghana

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ABSTRACT

Surveys were conducted in three fishing communities in southern Ghana where an improved fish-smoking technology (the Chorkor Smoker) had been previously introduced. Assessment of the extent of adoption of the technology and identification of factors influencing its effective adoption were investigated. Qualitative and quantitative data derived from the use of a combination of participatory rural appraisal technique (PRA) and structured questionnaires in interviewing 51 fish processors were reported. About 88 per cent of the respondents completely adopted the technology. Four main modifications were observed to have been made to the improved technology, namely reduction in the dimensions of the trays to facilitate easy handling, use of bricks instead of clay for construction, division of oven into compartments to facilitate turning of fish during smoking, and use of wooden sticks on top of the wire mesh for smoking big fishes so as to prevent 'net-marks' on the fishes. Benefits derived from adoption of the improved technology included lessening of drudgery of fish-smoking activity, reduction in smoking nuisance, better quality of fish, increase in smoking capacity, and fuel efficiency. Despite the numerous advantages, the processors encountered some problems. These included heaviness of trays, cost of maintenance, rusting of equipment during off-season, as well as non-availability and/or high cost of input. The key limiting factors for effective adoption of the improved technology included lack of finance or credit, high cost and non-availability of inputs, market and consumer acceptability, and ability for group formation.

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RÉSUMÉ

NTI, C. A., QUAYE, W. & SAKYI-DAWSON, O.: *Evaluation de déterminants pour l' adoption efficace d'une technologie améliorée du traitement de poisson au Ghana.* Les enquêtes se déroulaient en trois communautés de pêche au sud du Ghana ou une technologie améliorée de fumage de poisson (le fumeur de Chorkor) avait été introduite précédemment. Estimation du degré de l'adoption de la technologie et l'identification des facteurs influençant son adoption efficace, étaient soumise à l'investigation. Les données qualitatives et quantitives dérivées de l'utilisation d'une combinaison de technique d'évaluation rurale participative (ERP) et les questionnaires structurés pour l'entretien de 51 transformateurs de poisson, sont rapportés. Environ 88 pour cent des personnes interrogées adoptaient la technologie complètement. Quatre modifications majeures étaient observées d'avoir été faites à la technologie améliorée, à savoir, une réduction des dimensions des plateaux pour faciliter le marriement facile, utilisation de brique au lieu d'argile pour la construction, division de four en compartiment pour faciliter le tournage du poisson pendant le fumage, et utilisation de petit bois sur le treillis métallique pour le fumage de gros poissons afin d'éviter les marques du treillis sur les poissons. Les bienfaits dérivés de l'adoption de la technologie améliorée comprenaient la diminution de grosse corvée de l'activity de fumage de poisson, la réduction de l'ennui de fumage, meilleure qualité de poisson, augmentation de la capacité de fumage et efficacité de combustible. Malgré les avantages nombreux, les transformateurs rencontraient quelques problèmes. Ces comprenaient la lourdeur des plateaux, frais d'entretien, rouillure d'équipement pendant la mortesaison ainsi que la non-disponibilité et/ou le coût élevé de facteur d'intrant. Les facteurs contraignants clés pour l'adoption efficace de la technologie améliorée étaient identifiés de comprendre le manque de finance ou de crédit, le coût élevé et la non-disponibilité de facteurs d'intrants, acceptabilité au marché et au consommateur et la capacité de formation de groupe.

Introduction

Fish constitute the major source of animal protein intake in Ghana, with marine fish accounting for nearly 80 per cent of the fish production (Plahar, Nti & Steiner-Asiedu, 1997). To avoid excessive wastage of the large quantities of different species of fish landed during the bumper season, several traditional processing techniques are used for preservation (Okraku-Offei, 1970; Nerquaye-Tetteh, 1979, 1989). Smoking and sun drying are the most widely used techniques in Ghana. To improve the quality and availability of fish, and to enhance socio-economic well-being, and hence the quality of life of fishing communities, improved versions of traditional fish-smoking techniques were developed through the assistance of the Ghana/Netherlands Artisanal Fish Processing and Applied Research Project (AFPP) which spanned from 1988 to 1998. The technology was extended through demonstration by trained extension staff.

Traditionally, fish is smoked in round mud ovens having a single platform above the combustion chamber onto which a single layer of fish is loaded. The improved version of the traditional oven consists of a 65-cm high rectangular combustion chamber made of burnt bricks with stock holes leading to fire pits, and a set of usually 10 framed wire-mesh trays. The rectangular trays, each loaded with a layer of fish, make up the smoking unit when stacked up on the oven. The perceived advantages of the improved technology over the traditional one include an increased smoking capacity, fuel economy, and a better quality product (Okraku-Offei, 1970). The main objectives of the AFPP were to contribute to increased availability of, and access to quality fish products for the rural population through improved fish preservation; and also to reduce post-harvest losses to enhance the economic status of those involved in artisanal fishery activities (AFPP Project Document, 1988). The major components of the project included an applied training programme aimed at achieving these objectives through the development, dissemination, and adoption of improved fish preservation methods and techniques. Under the project, improved processing and preservation technologies were disseminated in 14 fishing communities in Ghana. Training programmes were also held under AFPP for several extension workers throughout Africa.

Results of baseline socio-economic studies conducted before the improved technology was introduced indicated very poor general living conditions in all the villages (Lokko, 1984, 1990). Specifically, the studies identified poor health of the people, low levels of income and consequent poverty, inefficient processing operations, and poor quality of diets as the main problems in the fishing villages. It was against this background that the improved fish-processing technologies were disseminated to enhance production, efficiency and improve the socio-economic and nutritional well-being of the people.

Although a high rate of adoption of the improved technologies has been reported, post-adoption impact studies have not been undertaken in most of the villages (Lokko & Ansong, 1994). Not much information is therefore available on the problems encountered by the processors in adoption as well as on the effectiveness and usefulness of the technologies in improving the socio-economic status of the people. Such information on evaluation is necessary to enhance strategies for disseminating the technology.

This study was therefore conducted with the aim of finding the level of adoption of the improved technology extended and factors hindering its effective adoption.

Methodology

Sources of data

Three pilot fishing villages, where the improved fish-smoking technology had been introduced over the 5 years preceding the study, were randomly selected for the adoption and impact assessment studies. The villages were Tema Manhean, Lekpongunor and Akplabanya, all in the Greater Accra Region of Ghana. Fifty-one fish processors were selected from the three villages

for the study.

Survey methodologies

A checklist was developed and used to collect information on the various determinants for the adoption or rejection of the technology, using the participatory rural appraisal technique (PRA). The PRA is an iterative, innovative, interactive, and multi-disciplinary way of solving development-oriented problems (Mikkelsen, 1995). The PRA technique used in this survey was focus group discussion. Three sets of focus group discussion, with each group consisting of five to eight women, were organized in each of the villages. Based on the data collected, a structured questionnaire was developed and used to collect information on the focal factors. After pretesting the questionnaire, a face to face interview was used to collect data from the respondents. The questions were read to the respondents in the local language and the responses were recorded.

Secondary data sources were analyzed to identify the types of technologies extended, and the methods by which they were extended. The data analysis involved frequency and percentage distribution.

Results and discussion

Characteristics of respondents

The ages of the respondents ranged between 30 and 70 years, with an average age of 46 years. Almost half (47 %) of the respondents were above 50 years, with 27 per cent below 40 years. This implied that fish processors in the communities surveyed were old. There is, therefore, the need to make fish-processing technologies more attractive to the younger women to sustain the village fish-processing industry.

Most of the respondents were illiterate. Only 10 per cent had formal education up to primary school level. The remaining 90 per cent had no formal education.

Of the sample interviewed, 86 per cent were married, 12 per cent widowed and 2 per cent single, with the number of surviving children ranging between 1 and 10. The average number of children per parent was six. For gender and social obligations, men were responsible for supporting the family while women were home-makers and in charge of food preparation, child care and other domestic activities like cleaning, washing and sweeping. Although men were the heads of the families, some of the female respondents were household heads and the main contributors to income. These women took their own decisions and performed functions meant for men.

The primary source of income of the respondents was fish processing. Secondary income sources included farming, petty trading, and food preparation for sale. While 47 per cent of the respondents were dependent on petty trading and food vending for their livelihood during the off-fishing season, 12 per cent engaged in farming. Forty-one per cent depended solely on fish processing for their income throughout the year by purchasing frozen fish from cold stores in the cities during the off-season to process.

Source of information, years of awareness, and use of technology

Most (75 %) processors collected information on the improved fish-smoking technology when the AFPP trainees and training team undertook the training of respondents in the construction of the oven and fish trays in the villages. The rest had information from friends, relatives and other village women, and by observation. The processors had also been aware of the technology for periods ranging between 2 and 12 years. A total of 94 per cent had been using it for various periods ranging from less than 1 year to up to 12 years (Fig. 1a, 1b, 1c). Although 6 per cent were aware of the technology, they were not using it due to their inability to bear the initial cost of purchasing the inputs for constructing the oven. Thus, three main sources of information on the improved fish-processing technologies were identified in the sampled communities. In order of importance, these were the direct extension activities of the AFPP and indirectly through other

processors.

Scale of adoption of the improved technology

The scale of adoption describes the adoption behaviour over the years, the components of the technological package adopted, and modifications made by the adopters.

Adoption behaviour. A review of the baseline surveys conducted in the past and post-adoption studies showed an initial growth in the use of the improved technology, followed by a more rapid increase, and then a slowing down as the cumulative proportion of adoption approaches its maximum (Lokko & Ansong, 1994). The pattern is consistent with the normal bell-shaped frequency distribution of number of mean adopters for years (Rogers, 1995). This was explained by the assumption that initially, processors wanted to see the relative advantage of the new technology over the traditional round metal oven, and started using the new technology as they gained confidence in the numerous benefits associated with its use. For instance in 1988, the Chorkor smoking technology was introduced to 12 processors at Lekpongunor. The number of processors who adopted it increased sharply to 143 after 6 years in 1994, and by 1998 the number had increased to 160. Out of the total respondents interviewed in this survey, 6 per cent were not using the new technology because they did not have the capital to construct the oven.

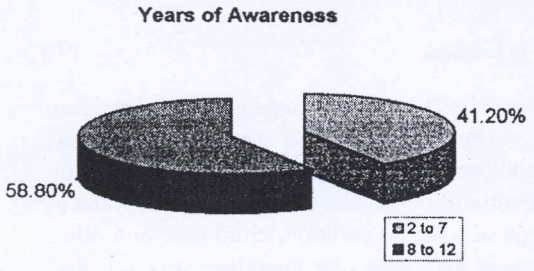

Fig. 1a. Distribution of level of awareness of technology.

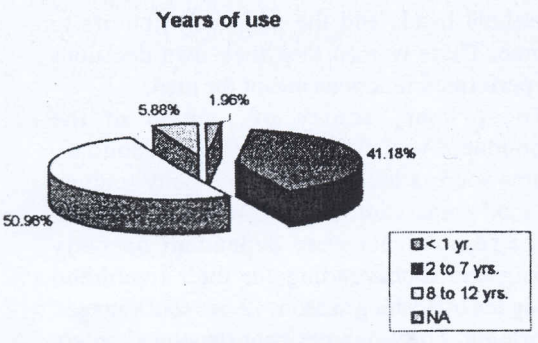

Fig. 1b. Distribution of years of technology use.

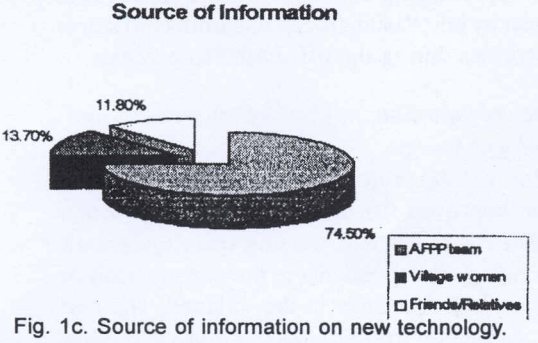

Fig. 1c. Source of information on new technology.

Aspects of technological package in use. The technological package initially extended to the processors consisted of a rectangular oven made up of two compartments, up to a maximum of 10 trays of framed wire-mesh, and a plywood covering. It was observed that 88 per cent of the processors interviewed used all aspects of the technology introduced. However, about 6 per cent used only the oven and the trays, but not the plywood covering. Thus, three categories of that adopters were identified, namely full, partial and non-adopters in decreasing order of importance. Those not using the plywood covering indicated that absorbed moisture from the environment resulted in a longer period of smoking. Six per cent did not use the technology due to their inability to bear the initial cost of purchasing the inputs for constructing the oven. The high level of adoption could be attributed to the compatibility of the new technology with the traditional smoking system. Similar findings have been reported elsewhere in Ghana (Rogers, 1995; Kusi-Boamah, 1998; Sakyi-Dawson & Kudadjie, 2001). Kusi-Boamah (1998) found that in the Asutifi District of Ghana, adoption levels of maize technologies

were directly related to the extent of matching with farmer needs. Sakyi-Dawson & Kudadjie (2001) also reported a perfect correlation between ranking of level of adoption of improved micro-enterprise technologies and net benefits among Dangbe women in southern Ghana.

Modifications to the new technology. Four main modifications were made to the improved technology by the processors. These included reduction in dimensions of the trays, use of bricks instead of clay, dividing oven into compartments, and the use of wooden sticks. It was observed that some processors had reduced the dimension of the trays for easy handling. Due to financial constraints, some processors also used half the size of the oven and fewer trays. Respondents at Tema Manhean used bricks instead of clay for constructing the oven because of its availability and durability. At Lekpongunor, it was observed that some of the processors had divided their ovens into two compartments to facilitate easier turning of fish during smoking. The top trays were transferred to another compartment of higher heat intensity when the intensity of the compartment was low. Finally, the processors put wooden sticks on the wire netting when smoking big-sized fish to prevent 'net marks' on the smoked fish and also to prevent the mesh from sagging. These adaptations indicate that micro-enterprise technologies need to be easily adaptable to different circumstances. The Chorkor Smoker has those characteristics, thus making it a winner (Sakyi-Dawson & van der Heijden, 1997).

Benefits derived and problems encountered with the use of the technology

The processors derived a combination of personal, economic, and environmental benefits from adopting the technology. Some of the benefits included safety, lessening of drudgery of fish-smoking activity and reduced smoke nuisance, better quality of fish which attracted higher prices, considerable increase in smoking capacity, fuel efficiency, and improved family health and nutrition. Nti, Plahar & Larweh (2001) observed the impact of adoption of this technology on family nutrition and health.

In spite of the numerous advantages associated with the improved technology, all 48 processors using the technology indicated some degree of problem with its use. Problems considered significant were those within the range above or equal to the average (Fig. 2). These included weight of trays, non-availability of input, and high cost of inputs. One main disadvantage identified with the improved technology was the weight of the trays which made handling difficult. About 26 per cent of the processors indicated that they found the fish trays rather heavy, resulting in chest pains due to continuous lifting of the trays. Economic problems relating to high cost of inputs as well as non-availability of inputs were observed by 18 and 20 per cent of the processors, respectively. Other problems indicated were cost of maintenance (4 %), fear of fire outbreak should a shed be constructed to protect the oven (6 %), and rusting of equipment during off-season when there was no fish smoking (8 %).

Factors influencing effective adoption of the improved technology

Several factors limit the rate of adoption of a technology. These include lack of detailed cost and return analysis on developed technology; lack of markets and consumer acceptability; failure of technology developed to address real problems of fish processors; unavailability of, and high cost of inputs; untimely introduction of technology; incompatibility of technology with traditional processing system and socio-cultural practices; external influence; and level of group formation.

To identify the key factors limiting adoption of the new technology, the above-mentioned factors were investigated, and peculiarities of adopters as well as non-adopters were assessed. The results showed that basically, any fish-processing technology developed should be less technical, consistent with the existing processing system, and easily learnt through observation. These actually enhanced the adoption rate of the new

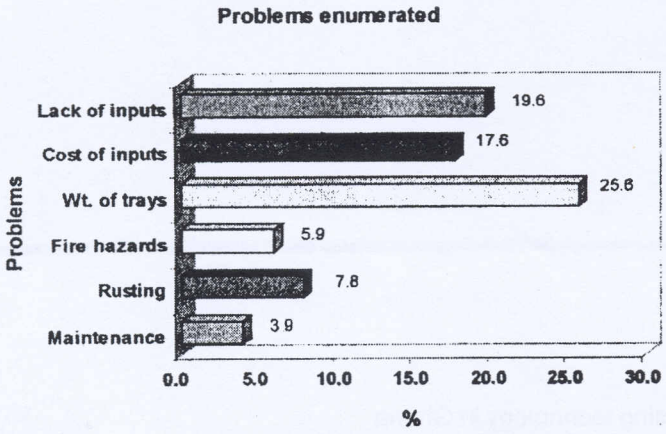

Fig. 2. Problems encountered by respondents in using the improved technology.

technology.

Table 1 shows the opinions of respondents concerning factors affecting the effectiveness of adoption of the improved technology. Seventy-eight to 90 per cent of respondents observed that lack of finance or credit, cost and availability of inputs were paramount. Also, 70 and 50 per cent of the respondents indicated that consumer acceptability and group formation, respectively, were among the important factors. On ranking the factors in order of importance, it was shown that the key limiting factors for effective adoption of the improved technology were unavailability of inputs, high cost of inputs, lack of credit or finance, and lack of market and consumer acceptability.

The respondents observed that the degree of adoption of inputs depended largely on availability and affordability of inputs. This was clearly shown by the variability in the ownership of ovens by processors. Those who had more than two ovens were those who had adequate financial resources within the community. Non-adopters attributed their situation to the high cost of inputs and therefore resorted to the use of the less expensive traditional round metal ovens which were more affordable. The processors suggested acquiring inputs at factory prices instead of buying from the open market.

Most of the respondents observed that since the technology was beneficial, funds should be sought to help adopters purchase inputs. Early adopters of the improved technology acquired inputs on credit, but late adopters had to mobilize capital over a long period of time to enable them purchase the inputs. Non-adopters also expressed the need for credit facility to adopt the technology. It was observed that the institution of an efficient credit programme would facilitate the scale of adoption of the improved technology.

The adoption of a new technology can be hindered or enhanced, depending on the market and consumer acceptability of the product. The improved smoker is widely used due to the better quality of the processed fish which attracts premium price on the market. All respondents commended the high consumer acceptability of the processed fish as facilitating the effective adoption of the improved smoker.

Group formation is another important factor to be considered in technology transfer. Early adopters were advised to form associations, as this helped in securing loans for members from financial institutions. The groups were also very instrumental in disseminating the technology to interested processors.

Conclusion and recommendations

The study showed that the method of dissemination used in the extension of the improved technology to the villages was very effective. The high rate of adoption of the technology observed was due to the economic, health, and environmental benefits associated with it. The major determinants limiting the effective adoption of the improved technology included unavailability and high cost of inputs, lack of credit or finance, markets and consumer acceptability as well as group formation.

TABLE 1

Factors Affecting Effective Adoption of the Improved Technology

Factor	In general		Ranked most important	
	Frequency	Percentage(%)	Frequency	Percentage (%)
Lack of detailed cost & return analysis on developed technology	10	19.6	1	2.0
Lack of markets and markets constraints	24	47.1	1	2.0
Impact of technology on individual and community development	23	45.1	4	7.8
Failure of technology to address real problems of fish processors	25	49.0	3	5.9
Unavailability of inputs	39	78.0	23	45.1
High cost of inputs	45	88.2	9	17.6
Lack of finance or credit	46	90.2	7	13.7
Quality/consumer acceptability	37	69.8	7	13.7
Culturalpractices/social obligations/beliefs/attitudes	23	45.1	1	2.0
External influence on decision making/gender roles	20	39.2	1	2.0
Time of introduction of technology and adoption behaviour of processors	18	35.3	1	2.0
Lack of group formation	26	51.0	1	2.0
Average	2.8	54.8	4.9	9.65

There is the need to study modifications made to the technology in order to bring to bear traditional knowledge in the technological package for effective adoption. This is because although a technology may be attractive in its relative compatibility and adaptability to the specific circumstances of the target beneficiaries, it is also important to build a dynamic process of refinement into it such that problems and constraints, which are direct aspects of the technology, can be removed. These changes need to be considered in any long-term innovative process.

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