KENYA INSTITUTE OF FOOD SCIENCE & TECHNOLOGY
WORKSHOP ON RESEARCH NEEDS AND PRIORITIES IN
FOOD SCIENCE AND TECHNOLOGY

RESEARCH NEEDS AND PRIORITIES IN FOOD SCIENCE AND TECHNOLOGY IN GHANA

BY

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Staple Foods of Ghana and their Production

Staple Foods

The major staple foods of Ghana may be classified under cereals, rootcrops and tubers, legumes, oil seeds and fish. Under the cereals, maize sorghum and millet may be considered as the major staple cereals. Cassava, yam, cocoyam and plantain may be named the major rootcrops, tubers and starchy vegetables. Mention would be made of cowpea, groundnuts and bambara groundnuts as the major staples crops under grain legumes. The oil palms and sheanuts can be considered the major oil producing crops.

While looking at methods used in the processing and preservation of the named major staples, some of the minor fruits and vegetables such as oranges, pineapples, tomatoes, onions and peppers would be looked at in relation to their processing and preservation.

Production and Consumption

In Ghana, 60% of the population is engaged in agriculture. The sector contributes 35.7% to the Gross Domestic Product, 19% of which is attributed to food and agricultural products apart from cocoa and forestry. According to the food production figures released for 1974 by the Ministry of Agriculture, the following quantities of crops were produced during that year. Animal census figures were also as indicated:

Table 1a

Commodity	Tons		Commodity	Estimated Nos.
Maize	468,000)	539,000	Cattle	800,000
Rice	71,000)		Sheep	900,000
Cassava	3,483,000)		Goats	750,000
Yam	701,000)	6,305,000	Pigs	125,000
Plantain	2,121,000)		Poultry	4,200,000
Groundnuts	104,000			
Fish	180,000			

The population of Ghana was estimated to be about 8 million in 1975. Taking into account the dietary habits of the Ghanaian people and the required dietary allowances for effective nutrition, the following quantities of food crops were estimated as

2/....

production needs that would enable the population of 8 million people to be fed effectively (Kordylas et al, 1974):

Table 1b

Crops	Tons
Cereals	908,000
Tubers	1,375,000
Fruits and Vegetables ..	1,300,000
Legumes	521,000
Vegetable Oils	176,000
Fish and Meat	306,000
Egg	2.8 billion

Comparing tables 1a and 1b, it can be seen from the 1974 food production figures that apart from tubers, rootcrop and starchy vegetable that had a figure of over 6 million tons, the production figures for the other food crops could be considered to be somewhat below the expected needs. It was therefore not surprising that by 1979, when the population of Ghana had increased beyond 10 million, Ghana was unable to feed her population and had to depend on importation of foods which by the end of the year had increased to over 150 million cedis per annum.

Processing Methods and Infrastructure

Cereals

Maize

The bulk of the maize produced locally in Ghana is processed by milling. This is usually done by small artisanal mills in the towns and villages. Before milling, the maize is soaked for 2 to 3 days for the grains to soften and start fermenting. This is followed by wet milling and the dough produced is further fermented by natural fermentation. The fermented dough is then utilized in traditional food preparation. Maize is not extracted in Ghana for the production of maize meal or maize flour and there are no industrial facilities yet available for the processing of maize in Ghana.

Both sorghum and millet are processed by traditional artisanal methods by grinding to produce 100% extraction flour. Traditionally produced millet flour is obtained by pounding humidified

3/....

millet grains in a mortar. The process is quite tedious and time-consuming. In areas where there are small artisanal mills, milling is done by the mills (FAO, 1977).

Wheat and Rice

Although wheat and rice are not included in the staple cereals of Ghana, industrial milling of cereal grains cannot be discussed without mention being made of the increasing demand being made on rice and wheat flour in Ghana.

Rice

Rice in some quantity and of excellent quality is traditionally grown in almost all regions of Ghana on small holdings. The rice produced is par-boiled and milled at the farm and village level. There has been a general trend of rising consumer demand for rice in the fast-growing urban population centres and also a rapid increase in institutional consumption (i.e. colleges, hospitals, workers' canteens, etc.). By 1966/67, annual rice imports in Ghana was over 6 million cedis. This constituted about 16% of Ghana's food imports at the time.

The Government tried to boost rice production by establishing rice mills with large amounts of foreign exchange and added purchasing funds to buy and process individual farmer's and co-operative farmers' crops, thereby serving as guaranteed outlets in the areas with the established mills. These led to high financial losses without any significant effect on national rice production (Reusse 1968).

Although past establishment of rice mills did not prove successful, the government still invested in 15 more rice mills fully equipped with par-boiling facilities. Of the 15 mills, only 1 mill installed in the northern region operated for a while. These government mills did not show ability to compete with the traditional rice processing trade at farm and village level in respect to either milling costs or economy.

The great care applied by the village processor at low opportunity cost and the high utilization of the small universally used village mills, which ingeniously operated by one man and adjusted from case to case, mill rice as well as maize, millet, guinea-corn, cassava chips, groundnut, copra and palm kernel, had for

4/....

many years now put any industrial competitor at a competitive disadvantage. At the same time, the lack of farmers' response to the establishment of outlets for their paddy at guaranteed price proved the comparative efficiency of the traditional marketing structure (Reusse 1968).

With Ghana's present economic crisis, and high cost of food in the country, proper rehabilitation of these mills as part of an agricultural production and food processing plan will greatly enhance the rice industry in the country.

Wheat

During the past 20 years the Ghana Government established a wheat mill project as the central part of an Industrial Food Complex at the harbour town of Tema. The milling section of the complex provides a capacity for an annual through-put of 63,000 tons flour (72% Extraction) (Reusse 1968). A private foreign investment in a similar milling capacity of about 40,000 tons flour was also concessioned in 1967.

Large amounts of foreign exchange are now spent for the importation of wheat to feed the flour mills. This has been mainly to the detriment of the indigenous staple cereals, the development of which is thus neglected. It is important to note also that in comparison to the indigenous staple cereals, sorghum, millet and maize, wheat four and bread can be bought by the poorer sections of the population only occasionally. The bulk of the wheat flour products (bread, biscuits, rolls, etc.) is thus bought by workers who desire a convenient meal which requires no cooling. Bread is also mainly consumed by the foreign sector of the population (Arabs and Europeans) and a considerable part also goes into institutional consumption, such as the army, hospitals, educational institutions and other government and private catering responsibilities.

Root Crops and Tubers

Cassava

Among the root crops and tubers grown in Ghana, the most important one which is processed into various traditional products is cassava. The others are usually consumed without much processing.

Cassava possesses a certain amount of toxicity which is caused by the presence of cyanogenic glycoside - linamarin, together with smaller amounts of the closely related lotaustralin. These substances hydrolyse under the influence of the endogenous enzyme linamarase to liberate HCN (Coursey 1973). Cassava deteriorates and discolours rapidly and it must therefore be processed within 24 hours. Gari which is a pre-cooked cassava meal is produced mainly in the cassava growing areas. Gari processing is almost entirely carried out under rural conditions. Some mechanized processing has been started on a modest scale. For the production of about 1 ton of gari a day, about 3 tons of freshly rooted cassava are needed to be assembled.

Traditional Processing

In the traditional method of processing gari, peeled cassava is washed and grated to give a fine mash which is put into hessian bags and tightly closed. Weights in the form of stones are placed on the bags to eliminate excess moisture and allow spontaneous fermentation during 3 to 4 days. Most of the hydrocyanic acid present in cassava is usually eliminated with the excess water during the first 2 days. After the fermentation period, the fermented dough is broken up and sifted to remove fibrous matter. The course meal produced is dried and fried in shallow metal pans at about 80° to 85°C to give untainted gari. Yellowish tinged gari is produced by frying in a pan greased with a little oil. During the frying, there is constant stiring to give crisp, free flowing granular gari. The produce may be passed through different mesh size sifts to produce gari grades of different particle sizes. The finished product has a swelling capacity of about 3 times its weight when hydrated.

Mechanized Processing

According to FIIR report (1962) on mechanization of gari processing, cassava roots, not more than 12 hours old are chopped and loaded into a rotating vessel with an abrasive lining filled with water. On rotating, the vessel peels the roots by its abrasive lining as well as by the rubbing action of the roots against each other. Incompleted peeled pieces are removed by hand.

Peeled roots are fed into a grater consisting of a set of revolving blades which chop the cassava into a fine pulp.

6/...

Dewatering of the cassava mash is done by pressing on a sieve with a mesh of 0.234" to bring the moisture content to 47 to 50%. This usually retains about 70% of the cassava mash. The mash is received into aluminium tanks mounted on wheeled carriages for fermentation. These have spouts at the bottom for degassing and further dewatering during the fermentation process. The fermentation is accelerated by "priming" the mash by inoculating with liquor expressed from a 3-day old naturally fermented cassava mash at the rate of litre liquor to 1cwt mash. The fermentation is usually completed within 48 to 72 hours when the pH of 4.0 $\pm$ 0.15 (0.85% lactic acid) is attained. Supplementation with soy bean may be added at this stage.

The fermented pulp is emptied into a continuous centrifuge which produces a filter cake of 50% moisture content. This is disintegrated in a mill with no additional milling effect, and passed through a continuous sieve type granulator to remove fibres and other foreign matter.

The granulated pulp is discharged into a rotary kiln which is externally heated by a baffled jacket of hot air (inlet 300^{o} - 320^{o}C) and outlet (200^{o} - 280^{o}C) for the "garification process". Heat is transferred across a 3/16" thick stainless steel tube where the gelatinizing mesh is moving parallel to the hot air. The extent of gelatinization usually determines the quality of the final product. To achieve maximum gelatinization, it is essential that mass transfer is reduced to a minimum, so that the core of each gari granule attains the gelatinization temperature before the onset of surface drying. A rotary rake dislodges the gelatinizing bed of cassava mash granules before it has travelled 45^{o} of surface. This prevents the gelatinized granules from sticking to the garifer wall. Under normal operational conditions, the fermented cassava mash is gelatinized for 15 to 20 minutes when its moisture content reduces from 45 - 50% to about 40%.

The gelatinized gari granules are conveyed via a vibratiny conveyor directly into a fired rotary louvre dryer. The bulk of the mass transfer takes place in the fluidized bed of this dryer (air inlet temp. 200^{o}C and outlet - 145^{o}C). The gelatinized gari granules are dried from 40% moisture content to about 8%

7/....

within 15 to 20 minutes. The product that is discharged from the dryer is hot, hardened and aggromerated.

This hot product is bulk collected into a storage bunker and allowed to cool. The cooled gari is then transferred through the bottom of the bunker into a disc mill where it is milled. The milled gari is sifted through various mesh sizes and the resulting final products are packaged separately as top and lower graded gari. Hessian sacks are usually used for the bagging.

Cassava Flour

Cassava flour is prepared in Ghana by allowing freshly chipped cassava to dry either in the sun or over a s low fire. During the drying period, some fermentation takes place. The dried chips are stored in this form and are milled and sifted into fine flour called "konkonte". During the drying period under traditional conditions, the chips are easily contaminated with moulds and aflatoxin has been isolated from cassava flour samples obtained from markets (Lokko 1979). Research has indicated that bread of acceptable quality can be made by diluting hard wheat flour with 30 to 50% starch. Soft wheat flour can take up to 30% dilution with cassava starch. The nutritional merits of this practice are, however, questionable (Kordylas 1978).

Legumes and Oilseeds

Cowpeas, groundnuts and bambara groundnuts are the three mostly considered common legumes. Cowpeas are not processed into commercial products at the present. The Food Research Institute of Ghana in collaboration with IDRC, Canada, has been carrying out some preliminary studies into the possibilities of processing the cowpea into flour which could be stored and utilized in the preparation of other traditional products. One of the major problems encountered with cowpea is the high degree of insect infestation and the high amounts of losses occuring through insect damage to the grain during storage.

Groundnuts are roasted, skinned, pounded or ground into smooth paste by small traditional processors. The product is used in the preparation of soups in Ghana. Recently, there has been attempts to produce groundnut paste and groundnut butter on industrial basis. Groundnuts are also roasted and sold as snacks.

8/....

The processing of groundnuts for oil would be discussed with the processing of other oilseeds.

Oilseed Processing

The major oilseeds - the palm-nut, the coconut and groundnuts are cultivated in Ghana. In addition to these, the sheanut, collected from wild-growing trees in the northern savannah zone, is an important source of fat supply. Apart from utilizing both the palm-nuts and groundnuts as raw materials for oil extraction they are both also utilized as ingredients in traditional soups. Crude oil produced traditionally is preferred by the population because of its comparatively low ffa content and its freshness and particular taste. Industrially produced oil is generally sold at prices equal to those prevailing for traditional oil, because of the preference. With the exception of groundnut oil, where the mills at the beginning were unable to reduce moisture to a satisfactory extent, the factory-made oils could compete effectively with respect to quality and ffa content. However long storage of oil seeds and/or oil in drums due to inadequate marketing outlets from the start, frequently caused degradation in the quality of the oil and this endangered the mills reputation in the markets.

All industrial oil milling is done by government mills, inclusive of one small joint government/foreign enterprise. Most of these mills with estimated total production capacity of between 5,000 and 15,000 tons annually utilize between about 4 to 53% of the total annual capacity. The low output of the mills is due to the inability to attract sufficient supplies from the surrounding areas, though crops in these areas could well keep these mills running at full capacity. However, in the beginning the mills discouraged farmers and supplying traders by delays of several months in the payment for supplies, due to heavy financial losses in competition with traditional processing trade.

In the case of groundnuts, it was realized that the mill can only compete in the domestic oil market, when supported by groundnut supplies at prices well below market level. However, at such prices, unfortunately fixed by the Cocoa Marketing Board (Ghana) (CMB) as sole-buyer of the traditional tropical export crops and agent for the mills, supplies of good quality groundnut hardly found their way to the mills (Reusse 1968).

9/

It can be seen that the overall share of industrial processing (only 10.8%) in the country's oil production is low, and this is not due to lack of industrial capacities but rather to the fact that the traditional processing trade is deeply rooted and a hard competitor to factory operation due to the generally lower cost of operation.

Fish

Traditionally, fish is processed by sun- drying , smoke-drying, salting and salt-drying. The fish is either dried in the sun or by artificial means. Traditional fish processing has been established and practised in Ghana since a long time. This is done by a large number of women operating thousands of ovens (Kagan 1970). Sun-drying of fish is carried on at the beach. Some fish is salted before sun-drying and this helps to well preserve the fish and to retain fresh silver colour. Dry-smoking is by far the most popular method used in the processing of fish.

With regard to industrial processing of fish the Ghana Government constructed two canneries at very high investment costs. One of the two projects is the "Tema Fish Complex", which is designed to incorporate a variety of fish processing activities, including fish meal production and a smoke-curing section, around canning as the main function. It has a moderate capacity of 4,000 tons canned fish per annum. The other project is a 15,000 ton (canned output) fish cannery, incorporated in the so-called "Interlocking Food Complex". As in most other sections of this Complex, production capacity of the cannery is over sized.

Fruit and Vegetable Processing

Apart from traditional dehydration of pepper by sun-drying and grinding into pepper powder, fruits and vegetables are not processed traditionally. Canning and bottling plants established by the government of Ghana during the 1960s utilized only about 20% of the production capacity. At the inception of these plants although the plants were producing under capacity, still stocks of finished products at the larger ones were mounting because of the smallness of the inland market, because of high production costs, sub-standard quality products, etc. The crops mostly processed industrially are pineapple, tomato and citrus.

10/....

While in view of the sizeable inland market, tomato products offer themselves for a large-scale canning project, technological difficulties were experienced in obtaining good quality products by canning indigenous tomato varieties. High acidity, resulting in bitterness of the canned products, and discolouration in processing were the main disadvantages observed and it was also further realised that there was higher waste compared with conventional standard, in the processing of local varieties. The latter factor thus increased the price for the net can input which was already high, due to strong competition for the consumption of fresh tomatoes and high cost of long haulage distances. In view of the high cost of raw material intake, purchase can only be afforded during the peak period of the tomato season when prices are lowest.

The citrus and pineapple products from the beginning of the industry had a small domestic market, since Ghanaian consumers prefer fresh fruit. The government helped the promotion of these products by protecting the processors with a complete ban on importation.

In spite of the difficulties and limitations experienced by the operating plants, 3 large new canning projects were also put up by the Ghana Government at very high investment costs with high foreign exchange component. These projects were stationed at Nsawam, Wenchi and Pwalugu to process pineapple slices and juice; mango jam, mango cream and tomato puree respectively.

Reviewing these projects in 1968, Reusse gave the following as some of the problems facing the projects:

1. All projects were facing grave shortcomings in raw material resources
2. All projects, run at economical scale, would produce far in excess of the inland market
3. All the projects' products would be unable to compete in the export market
4. All the projects were tying up considerable amounts of foreign exchange in unsold stocks
5. If the investment had not yet been made, the projects would all have to be condemned.

Evaluation of the General Performance of the Established Food Industries in Ghana

In General, the initial investment value for established food

11/....

industries in Ghana ranged from 55.5 million cedis in 1966/67 to a total potential investment of about 120 million cedis by 1970. The investment cost involved in the establishments included a high foreign exchange component, due to the fact that most of the machinery, equipment, building materials, etc. had to be imported. In addition to these costs, packaging and raw materials in most cases had also to be imported to support these industries. There was at the beginning, a general lack of qualified competent managerial staff to administer the industries and since most of the industries were wholly or dominantly government owned, the capital invested in the establishments and the use of the facilities were not liable to interest payments, and this thus contributed to wasteful usage and the slowness of some of the industries in establishing satisfactory levels of operation. There were frequent transfers and other changes of both managerial and other staff members, and a lack of training schemes especially for those employees on the job. There was also a tendency for over-staffing due to the employment of poorly qualified applicants under the influence of nepotism and tribalism.

After commissioning of the plants, none of them ever operated at full capacity, with an overall average productivity of about 35% of the full capacity. The lower utilization of these industries thus resulted in higher foreign exchange component in the cost price of the product, since net saving to the benefit of trade balance would only accrue if reasonable utilization of production capacities could be achieved. In calculating the foreign exchange component in the production of one cedi work of locally produced import substitute, it was realized that in some cases it took about ¢3.00 of foreign exchange component to produce ¢1.00 worth of the product locally, and the product obtained also did not meet acceptable standard of quality (Reusse 1968).

Establishment of Appropriate Food Manufacturing Industries

Consideration must be given to the establishment of appropriate food processing and manufacturing industries based on traditional staple foods and food processing methods. Traditional methods of food preservation and processing involving sun drying and fermentation must be given serious consideration. Since drying

12/....

does not involve costly preservation additives and a well dried product can be packed in relatively inexpensive containers, efforts for technical improvement of traditional methods and the development of new dehydrated products for domestic consumption or for export, such as the dehydrated palm-pulp developed by the Food Research Institute, must be encouraged.

While drying is generally considered as a costly process with regard to fuel input, the situation in Ghana with fuel wood and solar energy potential in most parts of the country favours this kind of heat processing.

There should be a careful rethinking and reviewing of government investment in large scale industries which must depend on increasing importation of raw materials from outside. Unless such industries are indispensable with regard to the importance of their products such as milk; or render such important supporting service to other industries, such as production of packaging materials, all existing large scale industries must be re-evaluated and proper plans made for the effective rehabilitation of those that can be properly integrated into a priority national plan for effective food manufacturing industries or those that cannot be rehabilitated effectively must be eliminated outright.

National or Sub-Regional Research and Training Institutions in Food Science and Technology

Training Institutions in Food Science and Technology

Training of students in Food Science and Technology is usually done at the University of Ghana in the Department of Nutrition and Food Science which was established in 1962 as a composite department of Biochemistry, Nutrition and Food Science, in the Faculty of Science and Agriculture. The present department is now wholly in the Faculty of Science, but provides courses in Human Nutrition for Agriculture, Home Science and Nursing students.

It offers two year courses in the three year Bachelor degree in either Nutrition or Food Science, and also in Nutrition and Food Science. Since 1963, the department has been training students in Nutrition and Food Science. For a period of 10 years a one-year B.Sc. Hons. degree has also been provided in either Nutrition or Food Science for those who obtained B.Sc. Gen. degree with a good class. The department also provides courses for a

13/....

one-year graduate diploma in Food Science for graduates from Agriculture and other relevant fields. It has also been made possible for graduate degrees of Master of Science (M.Sc.) and Doctor of Philosophy (Ph.D.) to be obtained from the department by research in Nutrition and Food Science.

Research at the University Level

In addition to the training of students, various research activities are also carried out by staff members and also by students as part of their training. The research subjects handled are geared toward problems in Foods and Nutrition in Ghana. Investigations have been carried out on the starchy raw materials and their industrial utilization. Work has also been carried out on the extent of storage losses of starchy tubers and their processing and preservation.

Fermentation studies have also been carried out on local products such as palm wine and the changes that occur during its production. Fish preservation, solar drying of vegetables and meat processing have also been looked at, nutritional studies and dietary habits projects have also been carried out on various groups of people in Ghana. Most of the research results from these activities have been produced in reports and in publications both internally and externally (Publication of the Department of Nutrition and Food Science, Legon).

Research at the National Research Institutional Level

The Food Research Institute of Ghana

Research in Food Science and Technology on the national level is carried out by the Food Research Institute which was established in October, 1963, and incorporated by an Executive Instrument in March, 1965. There was a 5-year period, from 1965-1970, when the Institute received UNDP assistance through the FAO. The Food Research Institute is one of the institutes of the Council for Scientific and Industrial Research (CSIR) which is the central research organization for the nation.

The Food Research Institute was established to assist the local food industry at all levels of organization, to improve and diversify their operations. It was expected that with the requisite impact on the food industry, agricultural productivity

14/...

would also be promoted. To achieve these objectives, the Institute undertook research on problems of food processing, preservation, storage, marketing and distribution and provided services and advice to industry and the public concerning food analysis, quality control, product improvement and development, and the marketing and distribution of food.

Five divisions were established as follows:

1. Processing
2. Analysis
3. Engineering
4. Economics and Consumption
5. Information.

Under these divisions, various research projects with bearings on the broad objectives of the Institute were tackled by individual scientists according to their disciplines, and although most of these projects were completed, they could not be implemented because of their narrow scope. A number of products developed at the laboratory stage needed further trials at a pilot plant stage to provide feasibility and viability data to induce interested entrepreneurs to undertake and transform them into effective large scale production. Unfortunately the construction of the Institute's multi-purpose pilot plant had been under construction for more than 10 years (Kordylas 1979).

From its inception, the Institute suffered from lack of effective direction. For the first 13 years of its existence, it never had a substantive Director. The first head was an Acting Director, since his resignation in 1970, two officers-in-charge took charge and it was only in April, 1978, that a Director was appointed.

Research Programmes and Projects in the Institute

In 1977, the research programmes of the Food Research Institute were revised and emphasis laid on mission-oriented Food Science and Technology programmes aimed at solving national economic and development problems through multidisciplinary approach and co-ordination.

Four main programmes were initiated and research projects were drawn up under these programmes (Kordylas 1977). Multidisciplinary teams were formed to tackle projects under the programmes

15/....

with clearly defined goals and objectives. The programmes drawn up were as follows:

A. i) The Storage Programme
   ii) The Processing and Preservation Programme
   iii) The Labour-Saving and Rural Technology Programme, and
   iv) The Economics, Marketing and Consumption Programme.

B. In addition to the 4 main Institute programmes, provision was made for Collaborative Programmes that can be undertaken with other Institutes in the country or with outside agencies. At the time of the drawing up of the programmes the following projects were being undertaken under this programme:
   i) The Winged-Bean Project - being undertaken with the University of Ghana and the Crops Research Institute
   ii) The Cowpea Project - an FRI/IDRC project
   iii) Rural Fisheries Development Project - an FRI/ Ministry of Agriculture, Fisheries Division/University of Ghana/IDRC project.

C. Nutritional Projects.

D. Consultancy.

Aims and Objectives of the Programmes

The Storage Programme

The Storage Programme aims at looking at the storage facilities existing at the rural levels with the hope of introducing proper storage facilities and storage methods that can be utilized to help minimize food wastage and spoilage at the farm and village levels and also at the market levels. The crops selected are cereals, root crops and grain legumes.

The Processing and Preservation Programme

The Processing and Preservation Programme is divided into 2 parts. Part one aims at evaluating and assessing traditional methods utilized in the processing and preservation of cereals, tubers, fruits, vegetables, oil-bearing crops, fish and meats. Processes and products found to be of particular interest for economic development are to be further studied for adaptation to small scale appropriate industries or put through a pilot programme to assess the possibilities of upscaling to industrial status. The Food Research Institute's Pilot Plant, is therefore, an integral part of this programme.

16/....

Part two of the programme aims at investigating the application of conventional as well as new methods in the processing of cereals, starchy roots, tubers, fruits, vegetables, fish, meat, oil bearing crops, into the following categories of foods:

i) convenient or labour-saving foods
ii) import substitution or exportable foods
iii) processed food as a means of preservation of perishable seasonal foods.

Any processes or products developed are to be put through pilot stages for feasibility and viability assessment for the prospect of large or small scale industrial production.

Labour-Saving and Rural Technology Programme

This programme has been planned as a support to the processing and preservation programme and it aims at contributing towards the development of appropriate technology within the small scale food industries. Projects are drawn under the programme to design and construct small scale labour-saving devices or equipment that could be utilized or absorbed at the village level into small scale traditional processes for maximum improvement and efficiency without undue disturbance.

i) Surveys have been planned to identify rural workshops in Ghana with respect to the types of machinery available to them and the types of work they have capabilities for;

ii) Specific workshops identified are to be assisted to construct parts of prototypes for assembling at the FRI workshop for trial testing and introduction to appropriate processors;

iii) Identified workshops may then take up production, distribution, repair and maintenance of designed devices and/or equipment.

Economics, Marketing and Consumption Programme

The programme aims at investigating some of the economic difficulties and methods involved in distribution and marketing of selected commodities being studied under the storage, processing and preservation programmes. Projects are planned to investigate:

17/....

i) agencies involved and facilities available in the distribution of the commodities from the production to the consumer level;

ii) factors affecting availability and pricing of the commodities, etc.

Difficulties and/or problems identified could then be tackled with the aim of finding solutions to them to help improve distribution and marketing of agricultural produce in the country.

The Choice for Industrial Development

Importation of Foreign Technology

Importation of foreign techniques into a developing country like Ghana has been found as discussed above to be very costly, because the rate of return was severely limited. Most of the technology imported was not adapted to the geological, climatological and above all socio-economic conditions of Ghana. This led to a state of chronic economic dependence on the exporting countries because of the terms of maintenance, running and servicing agreement for the imported machinery. The plants were often made up of highly automated elements which eliminated a good percentage of the labour force required. There has been very little dissemination of the productive process and innovative techniques involved. Thus the possibilities of using local unskilled labour has become extremely limited. To meet plant agricultural raw-material demands, large plantation type farms were established with the use of intensive capital techniques which entailed a limited use of the labour market. Most of these large production farms did not survive and since with the establishment of the food industries the government levied high duty and other taxation on imported items, raw material importation to feed the factories were also affected and thus these factories are now under productive or unproductive, degenerated, broken down or rejected.

Neglect of the Agricultural Sector

The Small-Scale Farmer

While fantastically huge sums of money were being invested in ventures which were failing to yield anticipated economic growth and desired industrialization, the nation continued to be fed by

the peasant farmer who lives in the rural areas and endures a life of absolute poverty and destitution (Kordylas 1979). According to the 5-Year Development Plan (1977) produced by the Ministry of Economic Planning, in 1974, agriculture contributed about 35.7% of the gross domestic product and employed about 65% of the labour force of the nation. Its contribution to the foreign exchange earnings of the country was about 62% and produced also about 60% of the industrial raw materials for the country's agro-based industries. The sector is dominated by small-scale farmers who constitute about 95% of the farming population. The holdings of these farmers scatter all over any given agricultural area and do not often exceed two hectares per farm family.

The technology employed in many processes, especially by the average farmer and the small-scale processor at the village level within the rural areas or the fringes of the urban centres is usually obsolete and hence is reflected in very low productivity per capita. The tedium involved in the use of this type of technology is worsened by the relatively low returns in relation to efforts made.

Farm level storage facilities are often non-existent or at best have been inadequate. At the selling point especially in the market places. The facilities are very scarce and often not available. Goods conveyed to the markets are either stored in the open or in private homes of friends and traders waiting for the market days. Only a few facilities for mechanical processing of produce is available at the site of production, so most of the processing and preservation of the produce are done by hand.

Local markets feature prominently in the marketing of foodstuffs in Ghana. The marketing system has not improved in any way and is less equipped to compete with the demands on it. There are no platforms to facilitate loading and unloading of foodstuffs and no pipe-borne water or electricity in any of the markets in the rural areas according to Nyanteng (1972) who surveyed and reported on markets in some rural areas in Ghana.

Traditional agriculture, by its tediousness and low productivity worsened by the general environmental hardship and under-development of the rural areas, has failed to attract the youth

especially those with some sort of education who are constantly rushing into the urban areas in search of employment. As a result of this exodus, the Ghanaian farmer is becoming progressively aged and if this trend is not reversed, eventually the ratio of the farming population to the entire population is likely to fall.

National Research Need and Priorities

Recognition of the Role of Agriculture in Industrialization

Large scale mechanized farming had not succeeded in the past in Ghana. Industrialization based on indiscriminate importation of foreign large scale technology had also illuded us. There can be no progress without expansion of agricultural production. The role that agriculture plays in our economy is so significant, in that it has the highest potential of all other sectors for simultaneous achievement of several goals. Majority of those involved in agriculture comprise small-scale farmers and it is obvious that any slightest easily disseminated type of innovation will register tremendous increases in the production of this sector, because of the multiplying effect of their numbers. It is therefore, only wise that attention should be directed to the development of the resources which the nation has in relative abundance, that is the development of the small-scale farmer.

Promoting agricultural growth and encouraging the efficient use of rural labour are the most important means of creating productive jobs and increasing food production. Particular attention must, therefore, be given to support the small farmer sector, since agriculture still remains the single most important source of employment. Increases in agricultural productivity and therefore incomes are important not only on their own account, but also because they make it possible to improve the purchasing power for the majority of the people which also makes it possible for the creation of domestic demand for industrial products. This in turn also helps to provide much of the fiscal resources needed to support industrialization.

Supporting Systems for the Small Farmer

It is important, therefore, that the complex intricacies of agricultural development must be given a multi-disciplinary

20/....

approach. Farmers must change production technology in order to increase yields for feeding the population and feeding any established industrial outfit depending on agricultural raw materials. Supporting system for increased farm output is very important and must be provided. To be able to purchase new and improved input, the farmer needs access to cheap sources of credit. He will also want assurance that these inputs are conveniently located and are available at reasonable prices. The farmer will not use fertilizer if it involves him in travelling long distances to supply depot and paying prices which are beyond his means.

If he has no facility for storing the bumper harvest or a ready market for the produce of the new technology, the farmer will prefer to stick to his traditional subsistence crops instead of taking what appears to him to be avoidable risks (Kordylas 1976).

There must, therefore, be a comprehensive agricultural planning which should be concerned not only with aggregate increased food production, but also with issues such as how a nutritionally adequate diet for low income consumers can be ensured. Because serious commitment and meaningful programmes cannot be accomplished, until the malnutrition problem is placed on the agenda of the planning body alongside problems such as housing, education, trade and transportation. For, without the purchasing power to convert food need into effective demand, the poor are outbid by the affluent for the food they so urgently need during times of critical food shortage.

Research Priorities

Research priorities therefore must be geared toward projects that would yield innovations that could be easily adapted and adopted by the rural sector for effective utilization not only in the food production sector but also in the storage, processing and preservation of the traditional foods produced. Processes that can be utilized for the effective improvement of the rural environment at a relatively low investment costs must also be looked for through research, utilizing the available resources inherent in the environment.

There must be a strategy based on local production of small farm

21/....

equipment that can be highly successful if applied in the mechanization of the national agriculture. To mechanize small farms, the design of appropriate machines developed, through research, must be provided to small manufacturers, entrepreneurs, and metal workshops in the country.

Further study is needed to clarify women's role and their contribution to economic development as well as to family and national well-being. Changes in land tenure systems and their effect on women, the relationships between development and population factors, the attitudes of men and women in exercising the right to control fertility and the availability of food supplies in relation to women's role in production, distribution and storage of food and to nutritional status must be actively looked at.

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