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FOOD PROCESSING AND PRESERVATION: CASE STUDIES OF EGYPT, CAMEROON AND THE CONGO*

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* The views expressed in this paper are those of author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO). This document has not been edited.

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TABLE OF CONTENTS

LIST OF TABLES

ANNEX

SUMMARY

The term "Appropriate Technology" in this report must be assumed to be technologies which are appropriate to the tasks in food processing. Such tasks include greater self-sufficiency in foods, rural development, adequate nutrition, increased industrial growth, strengthening of national technological capacities and increased exports. It therefore follows that such technologies can be small, medium or large scale, and may be low cost, fabricated locally or imported capital intensive technologies. The raw materials are either available locally or are imported.

Food consumption patterns are influenced to a large extent by the type of food crops produced and these differ from region to region. In addition, imported foods and drinks of elaborate quality abound to titillate the pallates of urbanites. These have combined to influence and dictate the types and levels of technological availability in food processing in each of the countries visited during the mission.

Egypt, Cameroon and Congo, are different in their levels of development and commitment to food processing industries, and in their level of food civilisation. Macro-economic policies in Egypt support mass production, export and foreign exchange earnings. Technologies are of necessity advanced and in some cases the latest in the market. Small to medium scale industrial villages are being set up to cater more for local consumption. Emphasis on export in Cameroon and Congo are mainly for industrial crops-coffee and cocoa and there is no protection for local industries in such areas as cereals, baking products, fruits and vegetable oils as illegal imports flood the markets. In Congo and Cameroon, the primary function of food processing for some time to come will continue to be the prevention of spoilage and the increase in storageability of basic foods designed to meet the nutritional needs of as many people as possible at affordable cost.

A strong case exists for active intervention by each developing country to devise solutions to the problem of improving the performance of food processing industries, the requirements of

which are quite clear:

a. agriculture must succeed in order to guarantee adequacy of raw materials for domestic and industrial use. The raw materials must be at the right price and quality; and adequate storage facilities should be provided.

b. infrastructural requirements of energy, water, transport and communication, are vital and crucial.

c. specialized personnel in engineering, maintenance, quality assurance marketing and management analysis will quicken the pace of food industrialisation.

d. through research and development, evolve appropriate processes and adequate plant and machinery for production, by utilising facilities in the engineering and machine tools industry, and exploring ways of utilizing and improving upon local raw material inputs.

e. products and services of good value and consistent quality will assure repeat purchase and consumer loyalty.

f. cost effective packaging and storage facilities for finished goods.

g. effective distribution and marketing.

h. information dissemination.

There is ample evidence which shows that exchange between developing countries would promote the development of more appropriate technologies thus allowing for specialization. Egypt, Cameroon and Congo have unique technolologies and facilities to share with the rest of the developing countries of Africa. These are:

i. technology for canning 'foul medames' (horse bean) which popularises the variety and improves protein intake in Egypt.

ii. The Food Development Centre in Egypt is a model that every developing country should emulate.

iii. Canning, solar drying and dehydration of fruits and vegetables in Egypt.

iv. Cable-way transportation for bananas in Cameroon to prevent bruising and improve quality for export.

v. production of flour from Dioscorea Dumetorium (sweet yam),

vi. Cassava bread production in Congo.

These production units should form the basis for co-operative programmes or projects,

If Africa must be transformed technologically by the year 2,000, there is the need for a greater sense of urgency more than ever before to develop indigenous African capabilities necessary for the achievement of the two goals of collective Self-Reliance and Self-Sustained growth through renewed emphasis on Research and Development. Afterall, what a country spends on Research and Development is increasingly a (function) particularly significant indicator of the place it can hope to have on the World scene, economic problems notwithstanding.

The food industry in Egypt is large, developed and is getting sophisticated. Food industries in Cameroon and Congo are developing. In the short and medium term, commitment to the development of appropriate small to medium scale industries, assisted with finance and backed by technical expertise should be pursued as a matter of priority. Longer term, a clear political will, and a consistent science, technology and industrialisation policy will lead to the development of large scale, appropriate technology- food industries.

INTRODUCTION

1.1 APPROPRIATE INDUSTRIAL TECHNOLOGY: FOOD INDUSTRY

Technology is systematic knowledge, and is a series of continuous activities which are constantly evolving with man's aspirations to provide a better life for himself.

Industrial technology is a concept of technology geared to production and commercial activities and is distinct from scientific knowledge which usually flows freely without significant constraints, whereas technological know-how is a commodity that is traded on the world market under vigorous protection. Technology can be embodied in tangible products such as machinery or industrial complexes, or can be in the form of patents, unpatented know-how, expertise and skills.(1)

The technologies chosen by developing countries - Egypt, Cameroon and Congo in this context, should obviously be appropriate, that is, they should contribute most to the achievement of greater technological self-reliance and increased domestic technological capacity (2) together with the fulfilment of economic and social objectives of development.

In general, three sets of factors should be considered in determining whether a technology is appropriate, namely:-

(a) Development Goals

These can include growth of employment and output through more effective use of local resources; formation of skills, reduction in inequalities in income distribution; meeting the basic needs of

the poor; improvement of the quality of life in general and promotion of self-reliance.

(b) Resource Endowments:

These include the availability and costs of local manpower, the level of skills and local management capacities, availability and costs of water and energy, and natural resources.

(c) Conditions of Application:

These include a number of economic and non-economic factors, such as the level of infrastructure, climate, natural environment, the social structure or the population, traditions, cultural and educational background as well as the location of industry, the size and demand of the foreign exchange situation.

Therefore, depending upon the circumstances, the most appropriate technology could be capital intensive involving large scale production, automated and continuous, or cost effective small and medium scale technolcgies which are batch and semi continuous.

The scope for chosing a technology that is appropriate in the sense described above varies according to sectors. As far as the food industry sector in Africa is concerned, Appropriate Industrial Technology must refer to those technologies which are appropriate to the tasks of food processing and preservation, providing the masses with nutritious food products which are of good value and consistent quality, and at costs which are affordable so as to guarantee repeat purchase. Success in doing so is measured by the profitable growth of enterprises and by the advancement of their reputation.

1.2 OBJECTIVES OF THE MISSION

In the context of the forum on Appropriate Industrial Technology for Africa with special attention to Food Processing and Preservation, the objectives of the mission are as follows:-

- carry out an in-depth analysis of the technological availability and requirements in the Food Industry Sector in Cameroon, Congo and Egypt and,
- identify potential production units oriented to co-operative programmes/projects.

The foregoing tasks were to be achieved through visiting each of the participating enterprieses (food industries) identified by National counterparts in the three countries in order to:

- profile their current activities
- evaluate the existing managerial and technical capabilities
- identify problem areas
- discuss future plans for improvement, expansion, diversification or specialization.
- backward integration, introduction of new technologies as well as product lines, product/ market developments of each enterprise, noting the particular weaknesses and strengths of each and recommending action on how to proceed.

Against this background, and given the peculiar situation in Africa (see later), efforts were made to link appropriate industrial technology with food stuffs most commonly grown and eaten in each of the countries, thus looking for local technologies developed for local raw materials in processing and storage.

Although ten years have elapsed since the first forum on Appropriate Industrial Technology was held and although many initiatives have been taken by UNIDO, FAO, ILO and other United Nations Organisations since then, there is still a general lack of sensitivity as to what food processing technology means.

During the mission, contacts were made with different people - planners, top level decision makers in government, entrepreneurs, non government organisations, women's groups and people dealing with the informal sector. They all tend to think differently about Appropriate Technology, and have divergent views according to their level of activity and the positions they occupy. Those dealing specifically with technological choice tend to think about imported technology, hence imported machinery and equipments not minding the costs, rather than encouraging local engineering capacities especially in small and medium scale enterprises. The concept of technology is an extremely dynamic one for entrepreneurs, the ultimate goal being the offer of products according to the market demand and in competitive conditions.

1.3 AFRICA'S FOOD SITUATION IN THE GLOBAL CONTEXT: A PRIORITY TECHNOLOGY ISSUE.

The highlights of Africa's current food situation can be summarised as follows:-

- Per capita food consumption has been declining for about 20 years. Sub-Sahara Africa is the only region of the world in which average per capita calorie intake deteriorated below minimum nutritional levels in most countries since the 1970's.

- Africa's annual population growth rate of around 3% will lead to a doubling in population within the next 20 - 25 years.

- Foreign exchange shortages are a major constraint in the ability of African States to import inputs for agricultural production and food on commercial terms.

- The combination of rapid population growth, declining per capita food production and foreign exchange constraint leads to a simple conclusion; - African States will be forced to demand concessional food imports for well into the future.

- Internal investments in food production in most African countries continue to be inadequate. Trade barriers, trade instability and in some cases, mounting protectionism handicap food trade, food production and the development efforts of many countries despite multilateral trade negotiations under the auspices of UNCTAD.(3) Lack of finance has meant reduced food importation and little or no local development of technology which is also dependent on lack of political will. Trade barriers and poor transport systems between some African countries are in themselves a problem.

- Since most of Africa's poor live in the rural areas, the neglect of agriculture and related rural industries throughout much of the post-independence period has been a major contributor to food insecurity in Africa.

These are the salient points of the context within which the present study on Appropriate Industrial Technology on Food Processing and Preservation has been undertaken.

2. SECTORAL DEVELOPMENT PERSPECTIVES: TECHNOLOGICAL AVAILABILITY IN FOOD INDUSTRY

This report relates to the states of food processing and preservation in three African Countries - Egypt, Cameroon and Congo. The countries are different in their levels of technological development, particularly agricultural production, food civilization, and in their level of commitment (investment) in industrial food processing.

The food industries in developing countries constitute a major component of manufacturing activity as a whole. During the mission, attempts were made to cover as far as practicable, a diversity of technological and product choices, as well as the location, scale and type of enterprises to be found in the food industries is Egypt, Cameroon and Congo.
Details of country visits are given in the annex.

2.1 FOOD CONSUMPTION PATTERN

Product characteristics (see Annex ..A..), production and supply statistics, nutritive value and consumption patterns of the main lines of traditional food resources are a central question in the choice of technology.

In Egypt, food civilisation revolves around cereals - wheat, rice and derived products e.g. Macaroni and pasta; foul medames (horse beans), fruits and vegetables - citrus, apples, apricots, mangoes etc; milk and derived products; meat, meat products and fish. The typical traditional breakfast serving is unleavened bread with white cheese or foul medames. Lunch and dinner are derived from rice, macaroni, meat and vegetables, eggs, cheese, bread, yogurt and fish.

Cotton seed and soyabean oil are the sources of vegetable oil. It should be noted that ecological conditions for agricultural production are not quite favourable and about 4% of the land is arable as Egypt lies North of the Sahara.

Cameroon and the Congo are countries that lie in sub Saharan Africa with favourable regional climatic conditions and enormous physical potentials to produce food. In Cameroon, maize, haricot beans and groundnuts are produced in every province. Cassava, yams, cocoyam, plantains, banana and palm oil are produced in all provinces except the Extreme North and North while sorghum, millet and rice production is limited to Extreme North and North West provinces. These food crops have defined the staple foods for various regions of the country and have contributed immensely in shaping the food habits and consumption patterns of Cameroonians. The patterns differ among tribal and ethnic groups and people in the rural areas are still suspicious when food is transformed. Palm oil and groundnut oil are the sources of vegetable oil.

In the Congo, cassava and derived products - foufou, cassava bread, and boiled cassava, are the traditional food staples, and are predominant in virtually all provinces, as the major source of carbohydrates, followed by bananas, plantains and yams. Meat is very expensive and therefore, the commonest source of protein is fish which is eaten more in the fresh form in Pointe Noire or along the coastal areas while in the South, dried, salted or smoked fish is very common e.g. in Brazzaville. The source of vegetable oil is palm oil and groundnut oil. Green leaves are the major source of minerals and vitamins with milled cassava leaf (saka saka) as the most common. Rice and green beans are also consumed in the Brazzaville area.

It is noteworthy that bread is commonly eaten in the three countries, often times with price subsidies from government. The price of bread is amazingly lower than that of local products e.g. yams, plantain and banana in Cameroon and has therefore become the basic food of the masses.

Beverage industries predominate the food sector in Cameroon and the Congo, supported by consumer demands in a recessed economy.

2.2 TRADITIONAL FOOD PROCESSING

The primary objective of food processing and preservation is to provide "Crowded" populations with the kind and quality of food they demand at all times of the year. The main beneficiaries of the food industry have been the consumers living in urban centres because food preparation has become easier, in many cases cheaper and in some cases of higher quality.

Against this background, it was observed during the mission that the three countries showeddifferent degrees of change in their level of development from traditional, domestic and artisanal/cottage type food industries into those with advanced technology and capital intensive equipments.

Traditional food technologies are those know-hows proven from early generations not only to be adequate but also propagated for food preparation and preservation by a specific geographical, cultural and social grouping of people. These technologies are generally simple, sometimes regarded as primitive, low cost, labour intensive, exhaustive, sometimes leading to loss of nutrients but generally adequate for their needs. Consequently most of these technologies have passed through the ages without much modification. In some cases, the technologies have been abadoned.

2.2.1 In Egypt, small village-owned mills existed in the past for processing of grains. Rice mills worked a few days a week, followed by sieving and the brans are used as chicken feed. The rural people also made wheat flour by themselves. Processes existed for the 'pickling' of cucumbers. The know-how for the milking of cows, the making of clay containers for milk collection, creaming the milk, making butter, cheese and yogurt existed even inside family homes. In Upper Egypt, local technology existed for sun-drying of grapes, apricots, dates, vegetables e.g. Okro and native molokaiya (corchorous olitorius). Slices of meat (beef) are salted, seasoned and sundried to produce a delicacy known as 'Basturma'. Bread was baked in brick ovens. During the mission, attempts were made to locate these technologies. The general impression is that while some of these still exist, local traditional technology is gradually disappearing, giving way to advanced or high technology. Consequently, there is rural-urban migration.

2.2.2 In Cameroon and the Congo, traditional processing of the following foods is widely practiced:

(a) <u>Roots and Tubers</u>:

Processing technology in both countries shows similar characteristics, although the end products are called different names. Cassava is peeled, washed, steeped for about 4 days to ferment during which softening of the tubers takes place. It is mashed manually and sieved wet to remove the fibres, and the resulting paste steam cooked in leaves. The final product is called CHICKWANGUE/ANTAGANA bread in Cameroon but known as Cassava bread in the Congo. Foufou is obtained after the cassava has been peeled, soaked, cut into pieces, sundried and milled.

The other variation is that cassava is peeled, cut into pieces, boiled and eaten, in a way similar to yams. Gari is prepared by peeling the roots, grating, fermenting for 4 - 5 days, dewatering, gelatinizing and drying the product. The gari obtained can be milled into any desirable particle size. Yams are either boiled and eaten as such or pounded to give a stiff or thick mouldable mass eaten with vegetable soup and meat/fish stew. Sundrying and milling of yams into flour is not common.

(b) Vegetables:

In Congo, cassava leaves are washed thoroughly in hot water, drained, and pound in a mortar to a certain degree of fineness and smoothness such that the original juice and flavour are retained. The final product is known as "SAKA SAKA" and is eaten virtually by every Congolese. The vegetable of equivalent popularity in Cameroon is 'bitter leaf' which is washed with hot water several times to remove the bitterness. It is eaten as such or sundried, packed and sold. Locally, it is called 'NDOLE'.

(c) Wet Milling of Cowpeas:

Cowpeas are washed in water to remove adhering dirt. The clean seeds are soaked in cold water for several minutes until the skin can be rubbed off by repeated working between the palms. The decoated seeds are then ground into a smooth pastry slurry which is used in preparing local delicacies.

(d) Wet Milling of Corn:

Shelled corn is steeped in water for 2 - 3 days during which some fermentation occurs in the corn. Chaff and bad kernels float on the steeping water surface and are skimmed or decanted off.

The fermented corn at the bottom of the pot is now removed and ground to a smooth paste and added back to the steeping water. The mixture is stirred, then allowed to settle. The white mass that settles at the bottom of the pot is 'starch' made into a product known as "corn pap". The wet milling of sorghum and millet follows similar patterns.

(e) Dry Milling of Cereal Grains:

Any one of the cereal grains can be ground into a fine mixture using a mortar and pestle. The ground mixture is sifted through sieves to obtain a flour for food. The procedure is extremely time consuming and labour intensive.

(f) Fish Processing:

Traditional methods of salting, drying and smoking have been practiced for ages. Salting is accomplished by rubbing dry salt into the flesh or by immersing the fish in a brine solution (pickle curing). Simple drying in the sun is a common method of curing in Congo and Cameroon. Smoking is the most common and most preferred method of preservation for obvious commerical reasons. The heat from the fire dries the fish while chemicals from the smoke impregnate the flesh, imparting a characteristic smoke flavour, depending on the raw materials used for smoking and the length of time the fish is smoked. The MUDEKA market in Cameroon is solely for marketing of smoked fish.

(g) Traditional Palm Oil Processing:

The fresh fruit bunches (ffb) are obtained manually from the palm tree. The fruits are picked manually from the bunches or by knocking the bunches against a hard surface to separate the fruits.

The fruits are then sterilized by boiling with water in pots or drums to soften fleshy oily parts. The sterilized fruits are then digested by pounding in mortar or by foot stomping in circular pits specially built for the process. When digestion is complete, appropriate quantity of hot water is added to separate the oil, the chaff and the nuts. The nuts settle at the bottom of the pits. Baskets are used to sieve out the mash or chaff which are properly washed off of oil entrained in it. The oil, floating at the surface of the water is skimmed into a pot. The crude oil is clarified by heating to remove the water and other impurities. The oil is then gradually removed into clean pots to cool before storage in cans. The method is crude, cumbersome, time consuming and the amount of waste is high.

Rural women are the key actors in traditional food processing. They expend so much energy which otherwise could be directed to more profitable ventures. Projects which disseminate appropriate technologies that release women from the more time consuming elements of traditional food processing are being developed at the Community Development departments of Ministries of Agriculture and Rural Development. Women's groups are becoming interested in mechanized food processing albeit small scale, but they need help in managing a business. They are generally not capable of balancing the books - especially the relationship between sinking and investment funds, and related expenses.

2.3 MECHANIZED FOOD PROCESSING

This section highlights the level of available food technologies in the subsectors in Egypt, Cameroon and Congo, and concentrates mainly on the enterprises visited during the mission.

2.3.1 FOOD PROCESSING AND PRESERVATION IN EGYPT

Food processing industry is considered as one of the main industrial sectors in Egypt. The agricultural population represents some 49 per cent of the total population of about 50 million. With a population growth rate of about 2.7% annually, steadily increasing imports of food products impose a heavy burden on the balance of payment. Half of its food stuffs, particularly wheat, wheat flour, frozen beef, frozen chickens and edible oil are being imported.

The food processing and preservation industry in Egypt is highly developed and organised, and represents one of the five major subsectors in Egypt. The sector, together with Agriculture, has potentially the largest impact on employment, living standards of the population and economic stability of the country. In order to achieve the natural socio-economic targets, including the increase in per capita domestic production, creation of job opportunities and utilization of indigenous raw materials and natural resources, Government's policy framework supports food security through mass production, balance of payment and export promotion. To this end, nearly 40 per cent of locally produced selected fruits and jams are exported, mostly to the Arab World and some European countries. Processing of traditional exports are encouraged. Egypt seems to enjoy comparative advantage in the production of food flavours, vegetable oils, jams, marmalade, biscuits, confectionery and starch. Yet Egypt is not self-sufficient in food production, except in rice.(4)

The public sector companies produce some 85% of the preserved food products in the country. Twenty public sector companies (each consisting of several industrial manufacturing plants, some as much as ten), belong to the Food Industries Corporation(5) (FIC), producing some 40 basic products and about 100 other products and by-products.

The production value in 1987 reached L.E. 2,005 million, a total workforce of 101,325 employees and a skilled level of 49 per cent. Two public sector companies belong to the Ministry of Export and Foreign trade, one with 2,700 employees, producing and exporting dehydrated onions, garlic and various dehydrated vegetables, with an annual turnover of 10 million US Dollars. Another company with 1,030 employees, owns and operates the largest stations for selection, grading and packing of agricultural crops in the Middle East, with an annual turnover of 20m US Dollars. Wheat and rice mills and fishing activities are controlled by the Ministry of Supply.

Since Government policy favours mass production, export and the generation of foreign exchange, technologies are of necessity advanced, up to date and optimal in scale. In fact, it is Government policy to automate all food processing technologies in every public sector company by the end of 1987 -92 development plan. Therefore, most machinery and equipment are imported and adapted to local conditions under transfer of technology agreements. Some unit operations are semi continuous while some are fully automated and continuous.

The following subsectors were visited during the mission;

- Fruits and Vegetables
- Vegetable Oils
- Grains
- Dairy Products
- Meats and Meat Products
- Baby Foods.

However, engineering details and data on economic aspects of appropriateness e.g. investment costs, production costs, management numbers etc. relevant to the objectives of the mission were not released by public sector enterprises. The Consultant was referred to the Food Industries Corporation (FIC) which has a central information bank for all industries in the group.

Data released belong to the groups and are indicative only; they can not be relied upon for meaningful analysis. Further details are given in Annex B and C.

2.3.1.1 FRUITS AND VEGETABLES

Technology capacity exists for processing all types of fruits and vegetables in Egypt. Two public sector companies - Edfina, established in 1956 and Kaha (1961) are the largest processors of fruits and vegetables in Egypt.

The unit operations, which exist in the fruits and vegetable processing industry at Edfina, Alexandria are:

(a) CANNING:

Products like tomato paste, apricot and strawberry jam, orange and quava juice, marmalades of all sorts, foul mɛ ames (horse bean) are canned. Most machinery are supplied by Food Machinery Corporation (FMC), USA. Unit Operations include:

- Washing, sorting, inspection, pulping and destoning are common for all fruits.
- recipe formulations - pectin, sugar addition, and citric acid.
- Cooking
- filling into cans, seaming
- automatic pasteurization; continuous flow, cooker-cooler model or
- autoclaving, using batch, horizontal and vertical models, cooling and packing.

Other processes include:

- automated continuous filling of jams and honey into jars equipped with steam vacuum sealing equipment to produce vacuum in jars, machinery supplied from Spain and England on credit agreement.

- form, fill and seal machinery for 35g jam (thermoformed polystyrene containers and aluminium foil cover) supplied by FORMSEAL, FRANCE.

- Doypack technology for UHT juice (retortable, form fill and seal aluminium foil laminates) supplied by Grace, Western Germany.

(b) FREEZING: Air blast and contact freezing are for green beans, peas and mixed vegetables, equipment obtained through co-operation (credit) with Germany and Frigo Scania of Sweden.

(c) CAN MAKING: Tin plates are imported. The company has two tin plate varnishing and can making lines based on the latest up to date technology from SOUDRONIC, (electronic copper welding for body making) supplied by an Italian firm, on licence from SOUDRONIC of Switzerland.

All facilities are in place to meet export demands of quantity and consistent quality satisfactorily:

i. the company has a good quality assurance crew, with a well equipped laboratory.

ii. the microbiology laboratory is modern, with an air filteration micro bench.

iii. quality of fruit, micro level, quality of cans, quality of seam and maturity of fruit etc, all help in determining whether to pasteurize or autoclave filled cans.

iv. the foregoing are checked by the laboratory and results immediately conveyed to production to take appropriate measures.

Therefore, products are of good quality and conform with Egyptian standards of identity. To meet the raw material requirements of the plant, the company enters into contractual supply agreements

with out-growers at a fixed price and given quality.

Total production at Edfina is about 50,000 tons a year with a workforce of 5,000 employees. The company has a modern engineering workshop where spare parts are manufactured and maintenance provided. Twenty five per cent of all employees are trained yearly.

(d) UHT FRUIT JUICE

The consultant also visited the Nile Company for Food Industries (under licence from Dolce), which processes fruits. It extracts fruit pulp from guava, mango, apricot and strawberry in season, preserving these for use throughout the year. UHT juice is produced, packaged in combiblocks, equipment and materials supplied from Germany. The company has found combiblock expensive and has designed lines for packaging fruit juice in bottles.

(e) DEHYDRATION

The technology for the production of dried onions was developed in Egypt about 30 years ago. Nine factories have been established since then, which together produce 6,000 tons of dried onions per annum, 99% of which is exported. Other products, e.g. carrots, foul medames (horse bean) and various fruits and vegetables are dehydrated in the facility.

The first two dryers in the group were supplied by Poland thirty years ago. Engineers in the group fabricated the rest of the dryers, based on the principle of steam operated drying tunnels with exhaust fans.

At the Kaferselim Onion dehydration facility near Alexandria, 40 tons raw onions (at 92% moisture) are processed to obtain about 4 tons finished product (at 5% moisture) in 24 hours generally, a ratio of 10 tons raw onions to 1 ton dried product.

2.3.1.2 VEGETABLE OILS

Solvent extraction plants have completely replaced hydraulic presses formerly used for extracting oils from oilseeds (cotton seed and soyabean), at the subsidiary companies of "The Extracted Oils and Derivatives Co., Alexandria, a vertically integrated company. This is facilititated by the local production of hexane, whose importation was stopped in 1982.

The consultant witnessed installation of new plants from a phased investment of LE 30 million to modernise and fully automate the plant by the end of 1989. These investments were necessary, because of increasing per capita consumption of oils and fats, to improve quality and increase production.

The investments for modernization over a 10 year period include:

- replacement of hydrogen facility by a new one, capacity 80 tons/day.
- addition of 120 tons/day extra facility to steam refining to add up to 200 tons/day.
- addition of cooling and margarine plant capacity 5 tons/hour.
- addition of a can forming plant, capacity 80 Cans/min, supplied by SOUDRONIC, Switzerland.
- addition of fat splitting and distillation capacity 2 tons/hour to produce commercial glycerine, free fatty acid and lecithin as new products.

- filling margarine, oil, shortening under nitrogen.

- soft package-polythene pouch filling machine from France (2 machines each producing 2 tons/hr flexible pouches of oil).

- up to date lines for all kinds of margarine, machinery supplied by Christenberg, Copenhagen, Denmark.

- filling various sizes (1k, 2kg, 4kg) ghee in cans.

- up to date technology in filling lines e.g. blow moulding and filling.

To assure a steady flow of raw materials, oils and fats are imported (80%) for the refining plant. The extraction capacity at the subsidiary companies is not fully utilised because of the lack of oil bearing seeds. It is planned to grow 250,000 tons of soybeans annually but 120,000 tons is being achieved, leaving a surplus capacity at the extraction plant. A further importation of 50,000 - 60,000 tons of soybeans still does not cover the extraction capacity.
An animal feed complex, utilising the company's soy meal (a critical component) is one of the largest in Egypt, with up to date technology in animal or poultry feed production.

2.3.1.3 GRAINS (WHEAT AND RICE)

The Ministry of Supply overlooks activities in the wheat and rice mills. More than 70% of the requirements of wheat and wheat flour is imported from USA, France, Saudi Arabia and Australia. Egypt is adjudged to be self-sufficient in rice production and it is a deliberate policy of Government not to import rice if rice production were going down. White rice is exported only after local consumption is satisfied.

There are 54 rice mills in the Public Sector Organisation for Rice Mills and marketing. Nine of their mills have been rehabilitated and modernised already. Old and obsolete equipments are being replaced by new ones until all 54 rice mills must have been reactivated.

At the time of the visit of the consultant to Alexandria Rice Mills Company, the mill was being modernised under a credit agreement between the governments of Federal Republic of Germany and Egypt. Old equipments have been pulled down and an automated, continuous processing facility was being installed. The new plant incorporated drying and complete storage facilities, including technologies which efficiently separate the husk, the brokens and bran from the rice with a yield of 67 per cent of complete grains from paddy rice, and brokens of less than 7 per cent.

The modernised factory at Alexandria has a capacity to process 300 tons/day of paddy or 200 tons finished product. The plant is equipped with destoners, magnetic, separators for sorters and rubber shellers from NAGEMA of Germany and SATAKE of Japan, including abrasion stones to whiten brown rice and release the bran. Friction machines separate the germs and both bran and germs are separated by air.

To substitute local consumption of rice and increase export target for white rice, companies within the group produce pasta and macaroni. One of such facilities belongs to Alexandria Rice Mills and was visited by the consultant. Semolina is imported from Turkey, Greece and France. Processing equipment which are fully automated and continuous are imported from PAVAN of Italy. The factory has two processing lines, one for long cut macaroni and the other, short cut macaroni, each line capable of producing 24 tons/day of macaroni The short cut line also produces macaroni of all types and shapes.

The factory is equipped with a modern analytical laboratory. The facilities include:

- infra red and air oven for moisture analysis
- ash oven for minerals determination
- sieve analysis for size of semolina granulation.
- spectro-photometry for beta-carotene content.

Organoleptic analysis is also carried out.

Total production targets at the end of planned modernisation and refurbishing of all rice mills including macaroni and pasta are:

Rice	5,493 tons daily
Macaroni and pasta	400 " "
Electronic sorted, long grain parboiled rice	160 " "
Animal feed	1.2 million tons yearly.

Plans are at an advanced stage to produce "non traditional feeds" containing rice husks, bran, brokens, germ, some urea (1.5 per cent protein) and salts.

The group has a Rice Technical Centre in Alexandria; equipped with facilities for research and training, lectures, demonstration and conferences.

Marketing is well organized. Rice is packed in heissian bags (50kg) or high density polythene (5kg,1kg) and delivered to the groups marketing organisation with distribution facilities in

Cairo and Upper Egypt.

2.3.1.4 DAIRY PRODUCTS

Egypt's dairy industry has advanced considerably in the last 10 years. In 1985, there was a major expansion. (financed by World Bank) at Misr (Egypt) Milk and Food Co., Alexandria, visited by the consultant during the mission. Public awakening warranted the establishment of organised milk collection, processing and distribution of milk to cater to the needs of expanding urban areas.

Milk collection is in holding tanks which are sent out to dairy farmers daily to collect raw milk. At milk reception, tests for acidity, specific gravity, water and average per cent of fat are undertaken before the milk is received through balance tanks into refrigerated silos (holding tanks of 50 tons capacity each).

Pasteurisation (3 pasteurizers each of capacity 10 tons/hr), homogenization (2 homogenizers 10 tons/hr each) and separation are unit operations in place to process the milk before being stored in holding tanks (six tanks, 15 tons capacity each).

The cheese department is equipped to process all kinds of cheese - cheddar, white, adam, gouda and processed cheese etc with aging and ripening shelves and rooms as required.

Pasteurized milk is packed with the latest advanced technology (form, fill and seal, 1/2kg, 1kg fully labelled polythene pouches); machinery with auto balance supplied by FINNPACK. Ice cream and big-dip are produced in continuous automated freezers, while yogurt is produced in an automated plant supplied by Hambar of Germany) with facilities for adding starter cultures, cooling, and dosing into 150g cups and incubation for three hours.

2.3.1.4a DAIRY RESEARCH CENTRE:- ALEXANDRIA

The centre, is the Regional centre for training personel in Middle East countries in milk and dairy production, established by the FAO in 1982. Because of diplomatic reasons, the centre was catered for only by Egypt after FAO's five years technical and financial support expired. The centre now lacks funds to continue.

The services provided include in - service training for those already employed in dairy industries and two years diploma course in dairy technology for freshers. There are moves to convert the centre to a Regional Centre for Arab countries, given a favourable political atmosphere.

Equipped with a modern pilot plant (five tons daily, pasteurized milk) and plants for derived products, the centre holds a lot of promise for would-be trainees.

b. The Nile Company for Food Industries Cairo has an ALFA-LAVAL unit for processing UHT milk. Sterile filling is in combi block (250ml, 1 lit) units and has become unattractive because the packaging material is expensive in today's economy. Twenty tons/day of yougurt is produced in an automatic French plant (STE PLASTIMEGANIQUE CONSTRUCTEUR) in which the yogurt is incubated, held, pumped and filled in a form fill and seal assembly (Formseal, France).

2.3.1.5 PROCESSED MEAT

At the time of visit, Halwani Brothers' processed meat factory was being refurbished and modernised.

A temperature controlled thaw, large cold storage, equipped with a Bentax system to kill bacteria has been installed. The cold storage would hold 3,000 tons of meat. Other installations include a fully automatic,computerised cooker smoker (five programmes) supplied by Reich with capacity for a 3 ton cook at a time and a douche system for cooling. About 15 varieties of luncheon meat, smoked turkey, various types of sausages and basturma (or pastrami) will be produced in the factory.

All livestock, slaughtered in strict accordance with 'halal' regulations and 'sharia' law, produced in Saudi Arabia, is ipso facto free from pork, and will be imported frozen to the factory. The following equipments have also been installed:

- bowl choppers (meat cutter)
- dual purpose mincers for frozen or warm meat.
- low temperature mincers (- 18°C) which would mince and mix mortadellas.
- a velati recipe assembly
- a Handtmann, seven ton/hour production filling assembly
- a six ton capacity meat tumbler to process Basturma in a way similar to local cottage production in Egypt.
- vacuum packing facilities
- chilled and frozen storage facilities.

The whole factory would operate at 12°C.

The installed capacity is 20 tons/day or a target sales of LE 4m/month. Assets are valued at LE 9m while working capital investment is LE 8m. (100 tons of imported frozen meat cost approximately LE 500,000).
A quality assurance laboratory is also part of the package.

2.3.1.6. BABY FOODS

Arab Medical Foods, a newly incorporated private company, will be the first company in Egypt to produce baby foods locally when equipment installations are completed by the end of September, 1989.

Licenced by Gerber (USA) for baby food production and Bush Boake Allen (BBA) for flavour production, a fully automatic, computer aided processing plant is being installed.

Unit operations include milling of cereals, slurry production, drum drying, extrusion cooking and agglomeration. Planned production is 1,000 tons/year baby foods initially, increasing to 2,700 tons/year.

Finished products include rice flakes, and wheat with milk for babies 4-8 months old. For babies nine months and above, the product is high protein (20%) cereal, flavoured with apple, or banana. Others are oral rehydration cereals based on rice and extrusion cooked crisp bread. All flakes will be agglomerated.

Research and Development is aimed at diabetic foods and health related products when the plant finally settles down. The raw material and finished product stores are fully ventilated while facilities e.g. water treatment and effluent plant are up to date in technology.

The food industry sector in Egypt is quite large. Some subsectors which could not be covered within the two weeks of the mission include:

- aerated and mineral water division
- fermentation, distillation and beverages
- sugar, glucose, startch and confectionery.
- tobacco and cigarettes.

The technologies of which are universally known. Most of these divisions are members of the Egyptian Chamber of Food Industries whose economic indicators, published last in 1985 for the years 1982/83 show

i.	output	-	LE 2,058 million
ii.	exports	-	LE 37 million
iii.	imports	-	LE 867 million

On the other hand, the value of food products for the public sector companies in the Food Industries corporation in 1987 was valued at LE, 2,005 million with total planned investments of LE, 82 million between 1987 and 1992 development plan. Certainly the equivalent figure for food industries within the Chamber of Food Industries must be assumed to be higher in 1987.

At the end of the 1987-92 plan, it is expected that automation of all technological processes in all public sector companies would have been completed.

2.3.1.7 LOCALLY DEVELOPED TECHNOLOGY

This refers to appropriate technologies developed for the production of food for local needs using local raw materials either within enterprises or at appropriate technological institutes.

1. Canning Foul Medames (Horse beans)

Foul medames is a famous breakfast food in Egypt. However, the cooking is energy consuming as it takes a long time before the beans are edible. The R & D team at Edfina upgraded the local processing technology by designing a canning procedure to make the beans available in a 'ready to eat' form to local consumers and for export. Process and equipment specifications were collated by Process Engineers and agreed with FMC of USA who supplied the equipments. Basically, the beans are cooked and sterilized inside the can at the same time. Canned horse beans are now being exported to Arab and European countries.

ii. Extraction of Pectin from Citrus Peels

This is a classical example of by-products utilisation with considerable savings in foreign exhange. The R & D crew at Edfina adapted technology to extract pectin from citrus peels. (see annex C.1). The finished product now substitutes for the pectin component of the recipe in jam production.

iii. Extraction of Agar agar from Seaweeds

Formaly, Seaweed obtained from the coastal areas in Alexandria was exported and a derived product, agar agar imported. Technologies have been developed to process seaweed to obtain agar agar by the scientists at Edfina. This is used in the microbiology laboratory.

iv. Production of Soft, white cheese

In Egypt, soft white cheese is the traditional Damieta cheese which is widely prefered. Traditional production processes are as old as civilization in Egypt. The processes have been upgraded by Dolce, the Nile Company for Food Industries, Giza, near Cairo. Processing equipments e.g. Vats for curd production, pressing frames (wooden) for whey discharge, containers for curing white cheese slabs and other related equipments are fabricated locally. All unit operations coagulation of milk in vats, pressing the curd for whey discharge for about 20hrs, and curing the curds in various concentrations of salt in whey are batch systems.
and this reflects real artisanal technology.

v. Solar Drying of Fruits and Vegetables:

At the Food Institute, National Research Centre, Dokki, Cairo, Egypt, (an appropriate technological institute), Scientists have developed local technology for local raw materials e.g.

- dehydration of vegetables and apricots using solar energy.
- tomato "concentrate" using solar energy; the dried product was adjudged to have better appearance and colour of tomato paste.

The scientists have also developed:

- technology for peanut butter production
- technology for sugar cane juice as a drink
- technology of cocoa butter substitutes from local vegetable oils produced from oil seeds grown in new reclaimed areas of Eastern and Western deserts.

vi. Production of Fruit Pulp

Dolce, a private food processing company in Cairo realised that there is immense potential in the export of the pulp of apricots, mango and guava. The engineers designed and adapted technologies for the extraction of the pulp based on the following unit operations:

Washing, sorting, destoning (for apricots), preheating for apricot only, pulper (obtaining the pulp), holding tank, benzoate addition, pasteurizer (90^{o}C), cooling to 10^{o}C and storing at-20^{o}C.

The company is assured of fruit at any time of the year for planned daily productions and are pursuing means of export.

2.3.2 FOOD PROCESSING AND PRESERVATION IN CAMEROON

Like Egypt, the food processing industry is one of the main industrial sectors in Cameroon and together with agriculture, have potentially the largest impact on employment and on the economic stability of the country.

Bakeries account for the largest number (58) of all registered companies (162) in the agro and food industries sector, but its employment and investment are not the largest. By far the largest subsector in employment and investment are those in the export group - cocoa, coffee, palm oil, cotton, groundnuts, tea, bananas etc. with investments valued at 47,430m CFAF, and employing 41,960 people.

With a population of 10.5 million (1987/88 estimates) and an expected population of 12.2 million in 1991, the annual population growth rate is estimated at 3.1%. The urban population is growing much more rapidly, at 5.5% per year. Food production is planned to increase by 4.3% per annum in order to have an exportable surplus and by association, satisfy industrial demand. Importation of foods, drinks and tobacco, agricultural and industrial equipments among others, impose a heavy burden on the balance of payments. The World Bank team and the IMF are assisting the government to restructure the economy.

Between 1979/80 and 1982/83, production of the branches of the food industry sector (excluding beverages and tobacco) increased from 88,300m CFAF to 310,700m CFAF, corresponding to a nominal annual growth of about 37%. The share of the sector in total industrial production rose from 25.2% to 27.7% during the same period.

Moreover, the rate of consumption of local resources remained relatively satisfactory (76%), thus placing food industries among those sectors which contributed most to the development of primary products(6).

On performance, the returns on investments have been remarkable. The value added substantially increased at a nominal rate of 32.5% per annum from 19,900m CFAF to 46,300m CFAF. The structure of the food manufacturing industry and value added are given in Table .1....

To meet the increasing food demand, the fifth plan had programmed the establishment of cereal food industries, manufacture of cocoa and coffee products, the creation of glyceride industries and other food industries such as animal, fish, sugar and fruit production. The projects envisaged included:-

- Yeast and alcohol production at Mbandjock (FERMENCAM).
- WESTCORN.
- Pineapples Unit.
- Ngouetou Maize Project.
- Tomato Project and
- Industrial Groundnut Meal.

These projects have not been fully implemented due to unforseen delays as a result of the poor state of the economy.

The 1986 - 1991 development plan aims at consolidating food self sufficiency and ensuring food security. Targetted increases for food crops at the end of 1990/91 plan are given as follows:-

a.	Cereals	1986/87 (Tons)	Target (Tons) 1990/91	Annual Average Growth Rate
	Millet & Sorghum	400,000	496,000	5.5%
	Maize	41,000	630,000	7.4%

TABLE 1

CAMEROON: STRUCTURE OF THE FOOD MANUFACTURING INDUSTRY

Branch	1979-1980		1983-1984	
	Production(%)	V.A(%)	Production(%)	V.A.(%)
Grain Processing	11.6	5.7	8.7	4.5
Processing of Agric produce	11.2	7.9	16.9	12.2
Baking and pastry	2.2	2.3	1.6	1.6
Other food Industries	0.2	0.3	0.5	0.8

V.A: Value Added.

Source: Department of Statistics, Ministry of Agriculture.

b. Tubers and Plantains

A balance between supply and demand was reported at the end of the fifth plan (1985) with an overall production of 2.8m tons.

The following projections are made for 1990/91.

Tubers & Plantains	1984/85(tons)	1990/91 Est.(tons)	Annual Growth Rate
Cocoyam (Taro)	188,000	237,000	3.9%
Yams	96,000	132,000	5.4%
Cassava	1,375,000	1,660,000	3.2%
Sweet Potatoes	50,000	70,000	7.8%
Irish Potatoes	N/A	60,000	Below market demand.
Plantains	1,001,600	1,230,000	3.4%

It is planned that storage techniques would be disseminated to reduce post harvest losses, and marketing channels of local surpluses improved.

c. Leguminous plants, all cultivated on traditional small holdings represent 8% of food production and are getting scarce on the market despite their importance in nutritional balance. New targets for production are given below:

Groundnuts	-	125,000 tons
Soyabeans	-	14,500 "
Beans/Peas	-	70,000 "
Egusi (Mellon)	-	58,000 "
Sesame	-	15,000 "

d. A greater development of cotton, cocoa and palm oil which are exported in their raw state is planned.

e. The demand for sugar grows at 5.8% per annum. The target is to produce 80,000 tons by the end of the 1990/91 plan which still falls short of demand, while making use of total capacity at CAMSUCO and SOSUCAM, the main sugar processing companies.

f. The target for palm oil at the end of plan is 120,000 tons and 15,000 tons table oil. To achieve this, existing oil mills would be reinforced and new ones built in cotton ginning regions.

g. Processing units are to be created for the production of fruit juice and vegetables.

h. Construction of new rice mills or extension of existing ones are planned, and there are measures to build new flour mills for the processing of grains.

i. Current production of chocolate and sweets stands at 8,000 tons per annum, 30% of which is exported. The creation of a new chocolate factory with a capacity for 5,000 - 6,000 ton/year is planned. A new unit for the processing of cocoa residue is expected to be set up.

j. Industries for packaging materials - cans, flexible and solid tubes-to produce 15 to 20m units a year are also in the plan, to be located near major consumers such as breweries.

The development plan (1986 - 91) on industrialisation aimed at local raw material utilisation should lead to the development of the small and medium - sized industries in the food processing sector to process:

i. basic agricultural products such as cocoa, coffee, cotton, palm oil, groundnut and their by-products.

ii. food products like yam, potato, fruits and vegetables, grains and animal products.

Before the arrival of the Consultant in Cameroon, the national counterpart had visited a number of enterprises in Douala:

- Camlait for yogurt and reconstituted milk production.
- Crevettes for shrimps and fish.
- Societe Camerounaise de Minoteries for wheat flour production.
- Milliat Freres for macaroni.
- Animal feed production at Bafoussam.
- Chococam for chocolate.
- Sic Cacao fcr cocoa processing.
- SOPRAL for bouillion cubes.
- Milky Way for concentrated milk.
- SELCAM for salt.
- Biscuiteries Reunies for biscuit production.

The consultant could not cover all the enterprises within the time limit of nine days. Appropriate Technological Institutes in Yaounde and Njombe were covered along with some of the enterprises which were ready for the mission. Since the counterpart had toured the facilities initially, the consultant was not allowed into some of the production areas on his visit. Unfortunately, the counterpart, who is not a scientist, was not provided with funds to accompany the consultant.

2.3.2.1 DAIRY PRODUCTS PROCESSING

Unlike Egypt, raw materials for yogurt and milk production in Cameroon are imported.

Unit operations are semi-continuous and consist of the following:

- Mixing milk solids non fat (MSNF) with the recipe quantity of water.
- Homogenization.
- Pasteurization (95°C for 10 min.).
- Cooling to incubation temperature (40°C).

- Starter culture addition (1-2%).
- Flavour addition (optional).
- Incubation in vats, 3 hrs.
- Stirring, dispensing and refigeration

The installed capacity is 15,000 lits of yogurt/day of 8 hrs. but a capacity utilization of 70% in November to March and 40% during the rainy season has been the norm. At the level of production, the product is prone to contamination. The company has therefore invested 20m CFA in an automatic yogurt making machine to safeguard the quality of the product by minimising handling, improve consistency and increase production. It is a turnkey arrangement and French contractors (name withheld) will supply the equipment.

The company also makes recombined milk. All ingredients - milk powder, vanillin, butterfat, stabilizers are imported from Europe and sugar is supplied locally.

Three types - full cream milk, medium cream and no cream are produced. The cost of plastic containers is high and this makes the production of recombined milk unattractive. Cost of packaging equipment and materials received from Tetrapack were too high, and with the low price of imported UHT milk from Europe, the company's recombined milk could not compete.

The major problem facing the company is that of the distribution of yogurt. Roads are not good and the company has lost many refigerated trucks in the last three years. The second serious problem is the lack of enforcement of controls by the government. Adulterated yogurts are common-place in town and when there are accidents (e.g. food poisoning), the company is implicated.

The problems notwithstanding, the company made an after-tax profit of 34m CFA in the 1987/88 financial year. There are 126 employees in the company with a skilled level of 17%.

2.3.2.2 FISH PROCESSING

The Consultant visited Crevettes, Douala, a public sector company established in 1968 with the sole aim of fishing and processing, under a joint venture between the Cameroonian government and American partners. The partners supplied the technology, and export was a major consideration in the partnership.

The installe capacity is 40 tons daily fresh fish and 3-5 tons of shrimps. At the time of visit, about 200kg of shrimps were being processed.

The technology is mainly American. There have been problems with the machinery since the Americans left seven years ago. The company kept the technology but there are problems obtaining spare parts for repairs and maintenance.

i. The cold room (-40°C) with capacity to freeze 40 tons of fish does not work.

ii. The calibrating machine for shrimps does not work.

PRODUCTION PROCESS

i. Trawlers are equipped with freezing compartments so that fish and shrimps can be kept frozen at sea pending off-loading at the processing plant. Fish is washed in salt water and arranged in alternate fish and ice layers. The shrimps are beheaded (American technology) and arranged in alternate shrimp and ice layers.

ii. At the factory, the shrimps are washed, and sizing and grading are done manually by trained staff.

The shrimps (in water) are frozen at -40°C. They are taken out, water added again and refrozen until there is a layer of ice such that the product is not exposed to cold injury. The product is kept at -18°C before sales.

iii. Fish is kept ice cold at sea, and in the factory, it is washed, graded and kept in buckets with ice. It is usually sold fresh or kept at 2°C for 2-3 days before sales.

The company is rich in "Netting technology," and saves at least 50% on foreign exchange by making and repairing its own nets.

PROBLEM AREAS:

i. The coast is small and fish resources are limited. Even then, the trawlers cannot utilise all of the area because it is rocky. It is imperative to find technology which rejects small fish, otherwise the limited fish resources will be depleted. The process needs to be regulated. The initial plan was for 10 trawlers to bring in 10,000 tons of fish yearly. Current performance is rated at 3,000 tons yearly.

ii. There is the need for training of Cameroonians in Fishing technology. Most of the fishermen are from South America.

iii. The company is government owned and may be sold under the structural adjustment programme. Problems of overstaffing and poor performance represent a waste of government resources.

2.3.2.3 GRAINS (Wheat)

Societe Camerounaise de Minoteries, established in 1966, is a private flour milling company, with an installed annual capacity of 120,000 tons of imported wheat. Ownership is 63 percent Cameroonian and 37% Foreign.

The company is associated with Comrade de Paris which owns 6-7 flour mills in Africa. Comrade de Paris assists the company in purchasing wheat in Europe and uses the same wheat in their mills.

Management is completely autonomous, and is fully backed by the National Investment Society of Cameroon. Employees in the lower level of the management cadre have about 20 years experience and therefore know their jobs very well. Of the 108 employees, 80 are skilled workers. This includes eighteen supervisors and six managers, three specialists in milling including a French specialist, the Director General and three other directors.

The mill is fully automated and involves unit processes such as storage, dry cleaning, blending, tempering or conditioning, breaking, sifting or bolting, purifying, reduction, flour dressing, improving and redressing and packaging; all equipment supplied by Comrade de Paris. There are no problems with technology.

The main problem facing the company is that of survival in a competitive world:

i. the company cannot lower product price enough to compete with subsidized imported flour from Europe and the USA, even though the company's price is the best in the group belonging to Comrade de Paris.

ii. therefore, the company cannot export because the price of its products is high.

iii. so far in 1989, the company has lost 1 billion CFA because product price went up by 25% due to increase in the cost of wheat, and sales are low.

iv. capacity utilization stands at 33%. In 1988 when the cost of wheat was low, the company still recorded a loss.

v. A major weakness is in the storage capacity (6,000 tons) which is not large enough to cope with anticipated increases in the level of production.

As far as expansion/diversification is concerned, the company is looking for finance for an additional 15,000 ton-capacity wheat silo complex, and a plant for animal feed. The company has finalized arrangements to have a school for bakeries. The company also plans to develop new products through its R&D facility.

The company has two patented inventions:

i. Special flour for puff-puff, which gives more puff per unit of flour.

ii. An automatic machine for loading bags of finished flour into trucks.

Both inventions are filed at the African Organisation for Intellectual Property, Yaounde.

The investments are valued at 2.5 billion CFA, and cost of production varies depending on the level of activity. It is estimated that if the company could mill 2/3 of its capacity (80,000 tons), it would be in a position to make some profit. This can only be achieved when the 15,000 ton-capacity silo complex is installed.

2.3.2.4 MACARONI PRODUCTION

Panzani Milliat Freres Cameroun is the sole private company producting Macaroni and Spaghetti. Established in 1965 under a joint venture (50:50) between Panzani of France and the Cameroonian government, the company has an installed capacity of 6,000 tons/year but actual production is 3,500 tons, a capacity utilisation of 50%.

Semolina flour is imported from Europe while Panzani supplied all machinery and equipments. 50kg bags are emptied into holding tanks and conveyed pneumatically as required. The process consists of mixing the flour with the recipe quantity of water and screw pressed/extruded while shaping into various forms takes place at the die-head. Seven different types of shapes/products are produced. A set of 3 air dryers completes the drying of the finished product.

There are seventy four (74) employees out of which 14 are skilled (4 engineers and 10 technicians). There are no problems with technology. However, there are not enough technical people and it would appear that employees are not motivated.

There are problems with markets. Total exports to UDEAC countries last year was 400 tons of product. With cheap Italian macaroni flooding the markets, Cameroonian macaroni could not compete. A further complication is that when credit is extended to customers, they cannot pay.

As far as Quality Control is concerned, Panzani sends auditors to the factory periodically. Routine quality control is limited in scope.

The plant is being refurbished at 100 million CFA/annum for 3 years and total investments are valued at 500 million CFA. A major problem is that of spare parts which must of course come from France, and the implication, if these are not in stock or do not arrive on schedule, is that production may be totally paralyzed.

The cost of electricity at 1.7 million CFA/month and water at 0.75 million CFA/month are considered too expensive for their operations.

2.3.2.5 CHOCOLATE, SWEETS AND BISCUITS

Chococam, a private enterprise, is the leading manufacturer of chocolate, sweets and biscuits in Cameroon. The business is a joint venture between foreigners (55%), private Cameroonian investors (30%) and the Cameroonian government (15%). The foreign partners provide finance and technology.

The company employs 400 people made up of the following cadre:

Directors	-	5
Production Executive	-	17
Supervisors	-	36
Marketing, Advertising	-	120
Other skilled workers	-	172
Unskilled labourers	-	50

The raw materials for processing are cocoa, cocoa butter, peanuts, skim milk powder, flour and coffee. Sugar, constitutes 60% of chococam's raw material requirement, while packaging materials constitute 30% of the value of imports. Total imports are valued at 1.5b CFAF.

Finished products include chocolate spread and chocolate tablets (for supermarkets), sweets, biscuits, bouillion cubes, cocoa malt powders, cocoa drinks etc; all in different (seventy five) shapes and sizes.

The installed capacity is 12,000 tons/year but actual production is 8,000 tons of product. Total investments are valued at 2.5b CFAC and total sales, 6b CFAC. The cost of production was withheld but profit is estimated at 10% of turn-over after tax.

Marketing is mainly local with export directed at Central African countries (UDEAC). There are difficulties in export markets generally as Chococam's products are priced higher than those of competitors.

To guarantee local raw material supplies, arrangements are being made with farmers to supply 50% of requirement and the company will pick up the balance from other suppliers.

The company funds research at the University of Technology at NGAOUNDERE to the tune of 7m CFAF, and also finances product development research in a centre in France (name withheld) where three products (canned plantain, canned meat and canned cassava) have been developed. The products are awaiting marketing tests.

Chococam's problems are many and varied:

i. Raw materials are very expensive; it is claimed that cassava from South East Asia is cheaper than that obtained locally; sugar is three times more expensive than imported ones even though Cameroon produces enough sugar.

ii. Costs of infrastructure - electricity, transport and water are rather high.

iii. There are no specialists to man high technology machinery and equipments. Hence there is no maintenance know-how.

iv. Infant foods developed seven years ago were too expensive, therefore the project was abandoned.

2.3.2.6 PALM PRODUCE

Two palm oil and kernel mills belong to the Cameroon Development Corporation (CDC) which also owns Tea, Rubber, Bananas, Pepper and Coconut plantations worth 33million CFA (at cost) as at June 1987, in the North West, West and Littoral Provinces covering an area of 36,445 hA.

The palm oil and kernel mill at Limbe with an installed capacity of 20 tons fresh bunch (ffb) per hour was visited during the mission. The other mill has an installed capacity of 40 tons ffb per hour. The raw materials are palm fruits, harvested on regular basis manually and transported to the mills, in tipping lorries, on the same day for processing. The raw materials are from CDC plantations, small holdings and private farmers.

The unit operations are harvesting of ffb, caging, sterilisation, threshing, digesting, screw pressing, clarification, separation, purifying, vacuum drying and storage.

The final products are crude palm oil, cracked palm kernels and bunch ash. From 20 ton/hour ffb, 4 tons of crude oil and 2 tons of kernel are obtained. It is estimated that the extraction rate of the plant is 22% instead of a rating of 21% guaranteed by the supplier.

Machinery and equipments are imported and assembled under a "turnkey contract" by DE WECKER of Germany. The mill is adjudged to be modern and completely integrated. By-products (fibres and shells) are used in firing the boiler to produce steam which actuates the turbine.

There are 17,000 employees in CDC. The palm oil mill employs 82, fourteen are skilled, seventeen semi skilled and 51 are unskilled.

Marketing is local and very unprofitable as supply exceeds demand. The world price of crude palm oil is unattractive. Women's groups buy the palm oil in bulk and retail it in open markets. The company plans to diversify into packaging the crude oil in plastic bottles or smaller units so as to get more involved in sales.

Diversification into palm oil refining and development of resources for making soaps and detergents are also planned.

Since production commenced, the plant has had series of problems:

i. problems of poor recirculation in the boiler tubes (Babcock, Atlantic), with subsequent cracking. Production stopped for six months in order to change the tubes.

ii. After one year of guarantee, there were problems with the frame of the alternator and the turbine could not be operated.

iii. Efficiency of the nut cracker is low and the company is losing money. It is planned to purchase a "super nut cracker".

The mill needs trained and interested engineers who are motivated. It is being run at the moment by those who have never seen any other mill before and this is a high risk. Therefore training and industrial visits to other mills are highly recommended.

Apparently, the mill had been delivered into the hands of the customers (the CDC) who, initially, had nothing to do other than to walk in at the front door of their new asset. Now, the corporation is facing the peculiar problems of "Turnkey Contracts" in the operation of the new factory.

2.3.2.7 TEA PROCESSING

The tea plantation, which dates back to 1928 when the first plantation was commissioned, now occupies an area of 340hA. The company produces black tea only.

Orthodox methods are used for production. Tea leavesare curled in the Rotorvane. The leaves(two and bud) are collected and transported immediately to the factory. The following are the

unit operations:

- withering in troughs for 12-18hours depending on weather condi*ions
- rolling and curling
- fermentation
- firing to produce black tea.
- sifting to extract dirt or impurities
- grading (four common grades - grade 1, blue, yellow and red labels).

Details of the process are given in the annex. Production output is 2 tons/hour.

There are difficulties in marketing, as the cost of production is high in addition to the problems of overhead costs. This has led to a rise in product cost despite a close competition in the market.

Machinery and equipment are old and efficiency is low. It is planned to replace equipments with new ones which are estimated to cost 400 million CFA.

2.3.2.8 BANANA PROJECT. (CDC)

The industry is geared towards efficient harvesting and packing of fresh bananas for the international market. Infrastructure is available to ensure speed in handling from harvesting in the field to final despatch to the ship.

The project is a joint venture between the CDC and Del Monte group of Florida, USA who have full rights for marketing the product.

The unit operations include harvesting, cable-way transportation, inspection, dehanding, floatation, selection, grading, fungicide spraying and packaging. Details of the process are given in the annex.

Raw materials are mature, freshly harvested bananas, fungicides, abundant water, cartons and stitching wire. The finished product is first class, boxed bananas.

The production output is about 1.4 million bunches/year of mature bananas, and are mainly for export.

Marketing of the final product is done by the Del Monte group, including financing and training of staff. All specifications for infrastructure and standard operational procedures are provided by them.

All employees at the time of visit were in training in order to develop skills all round the operation. The target is to use a maximum of 100 workers/packing shed, capable of circulating to most stages of processing. Training was planned to last for sixteen months.

The construction, supply, and installation of equipments in one packing shed cost 8 million CFA.

2.3.2.9

Time did not permit the Consultant to visit the following food industries which were covered in a preliminary visit by the counterpart. Highlights of the information gathered by the counterpart are as follows:

a. LIVESTOCK FEEDS, BAFOUSSAM

The installed unit operations are weighing, milling, mixing and packaging. Production capacity (installed) is 300 tons/day but actual production is 50-70 tons/day, a capacity utilization of 16%.

Most of the raw materials are obtained locally, but cereal grains and soybean cake are not available in sufficient quantities.

The technical partners are Versel of Belgium.

Investment costs amount to 1.2 billion CFA with an initial installation cost of 108 million CFA. A production cost of 110,000 CFA/ton of feed is considered high. A major contributory factor is the high cost of raw materials.

Consequently, the plan to export animal feeds to UDEAC countries may not materialise for a long time.

b. COCOA PROCESSING.

SIC CACAO, DOUALA, CAMEROON

Phased investments aimed at automation of factory operations in 1984 totalled 6 billion CFA. The factory began operations in 1952. The technical partners - (Cacao - Barry) own 51% of the business, the Cameroonian government 30%, and private investors 19%. Technology, know-how, auditing and engineering are fully supported by Cacao-Barry including providing training facilities on boilers, hygiene and safety of all plant operations.

The installed production capacity is 30,000 tons of cocoa beans annually. Actual production is 20-25 thousand tons of beans per year, a capacity utilization of 66-83%. Raw materials are cocoa beans which are locally sourced. Quality cocoa and substandard cocoa are processed in equal proportions to maximise export of Grades I&II cocoa beans.

The installed unit operations are precleaning, weighing, storage, cleaning, roasting, kibbling, winnowing, crushing, pressing, filtering, moulding and packaging.

There are no problems with markets. All that is produced is sold to either Chococam or customers in Europe. A profit of 550 million CFA was recorded in the 1987/88 financial year.

Training is done both locally and in France. The company has an in-house centre for training, and spends about 50 million CFA annually on training.

c. BREAD AND BISCUITS

- BOULANGERIES REUNIES, BASSA, DOUALA.

The enterprise is owned by Cameroonians (85% and foreign partners (15%). Investments in 1986 totalled 2 billion CFA, when all baking ovens and moulding equipments, mixers etc. were refurbished and modernised. Actual production commenced in 1956.

Producing biscuits, croissant, buns and various flavoured pasteries, the company's employees are 220 including 18 supervisors, seven managers and 3 expartriates. Technicians - electricians and mechanics are in place for regular maintenance and repair.
The raw materials-flour, milk powder, shredded coconut and milled groundnut (special grade), raisins, flavours and icing sugar are imported.
The frequency of break-down of the plant is high because machinery and equipment are not tropicalized. Marketing is local but bad roads to the villages are a major constraint.

The company also requires specialized people in food technology to assist in training the workers.
The installed production capacity is 1,200-1,500 tons of product/ year. Actual production is 1,000 tons.

d. BOUILLION CUBES
- SOPRAL, DOUALA.

Established in 1982, the company operates under licence, from Nestle' of Switzerland, with the 'Maggi' logo. Nestle' also provides technical assistance.

The company is owned by a Cameroonian, with investments totalling 1.956 billion CFA. All raw materials and equipments are imported. Mass, consisting of hydrolyzed vegetable protein, salt, caramel, vitamins A&B, glutamate, sugar, beef fat and maize starch, is imported, conditioned and pressed.

The process is basically that of mixing, sifting, remixing, pressing, packaging and collating. Mass preparation is semi continous, and from pressing to collating is fully automatic.

Installed capacity is 8,180tons/year but actual production is 3,050 tons. The cost of production is 2 million CFA/ton. Marketing is very competitive because of the importation of 'Maggi' from Nigeria.

Training is local and is backed by technical assistance from Nestle'. Every worker is trained for 2 years. Of the 53 employees in the company, seventeen are skilled including two Nestle' expartriates.

e. SWEETENED CONCENTRATED MILK
- MILKY WAY, DOUALA.

Milky Way is a private company established in 1981, for the production of canned sweetened condensed milk. The technical partners are Gloria France and France Lait with total investments valued at 1.903 billion CFA.
Installed production capacity is 15,000 tons of product but actual production is 8,000 tons. Raw materials - skim milk powder, buterfat, stabilizers and tin plate are imported. The company makes its own cans. The recipe quantities are mixed and preheated, homogenized, evaporated in a continuous, fully

automated, multiple effect, falling film evaporator to 28% total solids, sugar added and composition adjusted, followed by forced crystallization. Product is then canned and stored.

Total number of employees is 92 with 37 skilled workers. However, the company needs people with specialization in Food Technology and related fields. Training, formerly undertaken in France, is now available from a similar company in Senegal. The other problem is lack of spare parts.
Cost of production is considered high at 573,677 CFA/ton of sweetened condensed milk.

2.3.2.10 LOCALLY DEVELOPED TECHNOLOGY

a. ADAPTED MAIZE PLATE MILL:

To bring an appropriate technology to the rural poor in Cameroon's Northwest Province, the Cameroon Agricultural Tool Manufacturing Industry (CATMI) maize mill project was implemented.

The project locally manufactures an adapted maize plate mill for sale primarily to women's groups in villages in Cameroon, thus providing them with access to milling technology. The primary implementing organization is the Association for the Promotion of Africa Community Initiation (APICA). Appropriate Technology International (ATI) provided the funds to manufacture 40 mills to CATMI which had developed the milling technology. The CATMI mill is significantly less costly than locally available imported mills.

APICA manages loan funds made available to CATMI for mill manufacture, training a CATMI staff member to train mill operators in mill operations and to demonstrate the mill, and designing promotional materials for mill dissemination. (7).

To enable rural and semi-urban poor - the largest groups of all ATI projects - to gain access to the use of the mill, a lease/purchase scheme was designed.

In a separate development, APICA has developed a simple, low-cost, easy to operate medium-scale mill capable of producing high quality flour from local grains. It is expected to reduce the amount of time women spend in preparing grain by more than 98% as compared to the traditional method.

b. VERTICAL PALM OIL EXPELLER:

The artisanal sector offers important advantages in meeting the rural demands of palm oil in Cameroon. Rural consumers prefer the sharp taste of local oil with a high free fatty acid content over the taste of industrial-quality oil, and industrial products are usually not transported to rural areas.

Because the quality of fruits deteriorates in a short time, artisanal production using a press that operates quickly and located near the harvest site offers many advantages.

APICA, through its own subsidiary-Outils Pour la Communaute (OPC) has manufactured vertical axis expellers named Caltech, which depulp and press at the same time, a feature not found in alternative presses. In addition, cooking drums, bunch strippers and clarifiers were produced. Because of the availability of lease purchase arrangements, about fifty expellers have been sold (8). The vertical Caltech has the potential for much wider application; it is cheaper to produce and is expected to revolutionise rural small scale industries in palm oil production, owned by farmers groups of 20-25 families each.

c. PALM WINE AND 100% NATURAL PINEAPPLE JUICE:

The Institute of Agricultural Research (IRA) Njombe, has adapted technologies for the bottling and pasteurisation of palm wine and pineapple juice. The need for preservation during the peak season and increasing consumer demand in the urban areas necessitated the adaptation of processing technology.

The unit operations are filteration, standardisation (for sugar and alcohol content) bottling, crowning, pasteurization, cooling and labelling. Details of unit operations fo. pineapple juice production are given in the annex.

d. PATENTED INVENTIONS:

Societe Camerounaise de Minoteries, a flour milling company has patented two inventions:

i. the development of a special flour for puff-puff, which gives more puff per unit of flour.

ii. an automatic machine for loading bags of finished flour into trucks.

Technological details were not revealed.

e. PRODUCTION OF FARINE FROM DIOSCOREA DUMETORIUM (SWEET YAM)

At the Nutrition Centre, Yaounde, the transformation of sweet yam tubers into flour is a classical example of transforming local raw materials into useful products for the people by means of adapted technologies. In addition, the transformation of the yam specie which cannot be stored for long after harvest, helps to reduce post harvest losses.

2.3.3. FOOD PROCESSING AND PRESERVATION IN CONGO

Until 1983 Agro-Food industries were the most important branch of the industrial sector before the oil sector became predominant. The agro-food, beverages and tobacco industries accounted for more than half of manufacturing employment.

The share of the agro-food, beverages and tobacco industries in manufacturing, value added, grew significantly from 45.2 percent in the 1960s to 52.3 percent in 1985. The private sector, which dominates the agro-food and textiles branch of the industrial sector contributed the largest (86%) of value added.

The following are some of the largest private and state owned companies in food processing in terms of capital investment and employment. (9)

A. Nationalized Industries:

1 Societe Congolaise de Peche Maritine (COPEMAR) - processing of fish products:Capital(Cap)- CFAC 860 million.

2 Societe Nationale d' Elevage (SONEL) - development of semi - intensive stock-rearing and exploitation of by-products. Cap. - CFAF 80 million.

3 Sucrerie du Congo: Cap. - CFAF 500 million - sugar production.

B. Other Companies:

1 Brasserie de Brazzaville: Cap. - CFAF 450 million - production of beer and soft drinks.

2 Societe Congolaise des Brasseries Kronembourg: Cap. - CFAF 1,450 million - production and sale of beer and soft drinks.

3. Societe Italo - Congolaise d' Armement et de Peche. Cap. - CFAF 600 million. (51% state owned). Fishing and processing of fish, refigeration.

The Consultant observed that the production of innovative and nutritional foods is not a priortiy of most enterprises. The development of canned FOUL MEDAMES by Edfina, Alexandria, Egypt is a good example of innovation and nutrition. Chococam in Douala, Cameroon pays for the services of external collaborators in France for new product development. The company also finances research at NGAOUNDERE a local University of Technology.

Product developments should take full account of nutritional requirements of developing countries where the most widespread nutritional problem is a multiple nutrient deficiency of proteins, vitamins, minerals and calories. Appropriate technologies for food processing should be enhanced by unit operations such as formulating, blending, texturing and shaping which permit "on-stream" nutritional modification of the product, engineered and packaged in such a way as to perform optimally as regards safety, shelf - life, convenience, palatability and cost, as well as from a nutritional stand point.

The evolvement of standards is a technological requirement for food processing and preservation. Egyptian standards of identity are available and these are strictly enforced to meet the demands of export quality. In Cameroon, implementation of a standardization system in all sectors especially in the food industry is a strategy in the sixth, five year development plan. Camlait, a yogurt plant in Douala demanded government regulations for standards and quality of yogurt to prevent adulteration. Work is on - going in the Congo to set up industrial standards.

At Edfina, the need for Research and Development is well recognized. A separate R&D and pilot plant facility are being planned. In addition, it has been recognised that a two - week quarantine of finished products takes up available space, and a computer aided devise would be installed to save time. More sophisticated analytical equipments would be installed to speed up quality control so as to obtain uniform analytical results.

The population of Congo is estimated at 2.2 million (unofficial figures, mid 1989). Agriculture is still the most important sector in terms of employment, absorbing 35-40% of the economically active population. However, its share of GDP, which has been declining since 1979 showed a recovery in 1987 (Table 2). The development of the oil sector accentuated rural - urban migration, and about 58% of the total population, is estimated to live in the urban areas. Urban - rural migration has not taken place, despite a drop in oil prices which reduces foreign exchange earnings.

Thus, agricultural production has fallen; yields are low and food production is going down. Trends in agricultural production are given in Tables 3 and 4. A considerable part of the food production is destined for local consumption in rural areas and the supply of urban centres depends to a large extent on food imports. The value of food imports was 46m CFAF in 1984. The production of industrial products like sugar, palm kernel cake and palm oil has also been low. Cocoa and coffee however have developed more favourably.

Unlike Egypt, manufacturing enterprises in Congo are mostly directed towards the satisfaction of domestic demand and are mainly concentrated in the Brazzaville and Point-Noire districts as well as in the Niari Valley.

As far as food processing is concerned, bakeries constitute the largest number of industrial establishments in Brazzaville. Of the seventy four registered establishments, thirty five are bakeries, and two others-Kronembourg, Brasserie de Brazzaville which manufacture beer and beverages are some of the largest companies in food processing in terms of capital investment and employment.

Other food industries of note are palm oil production at Ouesso (Northern Congo), cassava processing at Matsoumba, sugar processing, groundnut oil and flour mills at Nkayi, flour mills and a poultry complex at Pointe Noire. Other industries which are export oriented are those of coffee and cocoa. Two industries, Societe'

TABLE 2

CONGO: SHARE OF AGRICULTURE IN GDP.

(m CFAF)

Year	Agric Sector	All Sectors	% Share of Agric in GDP
1978	27,833	198,306	14.04
1979	31,691	254,069	12.5
1980	34,429	360,397	9.6
1981	36,074	541,706	6.7
1982	47,772	710,020	6.7
1983	48,534	799,245	6.7
1984	52,130	958,509	6.1
1985	57,739	970,850	5.1
1986	56,709	640,470	5.9
1987	62,000	646,830	9.3

SOURCE: National Accounts.

TABLE 3

CONGO: TRENDS IN COMMERICIAL AGRICULTURAL PRODUCTION (TONS)

Year / Product	1983	1984	1985	1986	1987
Maize	2,601	3,760	4,457	2,471.5	1,366.7
Paddy rice	1,139.2	621.8	552.3	656	520.4
Groundnut	1,275.9	3,130.2	431.3	1,264.8	650.7
Groundnut (decorticated)	194	237.5	217.5	336.6	-
Beans	318.2	383.5	15.9	161.8	2.6

SOURCE: Congolese Office of Agricultural Production (O.C.V.).

TABLE 4

CONGO: CASSAVA TUBER PRODUCTION (STATE FARMS), TONS

Farms \ Year	1982	1983	1874	1985	1986	1987
Ferme de M'be'	9,951	2,142,5	1,873.5	-	2,507	-
C.A.I.E.M.	3,773.1	9,664	8,810	6,163	4,189	9,115.8
Ferme de Makoua	189	862	825.30	-	210	-
Total	13,913.1	12,668.5	11,508.8	-	6,906	-

SOURCE: Ministry of Agriculture and Rural Development.

Italo - Congolaise d'Armement et de Peche and Societe Congolaise de peche Maritime (COPEMAR) are involved in fish processing.

The industrial development strategies of the first Development Plan (1982-86) aimed at:

- ensuring food independence by making agriculture the basis of development, through revitalizing the agro-food industries and the development of supporting agro industrial linkages e.g. groundnut and maize processing.
- encourage private investment and promote small medium sized enterprises.

However, there are problems which constitute major constraints to industrial development in Congo, these are:

- the weakness of the transport infrastructures linking the North with theremainder of the country and particularly the Coast.
- management weakness and lack of technical support.
- prospects uncertain due to fluctuations in the oil market, hence financial constraints.
- small and medium sized enterprises are usually deprived of loans.
- the weakness of the domestic demand of 2.2 million inhabitants; thus the domestic market is far too small to support the expansion of the manufacturing sector.
- illegal imports;competition from neighbouring countries particularly Zaire and Cameroon,seems to inhibit industrial expansion, goods from Nigeria now floods the markets, foufou from Zaire is sold cheaper in CFA Francs which is foreign exchange in Zaire. The result is that the small markets are oversupplied and foufou from the cassava processing plant at Matsoumba is not selling. At the warehouse, there are 360 tons of foufou which has not been sold. The problem is further complicated by management inability to set selling prices which are well over processing costs so as to make margins.
- Due to logistic problems, the Consultant was unable to visit enterprises in Congo. Relevant documents to facilitate such visits were not available, due to administrative protocol.

However, through personal contacts, the counterpart and the consultant visited some organizations and enterprises located in Brazzaville.

1 AGRICONGO
KOMBE, KM 17 ROUT NATIONALE 1
B.P 14574, BRAZZAVILLE.

AGRICONGO is an Appropriate Technological Institute and is Congo's first experiment at gardening and producing food crops before the technology is transfered to peasant farmers. The company also specializes in the fabrication of tools for food processing in order to upgrade traditional technology. It is Congo's first attempt at adapting technology to the processing of local raw materials.
The centre is a partnership between ELF Oil Company, the Congolese government and private investors.

Various tools fabricated in the centre are on display e.g bicycle pedalled screw press, cassava cooker and extruder, and grain sheller (made of wood) designed for rural areas, groundnut decorticator etc.

The following products have been produced at AgriCongo.

a. Cassava Bread:

The traditional process for making cassava bread which involves soaking the tubers for one to two weeks (depending on the variety) and processing for another four days has been upgraded. The process of soaking softens the tubers. The cassava is peeled, soaked for two days and defibered. The resulting pulp is stored in polythene bags. The pulp is cooked, screw pressed and extruded (all in one step) into polythene tubes. These are cooked in hot water baths. The final product is a sausage-shaped cassava bread with a shelf life of nearly 1 month. Processing lasts 4 hours instead of the traditional four days.

b. Peanut Butter:

Peanuts are decorticated and roasted in a locally designed temperature regulated roaster (with a chimney which allows degree of roast to be controlled). Roasted peanuts are ground to a smooth paste in a Meule (100kg/hour). The paste is fed into a hand operated dispenser which fills 500g sachets and heat seals The peanut butter lasts 3 days, without preservatives, additives and colouring. Marketing efforts focus on women or mothers, to include it in the family menu,especially for children.

c. Soya Milk

Soymilk is produced in an Agro-Lactor, a computerised food processing equipment from Switzerland. The soymilk is considered an innovation in nutrition in Congo because cow milk is not available and the soymilk packed in 200ml sealed sachets is well accepted by children.

The soycake obtained as a byproduct is being developed into other protein rich food products.

Ginger juice is also produced on the Agro-Lactor quickly, cheaply and safely. The Agro-Lactor has also been adapted to the processing of palm wine, mango juice and tangerine. The idea is to adapt the Agro-Lactor into processing various local juices/ food drinks as far as practicable.

d. Cassava Leaf (Saka Saka):

A high protein leaf, saka saka is a vegetable that is commonly eaten. It is ground with dry fish and steamed with other condiments. The traditional technology of producing the ground leaf has been up-graded, by milling in a disc mill.

e. Other Protein Sources

In an attempt to improve protein intake, ducks are being reared on the farm.

Native pigs are also being propagated. The idea is to make them as lean as possible to reduce cholesterol and fat levels and so

provide cheap meat for the people of Southern Congo.

To this end, barbecue equipments are being fabricated using local raw materials.

f. Dacryodes Edulis: Tropical Prunes or Saffou:

These grow wild in Central Africa, especially in Zaire and Congo. Traditionally, the prunes are soaked in hot water and eaten. The prunes have a high content of oil and AgriCongo is interested in designing technology to extract the oil. The oil is commonly known as 'Safou' oil.

2

ETS MAKADI
40 Avenue des 3 Martyrs.
Moungali, Brazzaville. B.P 1260.

Mechanized Production of Saka Saka (Cassava leaf)

The factory represents a small enterprise in which the traditional technology of processing cassava leaf into Saka Saka has been upgraded.

Cassava leaves are purchased in the open market, transported into the factory and washed in hot water.
The washed leaves are drained and milled twice in a Disc Mill (Model FFC 37, Peoples Republic of China) for 30 minutes, the speed of the machine is 3600 rpm and the power rating is 7.5KW.
The finished product, known as Saka Saka is packed in heat sealed, labelled polythene sachets and refigerated.

The mill was purchased from China through the Chinese Embassy in Brazzaville and the motor adapted to local conditions. Product sales are by order or in supermarkets.

PROBLEMS:

a. The main problem is conservation of both raw materials and finished products. Fresh cassava leaves are perishable leading to changes in colour and taste and the leaves must be broughtto the factory quickly after purchase. To conserve the finished product, it must be refrigerated.

b. The problem of conservation limits the extent to which cassava leaves can be marketed. Marketing research has shown considerable export potentials especially in countries like Zaire, Central African Republic, France and Brussels.

   Thus, there is a technological requirement or problem and research must find ways of conserving cassava leaves.

c. The enterpreneur is barely making any margins at the moment since he has just started. Power in his area of Brazzaville is not steady and he has no money to buy a generator. The staff strength is five.

The banks have not granted him a loan, as there are no credit facilities to small scale enterprises.
As soon as he is able to secure a loan, he plans to install a cold room for both raw leaves and finished Saka-Saka.
He will also diversify into the production of peanut butter.

3. SAKASAKA - LOCAL PRODUCTION

Cassava leaves are picked and scoured with hot water thoroughly. The leaves are drained and pounded, using a motar and pestle, to a certain degree of fineness and smoothness.
The most important aspect is that consumers tend to prefer the locally pounded cassava leaf because pounding enables the natural "juice" of the leaves to be retained.

4. FUFU PRODUCTION (VILLAGE MILL)

Traditionally, fufu is produced by pounding dried cassava pieces using a mortar and pestle and sieving. The method is labour intensive, wasteful and unhygienic.

Cassava is peeled, sliced and soaked for 2-4 days. It is then washed followed by sundrying. The dried material is taken to a village mill where it is processed into fufu.

5. Enterprise General de Commerce
Agro - Industrielle du Loudima
Unite Industrielle de Torrefaction de Cafe'
B.P 1337
Brazzaville

The company, a medium sized enterprise, established two years ago, is set to begin production of coffee in August, 1989.

It is located in Loudima, a region where 60% of the national production of coffee comes from.

Imported equipments which have been installed are as follows:

a. Roaster (Legrain Hamerel)
Capacity: 100kg of roasted coffee/hr. Central heating by natural gas.

b. Coffee Grinder
Type MC 9001
Grinding capacity: 100kg/hr.

c. Packaging machine
Capacity: 7 250g sachets/min.
Calibrated in 0.1kg - 2.2kg.

d. Collating.

e. Cartoning, 60 sachets/carton

Total project Investment	47m CFA
Financed by:	
- Banks	25m "
Owner (Mr. Mavoungou)	9m "
Owner's personal Villa estimated at	71m "
Bank Credits up to	9m "
State Guarantee Fund	

MARKETING:

Production is aimed at local consumption since the price of coffee in the International Market is low at the moment, and the production unit needs to settle down before thinking of export.

The chances of success of this project are bright.

(a) Cost of raw coffee (1kg) - 110 CFA
Selling Price of processed coffee (1kg) - 1,000 "

Allowing for an unambitious 40% process loss (i.e 60% yield) and processing cost, there is considerable room for profit.

(b) The raw material occurs in abundant quantities.

(c) The project may be recommended by the Industrial Development Centre to the National Development Bank for extra funding. To this end, a UNIDO Coffee expert visited the company in June 1989 on the invitation of the National Development Bank to appraise the project, among others.

The installed annual (309 working days) capacity is 918,000 sachets (250g each) ground coffee or a daily (7 working hours) production of 420 sachets.

The company is in touch with Congo's Maintenance Society to select technicians who will assist engineers in the company.

ONAPEC
B.P 13241, R.P.Congo.

(Project de development de la Peche Continental du Congo)
Ministry of Industry.

At the time of visit, the project was only just starting.

The main aim of the project is to give assistance to fishermen by training them improved methods of fishing and to upgrade their traditional technologies in smoking and drying, which, at the moment, are recognized as primitive.

The upgraded version would be adapted to the needs of the Congolese fishermen and financial support would be sought in the promotion of such technologies. The centre is in co-operation with the International Fund for Agricultural Development (FIDA) and technical assistance is provided by the FAO.

A programme to achieve the foregoing was being drafted when the mission visited the centre.

3. TECHNOLOGICAL REQUIREMENTS IN THE FOOD INDUSTRY SECTOR IN CAMEROON, CONGO AND EGYPT.

3.1 SCIENCE, TECHNOLOGY AND INDUSTRIALIZATION POLICY

An obvious requirement is a government policy on science, technology and industrialization with appropriate strategies to achieve it. The policy, if implemented, lays the foundation of a national technology system, the presence of which is vital for the selection, transfer, adaptation and application of technologies which are appropriate to the tasks in food processing and preservation.

The history of post-independence scientific and technological development policy in Africa for the past twenty four years (1965 - 1989) has been marked by an emphasis on the transfer of appropriate technology to Africa. All these approaches are embodied in the Lagos Plan of Action 1980 - 2000 African document. Egypt, Cameroon and Congo, have in various ways explicitly demonstrated their faith in technology progress by making it mandatory and have evolved different strategies to accelerate it in their development plans.

In food processing and preservation in particular, Cameroon's strategy in the 1986 - '91 plan is the development of local raw materials, the consolidation of food self-sufficiency so as to ensure food security, the promotion of standardisation and a clear political will to provide the country with a more autonomous industrial base.(10)

At the seminar concerning industrial development strategies of People's Republic of Congo in February, 1989, recommendations made to Government included among others, the creation of a Government Committee for negotiation of transfer of technologies, standardisation and promotion of control of quality and Research and Development.

Government plans to set up small units of food processing which are aimed at industrialisation of rural areas.

In Egypt, Government's endeavour since 1984 has been directed towards renewed emphasis on export expansion, which views export as surplus production after having met the requirements of domestic demand through increased production. Other policies include an indigenous technology base to accelerate economic development through the effective utilisation of the centres of research and to support small scale and artisanal industries by financial means, choice of technology and co-operative activities. An important consideration is the encouragement of foreign investment in industries where technological know-how is not available locally or the technology is complex, the raw material is available locally and the product is intended primarily for the export market.

These articulated intentions, as laudable as they are, have not been pursued vigorously to the letter, and therefore remain to be fully implemented. The implementation of these policies has become difficult tasks because of challenges exacerbated by the sluggish overall economic environment. Developing countries are experiencing one of the worst international economic situations marked by inflation, monetary disorders, a drop in the price of export products such as cocoa, cotton and oil, a rise in the prices of imported goods and many other factors which considerably undermine their fragile economies. Against this background, it would appear that industrialisation by the establishment of large capital intensive food processing and preservation plants is not the solution. Greater emphasis ought to be on small to medium scale appropriate technologies to accomplish the tasks in food processing and preservation and policies designed to control, stimulate and promote them.

The intentions or policies are more of a general nature while technological choice and requirements in food processing and preservation are specific depending on the subsector being addressed.

There is the tendency therefore to lose direction, and end up with a technology system that is unablanced and fragmented.

The technological requirements in food processing are quite clear:-

- steady supply of local raw materials at the right price and the right quality.

- adequate storage for raw and finished products.

- appropriate processes and adequate plant and machinery for production.

- infrastructural requirements of energy, water transport and communication.

- specialised personnel in engineering, maintenance quality assurance, marketing and management analysis.

- products and services of good value and consistent quality which assures repeat purchase.

- effective distribution and marketing ensures consumer loyality such that the enterprise continues to remain in business.

In a 'mixed' economy, composed of some publicly owned and some privately owned enterprises, policy instruments apply at different levels; enterprises in the food industries are affected by national economic policies, by policies specific to agriculture and the entirety of the food industries, and by policy measures applying to particular food products, their markets and their techniques of production.

It is the business of government to formulate policies which do not conflict and which are especially effective in relation to food processing and the choice of appropriate technologies.

3.2 HUMAN RESOURCES DEVELOPMENT

Technological availability and the strengthening of technological capacity are bedevilled by various problems which border on inadequate development of human resources. In Egypt for example, University undergraduates are not exposed to Food Industries until they have left the University. Exposure at the graduate level is not a universal policy and depends on the exposure of the student advisor. This is also true of Cameroon and the Congo. Thus, it would appear that the training of undergraduates is theoretical and a deliberate policy of Government is needed to ensure that undergraduates combine theoretical and practical experience in industry while still at the University.

Some of the problems in Cameroon and the Congo also reflect the general lack of specialization and skilled manpower in the food industries subsectors. The problem of maintenance and the lack of spare parts are common. In some factories, experts come from abroad to audit processes and assess management ability periodically. Some equipment breakdown cannot be handled by local staff and experts are called from abroad. The General Conference on Education in Africa in 1964 recommended that the ratio of students at technical colleges to universities should be three to one, (11) in the general recognition that many more technicians are required than university graduates. The ratio remains to be achieved in the countries visited by the mission, even in the Congo with a high educational enrolment.

Technical and vocational education for the food industries must reflect local and national industrial needs. Such needs include the training of a sufficient number of mechanics in methods of designing, fabricating and repairing machines locally. The Universities' Departments of Food Science must also be concerned with a broad training that will provide perspective for the future, to enable graduates to prepare

not only for technical posts, but also for leadership in research and management. Therefore the content of courses should be modified and expanded to better suit manpower training to the demands of food industry.

Managers within a particular industry should be trained to be able to appreciate alternative technologies, the adaptation of machinery and its use to suit local conditions, ways of obtaining better information on all the possible alternatives and approaches to transfer of technology negotiations. For example, operators in a palm - oil processing industry in Cameroon have not seen any mill other than their own and therefore their training and exposure are limited. Well equipped laboratories and trained laboratory personnel are either unavailable or are luxuries in some of the enterprises visited.

These problems are not only clear manifestations of a faulty educational system but are also indications of defects in the transfer of technology agreements of some factories. The policies of governments on technical education should favour widespread industrial development. Therefore, technology and education plans should be closely linked. Educational systems should be restructured to place less emphasis on formal/paper qualifications and re-emphasise the learning of useful skills. However, the skills should be adequately compensated. Operators in the food industry can acquire capabilities in any of the following skills which are essential in the management of food industries:

- laboratory technology - food analysis, process monitoring and product development.
- production processes, production and process audit, productivity analysis.
- storage technology.
- food industry sanitation, hygiéne and safety.
- food process engineering.
- veterinary medical practice in food processing.
- food transport and marketing.
- enforcement of food laws and regulation.

Training in these skills directly influences the adaptation, absorption and diffusion of technologies in food processing and preservation.

3.3 AGRICULTURAL RESOURCES

Many of the enterprises visited during the mission complained of inadequate raw materials. Where raw materials are available, prices are uncompetitive. In Cameroon, rice is three times more expensive than the international market price. The prices of Sugar, Cocoa and Cassava were also high. Thus for a company whose sugar input is 60%, the export of finished products is unattractive. On the other hand, the importation of flour from Europe and USA where flour exports are subsided, makes the price of local wheat flour uncompetitive since there is no protection. In terms of raw material quality, a company in Cameroon had started to buy American wheat to blend in, at the 30% level, the wheat imported from Europe so as to improve the quality of flour produced, in recognition of the fact that wheat from different places have different properties.

In the People's Republic of Congo, agricultural production has declined and food production has gone down resulting in difficulties in meeting local demand. There is rural urban drift as fifty eight per cent (58%) of the population is estimated to live in urban areas. Agricultural production figures show a marked deficit for maize, cassava, paddy rice, groundnuts and beans in 1987. The situation in Egypt is understood as the country is self-sufficient only in rice. The bulk of inputs for processing are imported. Tables 2 and 5 show the declining share of agriculture in GDP.

Local supplies of raw materials are usually initially derived from those which saturate the fresh foods market. In the countries visited, there are seasonal saturations which require appropriate technologies for storage and preservation.

TABLE 5

EGYPT: SHARE OF AGRICULTURE IN GDP

Year	% Share
1977	27.5
1980/81	20.6
1981/82	19.8
1982/83	18.8[a]
1983/84	16.6[a]
1984/85	15.9[b]

a: Estimates.

b: Projected.

Source: Industrial Development Review Series. Egypt, UNIDO IS/637.

However, the regular supply of raw materials to industry throughout the year, requires a master plan interlinking agricultural and industrial developments and this should be mapped out by Government.

Inadequacies in the local supplies of raw materials actually negate the aspirations of appropriate industrial technology resulting in low capacity utilisation, which does not necessarily mean that the chosen technology is inappropriate. For example, several reasons are responsible for inadequate supplies of raw materials in Cameroon:

i. In the traditional sector, there is a low rate of utilisation of modern production factors (22% of the farmers use organic fertilizers and 32%, chemical fertilizers).

ii. The level of mechanization is very low= 13% are animal draught and 2%, motorized equipment.

iii. The traditional sector has all the characteristics of extensive farming with low productivity and is increasingly losing its young active population as a result of rural exodus.

Traditional agriculture still covers 90% of the cultivated area and although, food self sufficiency has on the whole been attained, 94% of the net food stuff supply comes from the traditional sector (12). This does not guarantee that there is excess for processing since as much as 35 - 50% of roots, and tubers are lost post harvest, and between 15 - 20% of cereal grains is lost due to poor storage. The problems of raw materials procurement for industry are further complicated by those of poor road net work, stiff price competition with middlemen, smugglers and poor quality. Therefore, agricultural production of primary

products must succeed in order to reap the full benefits of appropriate industrial technology.

3.4 INFRASTRUCTURAL REQUIREMENTS

3.4.1 TRANSPORT INFRASTRUCTURE

Transport is one of the major bottle-necks to the development of food production. Road, rail and river transport suffers from problems such as inadequacy of the supporting services, poor maintenance, unsatisfactory road facilities, excessive cost of fuel and spare parts, poor planning and lack of co-ordination. All these add to increased marketing costs either for raw materials for food processing or the sales of finished products. Rural area transport still depends heavily on headloading, buckets, bicycles, animal towed carts and push carts. The distribution of food products (yogurt in Cameroon for example) in rural areas is difficult because of lack of good roads that are impassable during the rainy season. A network of motorable roads is required as links to major roads between rural and urban areas of the countries visited.

3.4.2 MARKETING INFRASTRUCTURE

Marketing of food products remains the weakest link in the process of food production and could generally be described as inadequate and inefficient. The unsatisfactory performance of the marketing system especially the lack of guaranteed price stability could be singled out as the major factor in the inadequate incentive of farmers to adopt and use modern techniques and inputs necessary for increased food and agricultural production.

Quality, quantity and the right price of raw materials are essential incentives in the development of appropriate industrial technologies for food processing and preservation, and in order to realise the benefits, marketing inefficiencies must be removed:

i. Marketing information is inadequate and this restricts the orderly and timely flow of food from food supplies/reserves to food deficit areas. Standard pricing policy is also lacking.

ii. Supply of food commodity is highly seasonal. There is usually surplus commodities at harvest followed by a period of scarcity before the next harvest. This of course is the result of inadequate storage and processing facilities. At Edfina for example, all fruits, no matter the quantity are received and processed within 24 hours because of their perishability.

iii. Seasonal price fluctuations are so large that producers' incomes are low at harvest while consumers pay high prices close to harvest. For industrial processing, seasonal fluctuating prices pose problems of accumulating large stocks of agricultural produce.

iv. Price instability in local and foreign markets reduce incentives to produce more.

v. Wholesale and retail markets in both rural and urban areas are ill-equipped and insanitary. The sales of meat after pick-up from a hygienic abbatoir in Yaounde or Douala are in open areas with a lot of flies hovering over the meat.

vi. Marketing services such as standardization, grading, packaging and storage are still rudimentary except for export produce.

For finished goods, a broad based market development is contemplated at Edfina. Such development will involve export drive/promotion to other African countries. At the moment, export activities are directed towards the Arab world and Europe. In Congo, the domestic market is far too small to support the manufacturing sector or its expansion.

3.5 RESEARCH AND DEVELOPMENT

Only a few of the industrial establishments visited by the Consultant have research and development units of their own, and even these have a limited record and with very little horizontal transfer. In general, whatever research takes place, is by and large government funded through research institutes or universities. The research institutes established have been of various types, which belong to the categories of government controlled, autonomous, state - aided or quasi - governmental institutes, sometimes too many to function in an effective and co-ordinated manner.

Research and Development in the context of food processing and preservation involves:

- Process developments involving appropriate technologies for upgrading traditional technologies and the development of capacities for adaptation and absorption of other technologies.
- product developments involving the development of innovative and nutritious foods.
- storage and preservation techniques for highly perishable foods with high percentage of post harvest losses.
- fabrication of prototype equipment for processing, manufacture of spare parts.
- quality assurance involving quality control, hygiene and safety, technical standards and specifications.

In Egypt, the consultant visited the National Research Centre and the Food Development Centre both in Cairo, and the Diary Research Centre in Alexandria. The consultant visited some of the appropriate technological institutes in Cameroon and the Centre for Research Initiation and Project Technology (CRIPT) in Congo. The Food Development Centre in Cairo is a project under the auspices of UNIDO and will be fully functional in a few months. It is the view of the consultant that it will be a model to most developing countries.

The consultant observed serious limitations of some of the Research Institute which appear to be the principal causes of their ineffectiveness or their lack of capacities to solve technological problems. Prominent among the causes are:

i. a structure that is too ambitious, and executive officers with inadequate training and experience. The Institute of Agricultural Research (IRA) in Cameroon have too many ambitious programmes, yet no appropriate infrastructure and speicialized researchers.

ii. Failure to assess the applied research and development needs of the nation and clearly-defined industry - related priorities prior to formulating programmes.

iii. weak contacts and co-ordination with industry and government, lack of adequate funding, indiscriminate importation of technology.

iv. operational short comings including inept management, wrong type of staff, remuneration and lack of business orientation, priority - based research, commercialization efforts, package of services to industry and guarantees for technology development.

Thus, the impact of the effort in industrial research has been so feeble mainly because industrial research has been a government initiative with very little participation from industry. It is extremely difficult now to satisfy the funding requirements especially the maintenance of infrastructural activities and the purchase of new equipment under the current economic problems.

Where research institutes produce results for example, solar drying of apricots at the National Research Centre Cairo, palm wine processing at IRA, Cameroon and the production of farine from sweet yam at the National Research Centre Yaounde, commercialization has been difficult and the results stop at the publication stage or on the library shelves.

3.6 DEVELOPMENT OF THE ENGINEERING AND MACHINE TOOL INDUSTRY

It was observed during the mission that, in addition to the lack of technical capacities for maintenance, irregularities in spare parts supply constituted another draw back to the smooth running of food industries, despite the existence of Engineering maintenance societies in Congo and Cameroon. In a palm oil mill in Cameroon, there are very few local spare parts and the company's stock of imported spares against an eventual break down is worth 168m CFA; which represents a considerable capital tie-down.

The main problems of the oil mill, established under a turnkey contract are in the boiler whose tubes had poor circulation characteristics resulting in cracking, and subsequent break down in operations for six months.

These problems are best solved through the development of the engineering and machine tools industry. Experience in developing countries has shown that a broad - based industrial structure or appropriate technologies cannot be sustained without the existence of a growth oriented engineering sector and commitment to a maintenance culture. The engineering industry is traditionally an important source for the growth and development of technical manpower and a focus for the process of technological innovation. It is thus advisable for Cameroon and the People's Republic of Congo and indeed all developing countries to assign high priority to its development.

These requirements are well recognised in Egypt where all public sector food processing and preservation industries have well equipped engineering workshops. The engineers have the technological capacity to manufacture spare parts and build prototype equipments.

3.7 PACKAGING

Packaging is a central issue in appropriate technologies for food processing and preservation as processing and packaging are inseparably linked. Egypt, Congo and Cameroon and indeed

most developing countries rely heavily on imported packaging materials which in today's market, have become very expensive.

The main alternative for meeting the needs of the food industry consist of rigid packs (such as cans, jars, bottles and wooden boxes), textile bags, and flexible or semi-flexible packs made from paper, laminated plastic films, aluminium foil and other materials.

Recent developments and techniques in food industries have been strongly influenced by the emergence of new materials in the packaging industry as a result of the numerous ways that have been found to combine paper, plastic and aluminium foil.

The wrong choice of the packaging line and packaging materials can have a devastating effect on the business. For example, Dolce, a dairy and juice manufacturing company in Cairo have almost abandoned the combiblock system for packing UHT products. In today's economy, combiblocks have become too expensive and unprofitable to use, thus making the technology inappropriate. The company has changed to packaging a certain proportion of its production in bottles. Can making lines at Edfina are for forming cans only. The tin plate required is imported.

For export, companies have no choice but to use packaging materials which are up to date in keeping with trends in processing and packaging. Food packaging standards for international markets are stringent and therefore, a high capital outlay is required in meeting the standards of quality, hygiene, legal labelling requirements, and product shelf-life set by developed countries.

In order to lower packaging costs, it is the view of the consultant that Egypt, Cameroon and Congo should develop interest in finding technologies that make fuller use of their own natural resources to develop alternative packaging materials. Egypt's petrochemical industry is geared towards meeting this requirement very soon.

3.8 INFORMATION DISSEMINATION

The effective selection of technologies which are appropriate to the tasks in food processing require detailed operational information about appropriate alternative technologies. Enterprises in the countries visited, with the exception of a very few large ones, do not possess technological information, and more importantly, they often do not know where it can be obtained. Therefore, industrial and technogical decisions are taken on the basis of inadequate information. Where information does become available, the ability to evaluate such information for purpose of decision making is often lacking.

The dearth of information generally leads enterpreneurs into making private cost-benefit analysis of their own and entering into technology transfer agreements or turnkey contracts which contain elements usually not in their favour. A typical example is the CDC palm oil mill at Limbe, Cameroon, which was assembled by DE WECKER of Germany on turnkey contract. The boiler of the plant was apparently the wrong specification and there was a breakdown in operations for six months. It could be that those who wrote the specifications did not have enough information or did not possess the technological capacity and were unable to specify the technological services required and to negotiate the terms and conditions. Vetting of the final designs and specifications before DE WECKER assembled the plant was probably faulty.
As far as Dolce in Cairo is concerned, product choice (UHT juice and milk) and packaging (in combi block) were probably not the best alternative. In Congo, the sugar factory (SUCO) has been visited a couple of times by consultants to assess problems emanating from the wrong choice of technology and its attendant costs, production, management and marketing.

Technological choices in food-processing projects might be improved within each country by setting up Technological Search and Appraisal Unit, (13) whose main functions might be

to examine project proposals, evaluate the appropriateness of the product and the technology proposed, and to provide information on technological alternatives to all potential investors, small and large - scale for modern sector developments.

In Egypt, the body known as General Organization for Industrialization performs such tasks. In Cameroon and Congo, the Office of Industrial property exists. These units or others as appropriate should have information centres made up of information specialists and persons with techno - economic backgrounds.

The unit would develop its capacity to provide technological information by forging external links with international institutions such as UNIDO, FAO, ILO and the World Bank, the International Technology Development Group (ITDG), internal links with the banking system and small industry promotion organization, agric extension services and regional institution so as to assist all these bodies on technological aspects of project preparation and evaluation.

4. PRODUCTION UNITS ORIENTED TOWARDS CO-OPERATIVE PROGRAMMES/PROJECTS

Co-operation entails sharing skills and knowledge of technological capacities available within each country. Based on bilateral arrangements, such co-operation is facilitated by the exchange of technical information including the exchange of technical and scientific staff. The key to success in this respect is that developing countries must know that the information about such units is available in the first place. In addition, common raw materials facilitate such co-operation, and more importantly, the economies of the countries must be able to sustain such technological development.

4.1. FRUITS AND VEGETABLES:

Fruits and vegetables processing are important to the peoples of Egypt, Congo and Cameroon. In Egypt, technological capacity exists to process these commodities for domestic consumption and export. In Cameroon and the Congo, there are plans to establish such facilities and private enterprises have established small scale juice bottling units. There are immense opportunities in processing fruits and vegetables that are wasted.

At the current level of development, a small to medium scale multi-product factory seems to be the logical and optimal choice. With experience, such a factory can expand, diversify its products and organise contracts with farmers for regular deliveries. An export strategy however requires regular suppliers of particular fruits or vegetables, organised through a nucleus estate or contracted outgrowers to obtain the raw material for a well-run, relatively sophisticated factory producing a quality product at affordable cost.

A small to medium scale factory caters for local demand, as well as utilising horticultural surpluses and utilising simple appropriate industrial technology.

The choice of appropriate technology can be influenced if experts from Congo and Cameroon visit Egypt to make on-the-spot assessments of available facilities. It is also more cost effective if technical personnel are trained in Egypt. Such an arrangement is technically sound, and meets with economic paramenters of a joint effort development.

Such processes include canning fruit juice, production of jams, jellies and marmalade, and dehydration or drying of fruits and vegetables e.g. onions, with a view to producing vegetable or fruit products which are stable, can be stored with food value, and can be reconverted where necessary into edible products.

Canning Foul Medames (Horse bean) in Egypt is a means of popularising the horse bean, improving the nutritional status of the people and generating foreign exchange through export. Canning technology was adapted and this know-how can be transfered from Egypt to other countries, especially in the Arab World.

The use of solar energy for fruits and vegetable dehydration remains to be tapped, and joint efforts in this direction can produce viable results. All three countries have abundant solar power.

4.2. ROCTS AND TUBERS:

Cameroon and the Congo, and indeed other developing countries in the Tropics need to review improved appropriate technologies for roots and tubers.

a. Storage

The storage of fresh roots and tubers is dominated by a pervading sense of urgency because of the high perishable character of the crops. Fresh cassava must be processed or else must be used within 2 days of harvest. There is growing evidence to suggest that cassava can be held in reasonably good condition in moist absorbent material for up to six weeks. Sweet potatoes deteriorate beyond use within 5 to 10 days from harvest. Fresh yams, cocoyams and Irish potatoes are storable. However, in traditional storage, losses can average as high as 50 - 60% after 3 months.

These problems represent serious challenges to food processing technology and solutions can be found through co-operative research projects. For example, cassava can be converted into chips, a commodity which can be stored and transported.

b. Peeling

Mechanical peeling of yams, cassava, and cocoyam remains a challenge for technology in Cameroon and Congo because of the non-uniformity of shapes and sizes of these products. This is also true of most of the places in the tropics where these products are produced. If the technology had been developed, it is unknown, as peeling is till done manually. A joint effort at developing appropriate technologies for peeling is obvious.

c. Cassava Bread Production - the Congolese Example

AgriCongo has upgraded traditional technologies in the production of cassava bread by mechanizing unit operations, resulting in time and energy savings and a more hygienic product.

The same product is consumed in Cameroon and processing is by traditional means. Therefore, both coountries can share experience.

d. Cassava leaf (saka saka) Production in Congo

In Congo, the traditional pounding of cassava leaf has been mechanized by using a disk mill, again with considerable savings in labour. Such methods can be introduced in Cameroon and neighbouring developing countries.

e. Animal feed production, using peels from cassava is a final consideration in the total utilisation of the raw material.

f. Joint efforts are required in developing technologies for the processing of shelf stable products:

i. Yams into yam flour, flakes, or chips.

ii. Cocoyams into cocoyam flour or chips and

iii. Plantains into plantain flour and chips.

4.3 BANANA PRODUCTION IN CAMEROON:

The industry which is geared towards efficient harvesting and packing of fresh bananas for the international market is worthy of emulation by all developing countries which have potentials for banana production. Infrastructure (CABLE-WAY) is available to ensure speed in handling from harvesting in the field to final despatch to the ship. The advantage is that the procedure minimises handling and prevents damage due to bruising.

4.4. THE ABATTOIRS IN YAOUNDE AND DOUALA (CAMEROON):

The setting up of abattoirs and the services rendered to local butchers are recommended to developing countries which do not have such facilities. The abattoir is the first stage of meat processing in which animals are slaughtered and cleaned up in a hygienic way. This should be complemented by ensuring that the butchers are trained to present the meat to consumers as hygienically as possible.

4.5. SUGAR:

There is the need to assist sugar producing countries of Congo and Cameroon to diversify into:

i. the production of particle boards
ii. the production of yeast from molasses and
iii. cellulose production.

This will aid in increasing the productivity of sugar plants, which do not operate at maximum capacity. In addition, there are problems of management, repair, maintenance, marketing and the need for a proper co-ordination between raw materials availability and processing.

4.6. BY-PRODUCTS UTILISATION:

Wastes from abattoirs and fish processing industries can be processed into a highly digestible product. There are technologies (large and small scale) to process these along with by-products from agriculture and food processing. Developing countries should share experience in this field.

4.7 FOOD DEVELOPMENT CENTRE, KAHA, CAIRO:

Although not a production unit as such, the centre is a place where food technologists, engineers, analytical chemists, microbiologists and other related technical personnel can be trained in most aspects of food processing including quality assurance, research and development.

Through bilateral agreements, food technologists from developing nations, and the Arab World in particular would be trained at the centre.

4.8 DAIRY RESEARCH CENTRE, ALEXANDRIA, EGYPT:

The centre was built as a regional centre for training Middle-East countries in milk production and dairy products processing. Equipped with a modern dairy pilot plant, the centre can train thirty two participants at a time and has two classrooms and laboratories for that purpose. A trainee receives a diploma at the end of the course either for a two year program or a short in-service training.

4.9 PALM OIL PRODUCTION

Cameroon and the Congo can share experience in artisanal production of palm oil in the rural areas. The idea is that high transportation costs usually prevent industrial quality oil from reaching the villages. Therefore, the setting up of units for village level production of palm oil must be encouraged. Such developments, which represent the upgrading of traditional technologies have shown positive results in Cameroon, and these include the provision of cooking drums, bunch strippers clarifiers and expellers to depulp and press at the same time.

The setting up of such small scale palm oil processing units in the Congo is in line with government's rural industrialization policy.

5. REQUESTS FROM ENTERPRISES

5.1 EGYPT:

5.1.1 At Edfina Food Preservation Industry, Alexandria, Egypt, the colour of frozen green string beans turns yellow after two months. Investigations carried out so far have not resolved the problem. The Quality Assurance Manager wants information on any studies undertaken in other countries to eliminate such problems.

5.1.2 The seasons for fruits and vegetables are very short. Quality assurance must accept all fruits, hence the problem of large stock which must be semi-processed and kept frozen until required. This results in large stocks of bulky materials. The challenge for R&D is how to preserve semi processed fruits without the addition of preservatives or freezing.

5.2 CAMEROON:

5.2.1 At the Institute of Zoological Research, Yaounde, Cameroon, the preservation of green grass during the peak season for off-season feeding of cattle and other ruminants is a high priority. However, the technology for the preservation of the green grass is unknown. Drying and compacting of grass for fodder are known technologies, but these do not retain the green colour of the grass.

5.2.2 At the Abattoir, about 500 cows are slaughtered per day releasing so much ruminal waste, a source of high pollution. However, the waste which is a source of protein and other minerals, can be processed to obtain animal feed. The technology for processing such waste is being sought.

5.3 CONGO

5.3.1 Tropical prunes (DACRYODES EDULIS) grows wild in Central Africa, Congo and Zaire. It is ready to eat after soaking in hot water. It contains a high percentage of oil and methods for the extraction of oil are of interest to AgriCongo. Attempts at extracting the oil have produced unsatisfactory results.

5.3.2 Fresh cassava leaves and the processed form known as Sakasaka are highly perishable. Keeping qualities deteriorate after three to four days refrigeration. Storage is a major headache to enterpreneurs who have attempted to export these products to other parts of Africa and to Europe where there is a high concentration of consumers. The enterpreneur wants information on how to improve the shelf life of these products.

6. RECOMMENDATIONS:

Developing countries of Africa should map out clear science and technology policies toward the food industry and these should be consistent with development priorities and the steps governments are taking in order to overcome their countries' food problems. Egypt, Cameroon and Congo among others, are all different and therefore their goals of material food policies differ. In all cases, the "ultimate" must be the attainment of food self-sufficiency, rural development, increased industrial growth and maximisation of the use of local raw materials.

Congo and Cameroon enjoy the same patterns of food consumption and crop prodution and face similar obstacles in the development of their food processing sectors. The same is true of Egypt, and other countries in the Arab league. Therefore, there is considerable scope for co-operation among these countries in:

- Appropriate food processing technology
- Research and Development
- Marketing Development, International Marketing and
- Trade.

at regional and international level and with international organizations.

It is clear that each developing country has peculiar problems which must be solved and the following recommendations offer possible solutions.

6.1. AT NATIONAL LEVEL:

a. Conduct surveys, collect and evaluate data on available industrial food technologies (small, medium or large scale), and inventory of locally fabricated food processing machinery; evaluate data needed for planning decisions on technological options and the development of technological capacities. Establish a comprehensive data bank.

b. Establish or expand and strengthen existing agricultural research and development centres aimed at developing agricultural machinery and equipment, with a view to providing primary processing facilities to farmers such as dryers and threshers, and teach farmers and small scale processors loss prevention systems. The setting up of Farmers' and small scale processors co-operatives should facilitate this development. Farmers should be provided with incentives which would stimulate them to adapt new improved technology and encourage local production through the establishment of remunerative pricing structure.

c. National post harvest technology centres should be established or existing ones mobilised so as to develop appropriate technology and machinery for reducing post harvest losses; upgrade traditional technologies for products closely reflecting consumer demand and generate consumer awareness through education.

d. In order to make a significant breakthrough in the development of effective technological capability for food industries and agriculture, African Governments should make every effort to devote at least 1 percent of their gross national product to the development and promotion of science and technology in Food and Agriculture. The development of the Engineering and Machine tool industry and a maintenance culture should be a matter of top priority.

e. Establish a national focal point which will, among others:

- identify investment opportunities based on available local and national resources.

- perform pre-investment and feasibility studies for industrial projects.

- participate in negotiations and conclusion of agreement in technical co-operation or transfer of technology matters, turnkey contracts, licencing and registration of industrial establishments, in line with government's priorities.

- collection of data concerning industrial production and provision of assistance in the dissemination of information on technical and technological matters.

f. A national technological body should be set up for monitoring and evaluating technologies in food processing and preservation. The body should evolve strategies for simplifying sophisticated technologies and adapt these to rural industrialisation as required. The National Board for Technical Education and Authorities in the Universities should restructure the educational system and review food technology courses to produce skilled manpower according to pressing needs, so as to achieve a right balance between academic and technical education. The exposure of Food Technology students to food industry facilitates the application of basics learnt at College to practical aspects of industry. Such training should be undertaken by every food technology student while at school as it is vital and crucial to overall development of technological capacities. Specialization in the various branches of food technology should provide a sound foundation for acquiring skills in adapting or absorbing appropriate industrial technologies, and understanding transfer of technology, turnkey or licencing matters.

g. With the dwindling foreign exchange earnings and the inability to import inputs for food processing industries, there is now a greater dependence on indigenous research and development. Government Research Institutes and the Food Industry should co-operate, form R&D associations, identify areas for process and product development for the industry and jointly fund research and equipment fabrications.

h. Given the heavy dependence on imported packaging materials, each developing country must have an interest in finding technologies that utilize more fully her own natural resources of metals, natural fibres, timber etc. to develop appropriate packing systems.

i. Private enterpreneurs should be encouraged by way of soft loan incentives etc., to commercialise developed technologies and prototype equipments. Storage facilities such as silos for agricultural products should be established.

j. A major obstacle to the growth of the food processing and preservation sector that will need to be addressed vigorously is the lack of adequate transportation, warehousing, refrigeration, financing and other types of overhead facilities. There is the need for improvements in marketing techniques, organization, information, education and intelligence.

6.2 AT THE REGIONAL LEVEL:

Co-operation among developing countries, established and supported jointly by the appropriate United Nations agencies should constantly monitor the implementation of the food and agriculture chapter of the Lagos plan of action.

a. Establish Regional Centres for Information Dissemination, Research, Development and Training.

The centre should have data bank linked to the multi sectoral information network and the national focal centre.

The centre should have facilities for Research and Development in food processing and preservation technology and packaging in line with the priorities of developing nations of the region, with a view to training nationals of the region in such centres. Classical examples are the Food Development Centre in Egypt, the African Regional Centre for Technology in Dakar and the Engineering Design and Manufacturing Centre in Ibadan.

The foregoing should not necessarily involve the establishment of new infrastructure but existing institutions should be strengthened and expanded.

b. Promote co-operation among their research centres and similar R&D institutions. This would cover exchange of scientific experience, research findings, inventions, innovations and the scientists themselves. Joint scientific research work should lead to the promotion of subregional specialization and co-operation in manufacturing agricultural food processing and preservation machinery.

c. Commercialize the results of R&D and promote practical applications in industry by promoting exchange:

- publication and distribution of technical papers,
- preparation of project scale up proposals,
- organization of indusrial fora for scientists and industrialists
- participation in trade fairs and

facilitating transfer of the technology for large-scale testing and production.

d. Promote joint ventures to optimize transfer of technology and use of national resources, especially human skills and natural resources.

6.3. AT THE INTERNATIONAL LEVEL:

a. Having developed multisectoral information network for the dissemination of information on Appropriate Industrial Technologies, this should be linked with UNIDO, FAO, the Intermediate Technology Development Group (ITDG), Appropriate Technology International (ATI) and other relevant information data banks.

b. That technology is a key factor for development and that recipients of foreign technology have to deal with suppliers in strong bargaining position, who have been able to impose a variety of limitations on access to know-how and to charge higher prices than reasonable is well known. International co-operation in Appropriate Industrial Technology - Food Industry should proceed by means of transfer of technologies and technological choice which are mutually participatory, involving strategies which provide

information, material back-up, training, R&D and identification of growth opportunities. Such arrangement should be economically sound. The choice of sophistication and nature of machinery should be such that:

- local engineers can design it
- engineering shops in the country can build part of it and can be serviced, leading to capacities to mend and produce spare parts.
- part of the technological package should be that local engineers can make it eventually so as to upgrade local competence in the transfer of technology.
- it should respond to priority basic needs and a general development option.
- it is productive.

6.4 WITH INTERNATIONAL ORGANISATIONS:

Efforts and activities at all levels in the transfer of technological know-how and the development of appropriate indigenous technology for food processing and preservation should receive strong support and assistance from international organizations such as UNDP, UNIDO and FAO.

a. UNIDO should issue a compendium of new technologies developed in, used by or developed for developing countries in the field of food processing as a means of exploiting their local materials; the compedium would describe the technology and indicate the scale or range in which it can be used, the raw materials and equipment, any materials the technology can replace, and the technology source.

b. UNIDO should continue to organize international fora, consultations, solidarity ministerial meetings, round table ministerial and high-level meetings for co-operation, and to implement advisory services, study tours, training and other joint industrial programs.

c. UNIDO, FAO, should assist developing countries in upgrading and modernising their processing industries in quality control, with a view to penetrating international markets.

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ANNEX A

1. EGYPT: FOOD CONSUMPTION PATTERN

Basic Nutritive Category	Sub Category	Examples	Food Processing
ENERGY PRODUCING FOODS:	Starchy Foods		
	Cereals	Wheat, rice, millet and maize.	Bread baking (wheat), rice milling and macaroni production.
	Tubers	Potato.	
	Sugar	Sugar cane.	Sugar and molasses production. Candy and sweet production.
	Oils & Fats	Oil-seeds, animal fat and butter fat.	Soybean oil, cotton seed oil and butter production.
PROTEIN:	Animal protein	Meat, fish and milk.	Meat, fish and dairy processing.
	Vegetable protein	Peas, soybean, horse bean or foul medames.	Vegetable canning.
VITAMINS & MINERALS:	Fruits and leafy vegetables.	Apples, oranges, apricots and bananas.	Fruit and vegetable processing.

OTHERS (Beverages):		Beer, tea, coffee and soft drinks.	Beer brewing.

2. CAMEROON: FOOD CONSUMPTION PATTERN

Basic Nutritive Category	Sub Category	Examples	Food Processing
ENERGY PRODUCING FOODS:	Starchy Foods		
	Cereals	Rice, wheat, maize and sorghum.	Flour milling (wheat) and rice milling. Bread baking.
	Tubers	Yam, cocoyam and cassava.	Yam and cassava processing (flour and chip production).
	Sugar	Sugar cane.	Sugar cane processing.
	Oils & Fats		
	Oil-seeds	Groundnut oil, palm oil and cotton seed oil.	Edible oil production.
PROTEIN:	Animal protein	Meat, fish and dairy products.	Meat, fish and dairy processing.
	Vegetable protein	Beans	

VITAMINS & MINERALS:	Fruits and leafy vegetables.	Oranges, guava mango and banana.	Fruit and vegetable processing.
OTHERS (Beverages):		Cocoa and tea.	Cocoa and tea processing.

3. CONGO: FOOD CONSUMPTION PATTERN

Basic Nutritive Category	Sub Category	Examples	Food processing
ENERGY PRODUCING FOODS:	Starchy Foods		
	Cereals	Rice.	Rice milling.
	Tubers	Yam and Cassava.	
	Sugar	Sugar cane	Sugar and molasses production. Candy and sweet production.
	Oils & Fats		
	Oil-seeds	Groundnut oil and palm oil.	Groundnut oil and palm oil production.
PROTEIN:	Animal Protein	Fish, meat and game.	Fish processing (salting and smoking)
	Vegetable protein	Green beans.	
VITAMINS & MINERALS:	Fruits and leafy vegetables	Banana, plantain and green leaves.	Fruit and vegetable processing.
OTHERS (Beverages):		Beer	Beer brewing.