FOOD SYSTEMS

an account of the postproduction systems program
supported by the
International Development Research Centre

IDRC-146e

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IDRC-146e

Food systems : an account of the postproduction systems program supported by the International Development Research Centre. Ottawa, Ont., IDRC, 1979. 72 p. : ill.

/IDRC publication/, /IDRC/, /research projects/, /food crops/, /food processing/, /food storage/, /appropriate technology/, /developing countries/, /grain processing/, /drying/, /handling/, /rice/, /sorghum/, /cowpeas/, /potatoes/,

UDC: 631.56.001 ISBN: 0-88936-235-1

Microfiche edition available

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R.S. Forrest, W. Edwardson, S. Vogel, and G. Yaciuk

Mary Beaussart made a valuable contribution to the preparation of this book.

Contents

Foreword

Overcoming the huge postharvest losses sustained in many developing countries has been a prime concern of IDRC's Agriculture, Food and Nutrition Sciences Division from the outset. While it is undeniably important to increase yields of major food crops, an even greater increase in the amount of food available for human consumption could be realized by reducing postharvest losses. It has been estimated that wastage runs as high as 30% in some countries; thus a 50% increase in production would be required simply to replace the amount of food lost.

This has been the aim of the Postproduction Systems Program: to support research aimed at reducing postharvest food losses in developing countries to a minimum. This is no simple task. The scope and complexity of the postproduction system includes all the essential activities in the sequence from harvesting until the end product, in whatever form, is eaten by the consumer. Postproduction research therefore embraces agricultural engineering, food science and technology, nutrition and household sciences, and the social, economic, and physical environments by which they are conditioned and constrained.

In this area more than any other, the Division has sought to create in the international community an awareness of the importance of the total systems approach to postproduction technology.

Postharvest losses and inefficiencies can be aggravated by projects and programs that seek to modify one component of the postproduction system out of context to the whole and the environment in which it exists. A grain dryer or storage facility designed for wheat in Western Canada may prove disastrously ill-suited to rice harvested during the rainy season in Southeast Asia. Many misfortunes have resulted from an unduly optimistic expectation from the transfer of technology. Technologies that involve biological materials are usually difficult to transfer from one environment to another. On the other hand, fundamental scientific principles are universally applicable and transferable. It is therefore the philosophy of the AFNS Postproduction Systems Program that technologies, based upon sound scientific principles, must be developed where they are to be applied and in close cooperation with the rural people who are intended to use and benefit from them.

This booklet describes the postproduction research currently being supported by the AFNS Division of IDRC and includes short reports on each of the projects within the Postproduction Systems Program up to September 1979. These are by no means exhaustive accounts, and were written for both the technically experienced and the general interest reader. The addresses of the project leaders are included for the benefit of those readers who may wish to request more detailed information.

This is one of a series of booklets that describe the research program and projects supported by the AFNS Division. Others in the series include Trees for People (IDRC-094e), describing the forestry program; Fish Farming (IDRC-120e), an account of the aquaculture program; and Food or Famine (IDRC-143e), a report on the crops research program. A general account of the program entitled AFNS: the first five years (IDRC-089e) is also available.

We have received valuable critical observations on these earlier publications from a number of thoughtful readers. The comments of those who read this publication will indeed be most welcome.

Joseph H. Hulse
Director
Agriculture, Food and Nutrition Sciences Division
IDRC

Introduction

The massive research efforts of the past few decades aimed at increasing food production in the developing countries, particularly production of cereal grains, have been quite successful. Scientists have developed new varieties of crops that provide higher yields, need shorter growing seasons, and are to some extent more resistant to drought, pests, and diseases. Their acceptance by farmers in developing countries in many cases has been very good. Improved cropping practices, such as multiple cropping, intercropping, and new crop rotating techniques, have also added greatly to the crop yields.

However, in many instances, the beneficial impact of these developments is offset by the tremendous losses incurred during and after the harvest. The increases in production put additional pressures on already inadequate postproduction systems; and the higher-yielding varieties result not only in increased crop volume, but many of the new strains require different processing technologies, some of which may have to be developed specifically for the new strains.

So, while a great deal of research has been devoted to increasing the production of food, until fairly recently very little attention was paid to improvement of the postproduction systems to make them capable of handling the increased yields. Between 1952 and 1972 total food production in developing countries increased by barely three percent per annum yet postproduction losses in many tropical countries already exceed 30 percent. It has become obvious to many governments that high priority should be placed on research to reduce these unacceptably high postproduction food losses.

An important resource constraint that affects the postproduction system is energy, mainly energy for threshing, drying, transportation, and processing. Indications are that more than 50 percent of the total energy used by rural populations in developing countries is for cooking, with 30 percent being used for agricultural and village industries such as primary and secondary food processing.

Additionally, while nearly 90 percent of the energy used in industrialized countries comes from nonrenewable sources, this figure drops to 50 percent for the developing world as a whole, while the figure for the rural and urban fringe population would be so low as to be negligible. Due to the ever-increasing demand for fossil fuels and the scarcity of supply, it is unlikely these areas will receive a larger share in the future, so improvements must rely on making more efficient use of existing energy or on developing new sources applicable to their needs.

IDRC's Agriculture, Food and Nutrition Sciences Division established the postproduction systems (PPS) program to support and coordinate re-

Research efforts, until fairly recently, have paid little attention to improving the ability of postproduction systems to handle increased yields.

search activity in these vital but neglected areas. Consistent with the Division's philosophy that a desk in Ottawa is not necessarily the ideal place from which to develop an effective program of agricultural research, the Division has since the early days based its PPS program in Edmonton, where the project staff can work most effectively in close association with other scientists in their own disciplines. Originally housed within the University of Edmonton campus, the PPS group now has its own small base on Whyte Avenue, not far from the University.

The PPS Program

There are many different kinds of postproduction losses. They include weight loss through drying, nutritional loss, loss of quality or acceptability, loss of economic value, and deterioration or physical loss of the crop itself. The losses are caused by a variety of factors at different stages in the postproduction system. These stages include harvesting, threshing, drying, storage, primary processing, transportation, food processing, marketing, and utilization of the crop.

The research being supported within the PPS program covers all of the stages from the harvest to the utilization of locally consumed food commodities. Highest priority is given to research using locally produced, nutritious foods that are commonly used by the rural poor. For convenience, these food commodities have been divided into categories and are shown along with the accompanying stages of the postproduction system on the chart on page 16.

The purpose of this table is to illustrate the many processes a commodity may pass through between harvest and table, and the many commodities that may be involved. Each stage is integrally related to other stages within the overall postproduction system. Many of the research projects that are currently being supported within IDRC's PPS program relate to more than one of these stages and may also be concerned with several commodities. This total systems approach to postproduction food technology will be better illustrated in the next few pages as the general research activities within each PPS program area are outlined.

On-Farm Technology

The on-farm technology stage includes the harvesting, threshing, and transporting of the crop by the farmer. It also includes cultivation, tillage, and other on-farm activities performed in preparation for next year's crop.

In many developing countries, agricultural production could be significantly increased and improved by the introduction of appropriate mechanization. Unfortunately, much of the machinery manufactured and sold by the industrialized countries is unsuitable for the small farmer both in practical application and because it is simply far too expensive. To help solve this problem IDRC is supporting several research projects with the objective of developing economically feasible, appropriate technology for the small farmer.

A hoped-for spin-off from this research is the development and growth of rural industries to manufacture locally the resulting implements

On-farm technology in action: rice is threshed and bagged by the roadside in the Philippines.

and/or machinery. This would not only provide needed off-farm employment, but would also reduce foreign currency expenditures. Close cooperation with local artisans, manufacturers, and entrepreneurs is therefore an important part of the researchers' work.

Projects in this category include the development of plows in Egypt and India; groundnut and potato diggers in India; seed drills, cultivators, sprayers, and pumps in Egypt and the Philippines; field threshers in Egypt, Ghana, Korea, Mali, India, Indonesia, Philippines, and Senegal; and groundnut strippers in India.

Drying

The drying operation reduces the level of moisture in the harvested crop, which markedly impedes all the decaying processes in the crop. Decay can only take place when enough moisture is present — the tissue of most plants and animals (except for fully ripened seeds) contains from 79 percent to 95 percent moisture. To limit decay, the moisture content must be reduced as soon as possible after harvest.

In many countries the most common method of drying crops is simply to spread them on the ground and expose them to the sun and the wind. This, unfortunately, is often a hit-or-miss process and has the disadvantage of exposing the product to attack by birds, rodents, flies, moulds, and so on.

Simple wooden racks take full advantage of wind and sun to dry newly harvested millet in Senegal project.

This problem has been made even more acute with the advent of the new, higher-yielding varieties of rice and other crops. In the case of rice, many of the higher-yielding varieties also mature more quickly, enabling farmers to grow two and sometimes even three crops on the same field in one year. The resultant increase in production is often negated by high postharvest losses, because the later crops are harvested during the wet season, when drying the paddy by traditional sun-drying methods is not possible.

Over the past few years, IDRC has been actively supporting research into on-farm and farmer-cooperative crop-drying facilities. This type of drying facility is seen as a priority, because lack of transportation facilities to bring the produce to more centrally located, large-scale drying facilities is frequently a major constraint in the postproduction system. The small on-farm or rural cooperative-operated drying facilities must be of simple design, should employ suitable technology, and should be capable of being locally manufactured and maintained from materials that are both locally available and within economic reach of the small farmer or cooperative. Most importantly they should use fuels that are locally available. This approach is also being applied to the drying of other commodities, such as vegetables, fruits, legumes, and fish.

Projects in this category include the development of fish dryers in India and the Philippines; a process for rapidly reducing moisture content for short-term storage of wet paddy in Malaysia; large-scale solar grain dryers in Egypt; farm-level solar grain dryers in Thailand, Sierra Leone, and

Niger; and mechanical crop dryers in Guatemala, India, Indonesia, Korea, the Philippines, and Thailand that use a variety of renewable fuel sources.

Storage

The length of time the food crop is stored may vary from a few days up to many months. Storage may be required only until the crop is sold to the operator of the next stage in the food system, or the crop may be expected to provide the basic food supply for the farmer and his family for perhaps nine months. So stable storage systems are necessary to retain the whole stored crop with quality characteristics that are acceptable to the farmer, his buyer, and his family.

The tropical environment combined with the physical limitations of the types of traditional structures usually used for crop storage account in large part for the high losses of crops during storage. PPS projects in the area of food storage are focusing on assessment of the limitations of traditional structures and methods and their potential for improvement at a minimum cost, and with a minimum requirement for chemical control methods. These projects also take into account factors such as the climate, farming patterns, eating habits, and marketing conditions in each region.

Projects in this category include research into the use of sunlight, oil, ash, sand, salt, leaves, and other materials in the treatment of crops for storage in Ghana, India, Malaysia, Senegal, Thailand, and Upper Volta. Changes in the characteristics of legumes under various storage conditions are also being studied in projects underway in Egypt, Ghana, Guatemala, India, Indonesia, and Thailand. While the primary emphasis has been on storage on the farm, cooperative and large-scale storage is also being studied in India, Indonesia, Korea, and the Philippines.

Primary Processing

When the crop leaves the farm or its storage system, primary processing is necessary to render the raw commodity suitable for utilization either by the consumer or by a food processor. This may be a preservation process such as the icing of fish, a process to convert the commodity into a more useful form for consumption, or further processing such as the milling of grain or mincing of fish.

For many years, people in sorghum and millet consuming countries of Africa have been grinding their dehulled grain into flour, using available wheat, rice, and maize mills, which accompanied the flow of people from Europe and Asia. Today, these attrition and abrasion mills are a common sight in most villages. This mechanical milling, although its efficiency in many cases leaves much to desired, has nevertheless resulted in a significant reduction in the number of hours spent grinding grain into flour, using hand, or cattle-powered stone mills.

During this time, however, little has been done to mechanize the dehulling (dehusking, debranning) of these grains. Thus today, throughout

the sorghum, millet, and cowpea consuming world, this process usually remains a tedious, manual one, leading to increased consumer demand for commercially milled products. This demand is being partially met by imported wheat or maize that is milled into flour on arrival. This adversely affects the economy by discouraging local grain production and creating enormous trade deficits.

The local development of efficient, economical, village-level milling systems (typically such a system would include cleaner-dehuller-mill-sifter-packaging) will create a stable, growing market for the producers. This will provide them with the incentive to increase production, thereby raising farm incomes. Villagers will be able to purchase an acceptable, milled product, thereby freeing some of their time to engage in activities to augment the family income and improve its well-being. The regional economy will benefit and be strengthened by the shift away from imported grain products toward self-sufficiency, and the national economy will benefit from a reduction in imports.

In Nigeria, the highly successful Maiduguri Mill project proved the feasibility of a commercial continuous-flow milling system, and as a result other pilot mills are being established and tested in Botswana, Ghana, the Philippines, Senegal, and Sudan.

All of these milling systems are based on a continuous throughput operation. When located in cities or towns, where an adequate supply of grain is assured, bulk purchasing, processing, and sale in bags is the most appropriate method. However, in very small villages, the traditional way is

Modified versions of traditional grain storage bins are part of a study being carried out in Senegal.

for a person to take a small quantity of dehulled grain to the village mill to have it ground. This batch-type milling is an entirely different concept and calls for specific machinery.

A batch dehuller, developed for legumes, sorghum, and possibly millet, is currently being tested in conjunction with existing batch grinders in Botswana, Senegal, Sudan, and Thailand. The continuous throughput dehulling system has been or is being tested in Botswana, Ghana, Nigeria, the Philippines, Senegal, and Canada. Other primary processing facilities are being tested in a village food processing centre in Thailand. A process for preparation of minced fish is being developed in a comprehensive project in India.

Storage and Transportation

An integral part of the postproduction system is the handling and moving of commodities. After primary processing, commodities may require further storage and/or transportation before the next stage in the system — be it further processing, marketing, or utilization. Again, the environmental and physical conditions, and the length of storage time, will determine the final quality of the produce. Any improvements made earlier in the journey from the farm can be undone if this part of the system is not considered.

Primary processing at the Maiduguri Mill project in Nigeria.

Since IDRC's priorities lie primarily with people living in the rural areas, this component is essentially an extension of the storage component and is concerned mainly with the safe shelf life of produce before consumption in the home. Therefore, the storage and transportation requirements of small food processors are also of concern. They must collect, buy, transport, and store their raw materials, and then process them under difficult conditions in rural areas.

Because most emphasis has been placed on projects directed toward the earlier stages of the postproduction system, no projects have been supported dealing specifically with this step. A few projects have included a study of storage and transportation in their overall programs, however, including those in Botswana, Chile, Ghana, India, Senegal, and Sudan.

Food Processing

Not all food commodities can be consumed directly in the raw or semi-processed state. Perishable commodities are often harvested in amounts greater than can be consumed immediately in the community, and so processing is required to preserve the commodity for use later when food is less abundant. Processing is also required to extract edible components from raw crops and to convert raw materials into more conveniently used forms. Therefore, in the design of any food process, these functions along with the needs of consumers, processors, and existing marketing systems must be considered.

While bulk food processing has for many years been applied to temperate zone commodities, the processing of many crops consumed in the rural tropics has been left mainly to the individual, to be carried out in the home, or else the raw crop is exported for processing abroad. The lack of acceptable and convenient processed forms of traditionally consumed foods has limited the distribution and consumption of many of these commodities. At the same time, consumers are required to spend a great deal of time daily merely to process the foods to be consumed each day.

To date, the PPS projects in this area have focused on the quality characteristics of traditional food crops, on product development using these crops, and on process improvement for widely consumed foods and products based on these crops.

The physical, chemical, nutritional, and functional properties of various crops are being determined in several regions with the objective of establishing consumer-based standards for traditionally accepted cultivars, processes, and products. Such standards can then be used in selecting cultivars in crop improvement programs. Such studies on sorghum and millet characteristics are being carried out in Senegal, Sudan, and Upper Volta, and a related project in Canada deals with sorghum and millet obtained from major producing countries. In Kenya, a similar study of the characteristics of various fruits and vegetables is being carried out.

Another series of product development projects evaluates the quality characteristics of local legumes for inclusion in traditional foods, taking

Processed foods, such as bread, pass through the marketing stage to reach the end of the postproduction system — utilization as food.

account of processing and marketing requirements in the area. These include studies on cowpeas in Nigeria, the Philippines, and Thailand; mung beans in the Philippines; faba beans in Egypt; velvet beans in Indonesia; and kidney beans and other legumes in Guatemala.

Some studies are also being done to improve processing methods in rural areas to ensure efficient processing of local commodities. One process being developed in the Philippines uses agricultural waste as fuel to provide heat for village-scale fish-drying operations. Improvements are being sought to the traditional methods of drying potatoes in the Andean region of Peru using solar energy, and a drying process for coffee berries is being developed in Guatemala. This latter project uses methane gas produced by

fermenting the soft outer pulp of the berry, which would otherwise be wasted. In Mali an improved process for extracting the oil from shea nuts is being developed.

In Chile conventional soybean processing techniques are being adapted to treat the local legume, lupine, with the aim of substituting high-protein lupine products in local foods and thereby reducing the requirement for imported soybeans. In rural Thailand process and product development studies are being carried out to provide village-level facilities for the production of infant foods based on locally available commodities. Various new methods for fish processing are being developed in a project in India, and in Singapore a new approach is being tried to introduce improvements to traditional small family-operated food processing industries.

Marketing

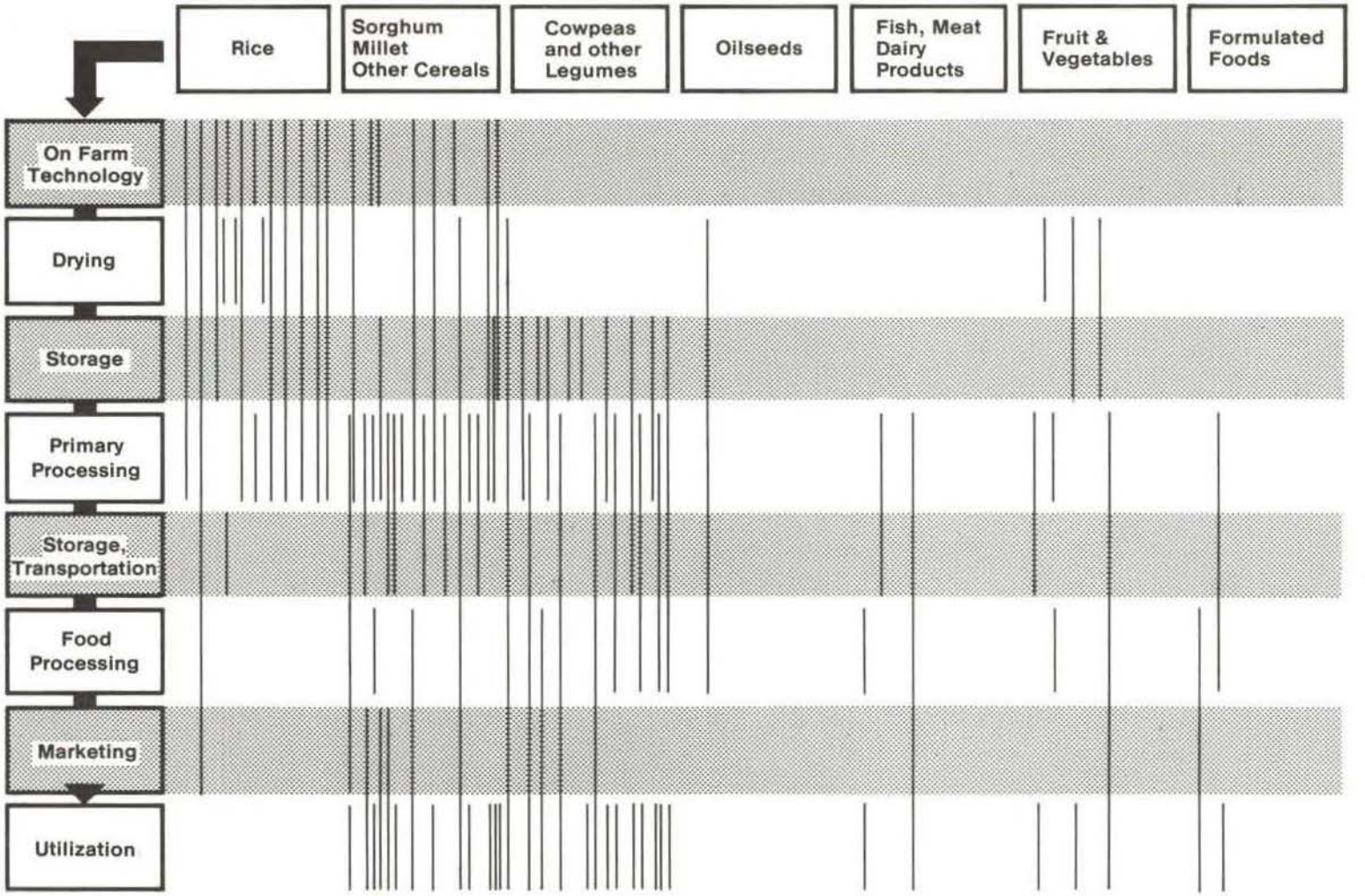
Marketing in the broadest sense encompasses all those activities necessary to effectively price, promote, and distribute food products to the consumers. Each product must meet the nutritional and economic requirements of the consumer, and must also be acceptable in terms of quality and utility. These factors will naturally vary from one group or region to another. The key aspect to marketing, then, is to be aware of the particular needs of each group of buyers, and the various alternatives available in the region for pricing, promotion, and distribution.

Little work is being carried out in this field by the PPS program at present, primarily because there is little scope for varying existing marketing conditions at the village level. However, existing marketing conditions are being assessed in a number of projects in Chile, Indonesia, Nigeria, Peru, Senegal, Singapore, Sudan, and Thailand, where new products or new forms of traditional commodities and centralized supply conditions are being developed. One of the purposes of these studies is to determine whether other approaches are necessary for more effective marketing. This stage will be further developed in future PPS projects.

Utilization

The final stage of the postproduction system takes place when the food is prepared and consumed. To a large extent what is eaten depends on the availability of raw materials, and the food processing equipment used in the home. Time constraints and the homemaker's processing knowledge and skills will also influence food consumption. Thus an awareness of these factors, along with a knowledge of the food habits and the nutritional contribution of local foods, is important for studies aimed at improvement of any stage of the food supply system.

In this area PPS projects have concentrated on two aspects: surveys of utilization practices, and surveys of product acceptability. The resulting information is used in designing and evaluating the other stages in the post-



This chart illustrates the PPS group program. Each commodity (along the top of the diagram) passes through the various postproduction system stages (on the left) on its way from harvest to consumption. The vertical lines indicate the scope of activity in individual PPS research projects. Some projects cover several stages of the system, while others consider only one stage.

production system of a specific food. Products tested for acceptability include new cultivars, new products, and familiar products processed by new methods.

In Thailand the consumer acceptance of whole dried cowpeas is being evaluated. Because cowpeas are normally eaten as a fresh green vegetable in Thailand, a new form of a familiar crop is being evaluated. New varieties of millet, sorghum, or other legumes are being tested for consumer acceptance in Ghana, Guatemala, India, Nigeria, Senegal, Sudan, and Upper Volta. In Botswana, Egypt, Ghana, India, Indonesia, Korea, Nigeria, the Philippines, Senegal, Sudan, Thailand, and Upper Volta mechanical processes for dehulling and grinding sorghum, millet, maize, rice, or specific legumes are being evaluated by measuring the consumer acceptance of the resulting milled product. Fish products are being evaluated in India and the consumer acceptance of formulated foods using more than one locally produced ingredient is being determined in Chile, India, Thailand, and Singapore.

Future Directions

As this brief outline has already made clear, the postproduction systems program encompasses a wide range of commodities and activities, many of which overlap. It will also be readily noted that more emphasis has been given to certain commodities and steps than to others.

The heavy emphasis on cereal and legume crops is expected to continue because these foods are major sources of protein and calorie requirements. Other important sources of these nutrients include fish and oilseeds; thus, where possible, additional work will be supported in these areas. Additionally, the importance of vegetables and leaves as micronutrient sources cannot be overlooked and further investigation along this line will be pursued on a limited scale.

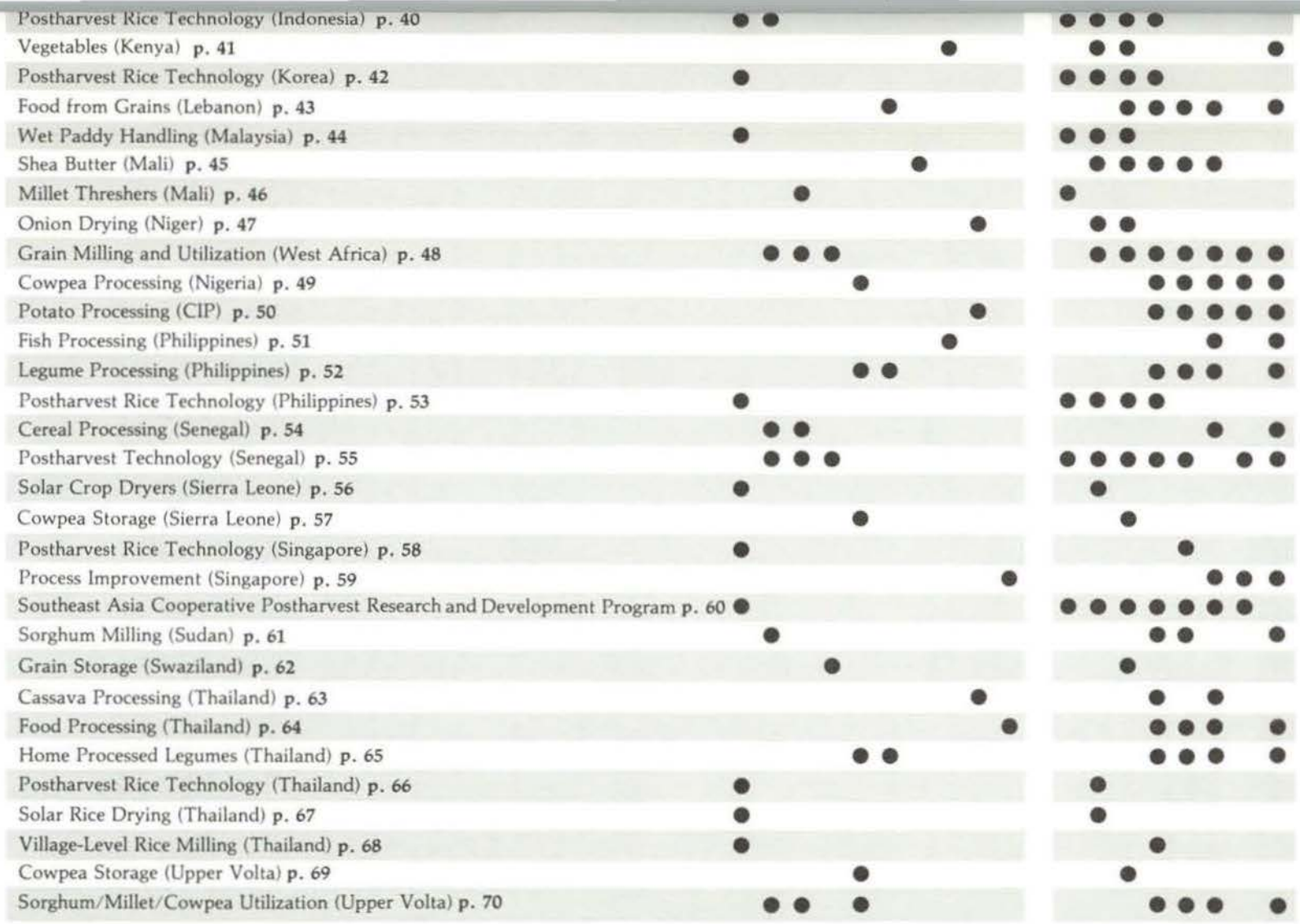
As the early stages of food supply come under control, the need to improve and broaden the utilization, marketing, and processing of these commodities can be expected to increase. Therefore, more research will be required into the needs of the small food processor, who is likely to become a limiting factor in the consistent supply of foods to rural consumers.

Since energy is a major resource constraint in PPS, additional emphasis will be placed on ascertaining the energy needs of the rural sector by looking at the forms of energy that can be most effectively utilized and determining the potential effect of making additional energy available.

On the following pages, each of the PPS projects current at the time of publication is listed, along with a description of its objectives, the general background to the research problem, and the progress of the project to date. Projects already completed are also listed to provide a background to the program's ongoing activities.

For convenience the projects are listed alphabetically by country. Further information on a particular project can usually be obtained directly from the project leader whose address is shown. A list of IDRC publications and films dealing with PPS research activities is included as an annexe to this booklet.

Projects (listed alphabetically by country or region)	Rice	Sorghum	Millet	Maize	Cowpeas	Other legumes	Oilseeds	Fish, meat, dairy produce	Fruits and vegetables	Formulated foods	On-farm technology	Drying	Storage	Primary processing	Storage/transportation	Food processing	Marketing	Utilization
Sorghum Milling (Botswana) p. 20		●												●	●		●	●
Grain Milling (Botswana) p. 21		●												●	●		●	●
Food Legume Utilization (Canada) p. 22		●	●		●											●	●	●
Food Legume Processing (PRL) (Canada) p. 23		●	●		●									●	●			
Composite Flours (Canada) p. 24		●														●		●
Sorghum/Millet Milling and Quality (Canada) p. 25		●	●											●	●			●
Lupine (Chile) p. 26						●								●	●	●	●	●
Faba Beans (Egypt) p. 27													●					●
Small Farm Equipment (Egypt) p. 28	●	●									●							
Solar Dehydration (Egypt) p. 29								●	●					●	●			●
Sorghum Improvement (Ethiopia) p. 30		●												●	●			
Grain Storage (Ghana) p. 31				●									●					
Cowpea Processing (Ghana) p. 32					●								●	●	●	●		●
Small Farm Equipment (Ghana) p. 33	●										●							
Crop Drying (Guatemala) p. 34									●			●						
Grain Legume Quality (INCAP) (Guatemala) p. 35						●							●	●	●			●
Household Grain Processing (India) p. 36		●	●			●							●	●				●
Postharvest Technology (India) p. 37	●	●	●	●							●	●	●	●				
Fish Processing (India) p. 38								●						●	●	●	●	●
Legume Processing (Indonesia) p. 39						●							●	●				●


Postharvest Rice Technology (Indonesia) p. 40
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Postharvest Rice Technology (Korea) p. 42
Food from Grains (Lebanon) p. 43
Wet Paddy Handling (Malaysia) p. 44
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Grain Milling and Utilization (West Africa) p. 48
Cowpea Processing (Nigeria) p. 49
Potato Processing (CIP) p. 50
Fish Processing (Philippines) p. 51
Legume Processing (Philippines) p. 52
Postharvest Rice Technology (Philippines) p. 53
Cereal Processing (Senegal) p. 54
Postharvest Technology (Senegal) p. 55
Solar Crop Dryers (Sierra Leone) p. 56
Cowpea Storage (Sierra Leone) p. 57
Postharvest Rice Technology (Singapore) p. 58
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Cassava Processing (Thailand) p. 63
Food Processing (Thailand) p. 64
Home Processed Legumes (Thailand) p. 65
Postharvest Rice Technology (Thailand) p. 66
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Cowpea Storage (Upper Volta) p. 69
Sorghum/Millet/Cowpea Utilization (Upper Volta) p. 70

Sorghum Milling (Botswana)

IDRC grant: $125 000
2 years from June 1976;
extended to March 1979

recipient contribution: $37 200
file: 75-0137

contact: General Manager
Botswana Agricultural Marketing Board
Gaborone, Botswana

Objectives

To develop a suitable village-level milling system for processing sorghum into meal, as acceptable in quality and price as imported maize meal.

Background and Progress

As in many other developing countries, the government of Botswana has placed a major emphasis on the development of arable land agriculture to achieve and maintain self-sufficiency in grain production. Because of agronomic and climatic factors, this is likely to be achieved mainly by increased production of sorghum.

The domestic annual consumption of grain in Botswana, primarily maize and sorghum, is currently estimated at 80 000 tonnes. Although climatic conditions are better suited to the production of sorghum than maize, during the last two decades there has been an increasing consumer shift away from sorghum in favour of maize, most of which is imported. A major reason for this phenomenon has been the increased availability of industrially produced, prepackaged maize meal, which obviates the need for home milling.

In this project a small acceptability study on sorghum flour was carried out in the area surrounding the Pitsane mill site. Three hundred and forty householders from six different districts were contacted at home, in the marketplace, at clinics, and at bus or rail stations and asked a dozen questions regarding the use, texture, preparation, and willingness to purchase sorghum meal if available, and at what cost. The mill was adjusted to produce sorghum flour of the preferred particle size. The resulting product was immediately very popular. As a result of this study the acceptability of a dry-milled sorghum flour and the technical and economic feasibility of dehulling, milling, and marketing sorghum flour in Botswana were confirmed.

Grain Milling (Botswana)

IDRC grant: $80 000
2 years from June 1978

recipient contribution: $38 500
file: 78-0023

contact: Mr Richard Carothers
Rural Industries Innovations Centre
P.O. Box 18
Kanye, Botswana

Objectives

To determine the technical, operational, and economic feasibility of "scaled-down" models of the milling system developed in Sorghum Milling (Botswana), project 75-0137. Specifically, to develop and manufacture small decorticators based on the dehuller design used successfully in Botswana and Nigeria; to test the performance and economic feasibility of small sorghum milling systems incorporating the modified dehuller in three Botswana villages; and to determine the acceptance of these mills by the village communities and their influence upon sorghum demand and utilization.

Background and Progress

In late 1977 commercial operations of a pilot continuous-throughput sorghum milling system in Pitsane, Botswana began and a feasibility study of the pilot mill was conducted. The milled sorghum product was an immediate success, although the sorghum meal was 20 percent higher in price. In addition to those who buy from the Pitsane mill, a large segment of the population would prefer using a milling service for their own grains (the remaining 85 percent of the grain production) rather than buying mill-processed flour made with grains purchased through the market or agents. Thus, while the mill at Pitsane is technically and financially sound, and assured of a continuing demand, there is also a need for a smaller batch-type sorghum milling system for use in villages where sorghum is grown.

A batch process sorghum dehuller has been developed and constructed at the Rural Industries Innovations Centre in Kanye using available resources. The design of this dehuller is based on an improved design from the Prairie Regional Laboratory (PRL) of the National Research Council of Canada. Following construction, the dehullers were tested for milling efficiency before being installed in three villages of varying size, location, and economic activity. The mills are operating completely under local management with technical assistance from the project adviser during the initial months of operation.

Food Legume Utilization (Canada)

IDRC grant: $42 400
2 years from September 1973 file: 73-0032

contact: Dr Arthur K. Sumner
College of Home Economics
University of Saskatchewan
Saskatoon, Saskatchewan
Canada S7N 0W0

Objectives

To carry out a systematic study of the composition and the physical and technological properties of various legume, millet, and sorghum flours and fractions alone and in mixtures; to develop processes for making noodles and other simple staple combinations of the best flour mixtures, including a study of simple drying systems and the effect of size on drying rate; and, to study the characteristics of the cooked products.

Background and Progress

This project was directly linked with and complementary to the processing project at the PRL in Saskatoon. Both projects were in support of the Maiduguri Milling Project in Nigeria.

Various samples of mechanically and traditionally milled millets, sorghums, and cowpeas were analyzed to compare their chemical and physical properties.

The development of high-protein foods such as snacks and noodles and the determination of their acceptability was another objective. Composite flour noodles were found to be acceptable to the group of Nigerian women tested. The wheat-sorghum composite flour noodles were preferred by most people over the wheat-millet noodles. Both the cowpea-sorghum and cowpea-millet snacks made and sold by commercial food sellers proved to be well accepted and sold with no difficulty in spite of being "new foods." Consumers showed an overall preference for the cowpea-sorghum snacks over the cowpea-millet ones primarily because of the latter's dull colour and higher oil absorption.

Studies on the use of composite flours showed that good quality Nigerian-type bread can be made, using typical Nigerian recipes and methods, from composite flour consisting of 80% wheat/20% sorghum. Good quality composite-flour bread was also produced from 75:25 wheat/sorghum, 80:20 wheat/maize, and 80:20 wheat/millet flours, using the same method.

Food Legume Processing (PRL) (Canada)

IDRC grant: Phase I $26 200
2 years from October 1973
Phase II $44 000
2 years from September 1975

file: Phase I 73-0051
Phase II 74-0168

contact: Dr C. Youngs
Prairie Regional Laboratory, NRC
University of Saskatchewan
Saskatoon, Canada S7N 0W9

Objectives

The objective of Phase I was to support the milling research being conducted in Nigeria on cereals and legumes, particularly millet and cowpeas.

Phase II was designed to continue this research and to evaluate simple grain processing equipment suitable for use in developing countries to produce: high-protein fractions from cowpeas and other tropical food legumes; and light-coloured, stable cereal flours from sorghum and millet. The effect of mechanical decortication on the nutritional qualities of the Nigerian grains and legumes was also to be studied.

Background and Results

The initial study by PRL was to find suitable decorticating equipment because the equipment then being used in Nigeria was not adequately dehulling the grains. A simple abrasive thresher was identified, tested, and modified to dehull sorghum, millet, and cowpeas. Several types of mills were then tested and one type was chosen to grind the dehulled grains into flour. However, millet flour produced by this mechanical dry-milling process had a gray-green colour, which was unacceptable to the Nigerian consumer used to the white millet flour produced by the traditional method. It was determined that the pigments causing this discolouration were pH-sensitive, so a simple acid treatment was developed to enable the production of mechanically processed white millet flour.

During the second phase, the equipment identified in Phase I was further tested and modified. Cowpeas, sorghum, and millet were successfully dehulled and ground into various fractions that were chemically and biologically analyzed and compared to those from the traditional process. Further research was conducted on the millet flour discolouration problem and nutritional analyses were carried out on the grains produced by the various methods.

Composite Flours (Canada)

IDRC grant: Phase I $20 000
Phase II $9 300
completed May 1974

file: Phase I 71-0020
Phase II 74-0040

contact: Dr Walter Bushuk
Faculty of Agriculture
University of Manitoba
Winnipeg, Manitoba
Canada R3B 2E9

Objectives

To develop various dough-making machines that are hand-operated and simple to construct; and, in a second phase, to determine how the mixing of flours from tropical plants such as cassava and sorghum with wheat flour affects the quality of bread made in these machines.

Background and Progress

This project was initiated to explore the means by which the utility of various cereal flours and root starches could be increased and improved. The primary objective was to develop a technology to permit significant replacements of wheat flour by sorghum, millet, maize, and triticale flours or by cassava starch.

A mechanical development process, in which dough "ripening" is replaced by repeated sheeting of the dough between hand-propelled sheeting rollers, was developed and shown to be an effective and practical method of producing acceptable bread from composite flours. The non-wheat flours used in the composite flours include: cassava (flour and refined starch), maize, faba beans, millet, sorghum, and triticale. Satisfactory bread, but of diminished loaf volume, was obtained from composite flours containing up to 30% non-wheat flour.

Sorghum/Millet Milling and Quality (Canada)

IDRC grant: $72 000
2 years from July 1978 file: 78-0008

contact: Dr C. Youngs
Prairie Regional Laboratory
National Research Council of Canada
University of Saskatchewan
Saskatoon, Canada S7N 0W9

Objectives

To design and construct an efficient abrasive dehulling system that could be readily manufactured in developing countries and used for milling sorghum, millet, and food legumes; to develop standard tests that can predict the suitability of cereal and legume grain types for milling, and other essential processes and uses; and to determine important characteristics in sorghum, millet, and legumes that influence acceptability and quality as demanded by consumers, and to present chemical, physical, and other standardized tests that accurately reflect desirable properties.

Background and Progress

During previous projects supported by the Centre at the PRL a grain threshing unit was adapted for the dehulling of sorghum, millet, and cowpeas. This unit proved successful as a village-scale dehuller or pearler for sorghum in particular, and in Nigeria, Botswana, and several other African countries there has been an interest in establishing a number of similar village mills. Since the original unit was not designed for dehulling or pearling, and the modifications made were those that could be readily made to the equipment, it was desirable to modify the design of the unit for the specific job of dehulling before large numbers were manufactured and distributed.

A streamlined design for a batch dehuller has been developed and tested in the laboratory. Work is in progress to develop a standard milling test to predict the milling characteristics of sorghum and millet processed in the dehuller. A number of samples of acceptable and not acceptable sorghum and millet have been forwarded from several sorghum and millet producing countries in Africa and from India. These samples are now being evaluated to determine their physical, chemical, functional, and milling characteristics. The results of these tests will be used to determine the cause/effect relationships and methods for predicting cooking quality.

Lupine (Chile)

IDRC grant: $96 000 recipient contribution: $264 025
18 months from July 1978 file: 78-0007

contact: Dr Franco Rossi V
Head, Food Technology Area
INTEC/CHILE
Casilla 667
Santiago de Chile
Avda. Sta. Maria 06500 (Lo Curro)

Objectives

To develop methods of substituting lupine for soybean ingredients in presently used products without reducing their acceptability and nutritive qualities. Specifically, to test and adapt existing small-scale soybean processing methods for lupine; and to determine the effects of traditional storage methods on the nutritive and functional properties of lupine.

Background and Progress

In recent years, in Chile as well as in other Andean countries, soybeans in various products have become an integral part of the diet of many consumers, and the demand for soybean and soybean products is increasing. Soybean, however, is not an established farm crop and has little production potential in the area, thus soybean is largely imported.

Lupines are a legume similar to soybean and have a protein content of approximately 40% on a dry-weight basis. For centuries they have been cultivated and consumed by Andean peoples using marginal land not used for other crops. The nitrogen fixing properties of lupines along with their high yields (300 t/ha) make them valuable for intercropping with wheat and other cereals.

In this project, the group will apply existing processing technologies for soybean to lupines. Technologies will be developed for the production of full fat and defatted lupine flour; textured lupine products; lupine protein concentrate; and for the utilization of such products in blended foods. After the product and process development studies have been completed pilot-plant studies will be carried out to determine the economic feasibility of the processes. Additionally, the overall acceptability and functional and nutritional properties of the products will be evaluated.

Faba Beans (Egypt)

IDRC grant: $105 100 — recipient contribution: $90 000
3 years from March 1978 — file: 78-0056

contact: Dr Ahmed M. El-Tabey Shehata
Chairman, Department of Agricultural Industry
College of Agriculture
University of Alexandria
Shatby, Alexandria
Egypt

Objectives

To identify the agronomic and storage factors that affect the cooking and nutritional quality of faba beans; to determine the biological and chemical basis for the noted differences in quality; and to develop simple, rapid methods for evaluating and predicting the cooking quality of faba bean varieties to guide plant breeders, agronomists, and others in their efforts to develop improved lines and more desirable storage practices.

Background and Progress

Vicia faba beans, also known as broad beans or horse beans, are an important high-protein legume throughout much of the Middle East. In many countries they are used as a cooked bean puree, as cooked dehulled beans, and as germinated beans. "Falafel," a fried dough product is also prepared using these beans. While these products have been consumed for many years in Egypt, the processing and postproduction technologies of these foods have not been a subject of study. Little research has been done either to determine or to improve the factors influencing the quality of traditional faba bean foods. Therefore, the quality of beans produced and stored under varying conditions continues to fluctuate greatly.

In this project, samples of specific varieties of faba beans are being collected from farms having varying agroclimatic conditions. Storage trials will be set up at various farm locations using underground stores and ceramic barrels. Samples collected after harvest and during the storage trials will be analyzed in the laboratory to determine their biological and chemical characteristics. The quality of cooked products will also be determined. The analytical and cooking results will be correlated with agronomic and storage criteria to determine patterns of interaction.

Small Farm Equipment (Egypt)

IDRC grant: $96 000
2 years from February 1978

recipient contribution: $195 600
file: 75-0028

contact: Eng. Nabil El-Shami
Works General Manager
Société Anonyme Du Beheira
21, Talaat Harb Street
Alexandria, Egypt

Objectives

To develop and evaluate equipment based on a 10 hp agricultural (diesel) mechanization system including a multicrop thresher; a traction unit; drills for wheat, barley, and berseem; maize and cotton planters; an axial-flow irrigation pump; a sprayer unit that can be mounted on a wagon pulled by the traction unit; and a seed cleaner/winnower.

Background and Progress

Egypt is predominantly an agricultural economy, depending on this sector for 88 percent of its foreign exchange earnings. Cultivation is intensive and cropping intensity is equally high, producing an average of nearly two crops per year in the irrigated valley and delta. Agricultural power is largely supplied by man and animal. There are approximately 17 000 operating tractors in the agricultural sector and these are used for primary tillage. Most of the other operations are done by hand or animal power. There is a shortage of unskilled farm labour, particularly during certain seasons, and consequently there is increasing demand for more mechanization of agriculture, particularly for the small landholder (average holding 1.0–1.5 ha). Large-scale mechanization programs by cooperatives have failed to meet this need for various reasons.

The Beheira Engineering Corporation, a public-sector corporation under the Egyptian Ministry of Agriculture, has over 1200 employees working in machinery development, fabrication, and repair, as well as in land reclamation.

In this project, the Corporation is evaluating, adapting, and testing the "10 hp Agricultural Mechanization" concept, used with great success in the Philippines. The concept is that a single lightweight 10 hp diesel engine powers a variety of farm machines ranging from threshers, drills, planters, sprayers, and pumps, to a half-ton utility vehicle. The farmer would purchase the engine and one implement and gradually build up a more or less complete line of powered implements centred around the single light-weight diesel engine.

Solar Dehydration (Egypt)

IDRC grant: $123 900
2 years from July 1977

recipient contribution: in kind
file: 76-0111

contact: Dr I.A. Sakr
Solar Energy Laboratory
National Research Centre
Dokki, Cairo
Egypt

Objectives

To develop methods for utilizing the available solar energy at different latitudes in Egypt for the drying of agricultural products such as fruit, vegetables, and fish. It is essential that an economical method be found to dry these commodities to facilitate transportation to consumers in nonproducing areas, to increase the storage life of such products, and to eliminate periodic shortages and subsequent high prices.

Background and Progress

The cultivated area of Egypt is only about four percent of the total land area; whereas, the population is scattered throughout, requiring extensive transport of food products. The arid climate makes long storage periods necessary and the storage of dried products more practical than most other storage methods. Energy sources are very scarce; however, the country does enjoy intensive sunshine varying between 700 and 900 Kcal/m²/h with an annual average of 3600 sunshine hours.

Solar air heaters have been constructed at the test site in Cairo and are being coupled with a dryer unit. Initial tests on drying will be carried out at the National Research Centre prior to moving the unit to Fayoum, located in the grape and apricot producing area, 100 km southwest of Cairo.

Sorghum Improvement (Ethiopia)

IDRC grant: $505 700 recipient contribution: $15 300
3 years from October 1979 file: 79-0016

contact: Dr Brhane Gebrekidan
Ethiopian Sorghum Improvement Project
College of Agriculture, Addis Ababa University
P.O. Box 414
Nazareth, Ethiopia

Objectives

This is the third phase of a project supported within the IDRC Crops Program. As such, the objectives of the research are mainly to develop improved varieties of sorghum. In this phase, a processing objective was included and therefore the PPS program has become involved in the project. The objective of the processing component of the project is to test a sorghum milling system for operating efficiency and to test the consumer acceptance of the milled sorghum flour.

Background and Progress

It has become apparent in Ethiopia and throughout Africa that a major constraint to increased utilization of sorghum is the time-consuming activity of dehulling the grain by hand, using a mortar and pestle. With the prospect of increased yields the problem of processing sorghum is becoming more and more acute. To tackle this problem, the Institute of Agricultural Research in Ethiopia through their Department of Agricultural Engineering, will conduct a milling study within the sorghum improvement project being supported at the College of Agriculture, Addis Ababa University.

The project will test a grain dehuller based on design specifications developed at the Prairie Regional Laboratory of the National Research Council of Canada in conjunction with a number of research projects in Nigeria, Botswana, and Senegal. The dehuller contains a series of vertically oriented abrasive discs. The mill will be located in Nazareth and initial trials to optimize milling performance will use maize, sorghum, and a variety of legumes purchased in the local market. Subsequent tests using sorghum produced by the sorghum improvement project and farmers in the region will be milled in bulk samples of mixed varieties depending on supply. Operating efficiency will be measured, and acceptability of the resulting milled products will be determined by in-home consumer studies with the homemakers' usual flour as the control.

Grain Storage (Ghana)

IDRC grant: $19 700
2 years from August 1973
supplement $6 000

recipient contribution: $12 000
file: 73-0009

contact: Prof E. Bamfokwakye
Vice Chancellor
University of Science and Technology
Kumasi, Ghana

Objectives

To conduct a comparative feasibility study of four different storage structures for maize; and to evaluate the use of plastic sacks, with and without the application of carbon tetrachloride as a pest control chemical, for the storage of cowpeas.

Background and Progress

Maize and cowpeas are important crops in Ghana. While great strides are being made in increasing production these gains are often negated by the lack of adequate storage facilities.

In this project, four storage structures were compared and evaluated: butyl-rubber silos; imported galvanized steel bins on concrete base; plywood bins; and ferro-cement bins.

The research into the storage of maize formed part of a MSc program of a Ghanaian graduate student, and the results were submitted in a thesis "Maize Storage under Hot Humid Conditions" Department of Agricultural Engineering, University of Alberta, Edmonton in Spring 1979. It concluded that the plywood bins had the greatest potential for successful storage of maize under these conditions.

The sack-storage of cowpeas study provided the basis for a BSc Degree from the Univerity of Science and Technology for another Ghanaian student. The conclusion here was that the best method for the storage of cowpeas was in polythene-lined jute sacks with ethylene dibromide fumigation.

Cowpea Processing (Ghana)

IDRC grant: $180 000
3 years from March 1977

recipient contribution: $95 100
file: 76-0003

contact: Dr Florence E. Dovlo
Food Research Institute
P.O. Box M20
Ministry Post Office Branch
Accra, Ghana

Objectives

To develop standards for flour prepared from popular cowpea varieties for specific household and commercial food uses; to evaluate mechanically prepared cowpea flour in relation to the developed standards for cowpea flour; to develop, adapt, and evaluate the equipment used by households and food sellers in the preparation of specific foods using standardized cowpea flour; to develop and establish cowpea processing technologies suitable for operation by rural communities; and to evaluate in traditional foods and composite flours the products made by the small-scale industrial processing technologies.

Background and Progress

Cowpeas are the prime source of protein for many of the rural people of West Africa. They are generally eaten as beans, or in the form of "akara" balls. A type of doughnut, the akara ball is a very popular snack food.

The making of akara balls is a long, tedious process. The cowpeas must be dehulled before the cowpea flour or paste can be made. Any hull in the flour usually results in akara balls of poorer quality. The quality of akara balls is also dependent on certain factors such as foaming capacity, foaming stability, and fat absorption. Certain cowpea varieties appear to be better than others with respect to these qualities. Similar varieties behave differently after storage under certain conditions.

The Food Research Institute has now identified some of the functional properties that make a cowpea variety acceptable and has determined their presence or absence in local varieties. They are now in the process of testing a mechanical dehuller to produce a cowpea flour. Storage trials on the flour are also being carried out.

Small Farm Equipment (Ghana)

IDRC grant: $25 000 — recipient contribution: in kind (salaries)
2 years from November 1976 — file: 76-0091
(extended to April 1979)

contact: Dr B.A. Ntim
Director, Technology Consultancy Centre
University of Science and Technology
Kumasi, Ghana

Objectives

To assess the viability of the use of pedal-operated rice threshers in Ghana as part of a program to stimulate an agricultural support industry to manufacture and maintain basic machines and equipment.

Background and Progress

The Technology Consultancy Centre (TCC), a department of the University of Science and Technology, is charged with the responsibility of extending the expertise and facilities of the University to promote agricultural, industrial, and commercial developments in Ghana. Approximately 25% of TCC's efforts are directed toward conventional consultancy work for government agencies and private businesses. Its other activities are concerned with promoting small-scale rural industries, craft industries, and small agricultural developments. Thus, the TCC operates mainly as an agency for "grass roots" development.

The rice thresher developed at the International Rice Research Institute (IRRI) has had considerable success in Southeast Asia. Much of the rice grown in Northern Ghana is on small holdings. As such, a power-driven thresher would be impractical and out of the reach of most farmers. Since the fields on mission farms in the area are similar to those of the average farmers, the TCC has worked closely with them in testing this thresher.

To date, the TCC has modified the IRRI thresher to Ghanaian conditions and has built twenty of the resulting prototype; they are now being field-tested. Initial results indicate that although the thresher is widely accepted by the farmers, economic conditions in Ghana do not allow the TCC to make an accurate economic feasibility study at this time.

Crop Drying (Guatemala)

IDRC grant: $122 600 recipient contribution: $126 680
2 years from May 1979 file: 78-0027

contact: Juan Francisco Menchu
Assistant Head, Applied Research Division
Instituto Centroamericano de Investigacion
y Tecnologia Industrial (ICAITI)
Apartado Postal 1552
Guatemala City, Guatemala

Objectives

To develop and test an economically viable crop drying technology for small and medium-sized processors, benefiting thousands of the smallest and poorest coffee producers and encouraging the growth of local agro-industry while dealing with the increasing problems of pollution by coffee waste. Specifically, the objectives are: to develop and test a crop drying system compatible with the needs and the level of technology available to the small- and medium-sized producers (approximately 200–500 tonnes per year); to modify and test the existing system for the production of methane gas using optimum amounts of coffee pulp (as a substrate) and animal waste (as an inoculant); and to determine the most economical and practical fuel source for a mechanical dryer from existing fuel sources and methane fuel produced from a coffee pulp/animal waste substrate.

Background

The coffee industry is dominated by companies, many of them in the "multinational" category, that control large plantations. Nevertheless, in Latin America there are thousands of small holders who grow coffee. Many of these (4500 out of a total of 38 000 small coffee growers in Guatemala) have organized themselves into cooperatives that, in turn, have formed federations to channel the coffee harvest toward the export market. These federations have set up small centres or "beneficios" where the coffee beans are processed. The development of these beneficios has gone a long way toward assisting the small farmers to improve the quality of their product and to compete with the big coffee estates.

However, only the large beneficios in more accessible areas have the size and capital to invest in crop dryers, which are generally operated with conventional fuel heat sources and electricity, contributing further to the high cost. This project seeks to adapt the flat-bed dryer, which is easy and inexpensive to construct, to the drying of coffee beans. This type of dryer can use many different fuel sources, and the project will compare methane gas derived from the anaerobic fermentation of waste coffee pulp and animal dung with more conventional energy sources.

Grain Legume Quality (INCAP) (Guatemala)

IDRC grant: $485 000
3 years from April 1977 file: 74-0159

contact: Dr R. Bressani
Head, Division of Agricultural and Food Science
Institute of Nutrition of Central America and Panama
Apartado Postal 1188
Guatemala City, Guatemala

Objectives

To improve the nutritional quality, cooking properties, acceptability, and utility of the food legumes of the genera *Phaseolus*, *Vigna*, and *Cajanus* and to extend their usefulness as supplementary protein sources in human diets based on cereal grains and root crops; specifically, to determine the genetic, agronomic, and environmental effects on the protein content and composition and nutritive value of these legumes; to identify the physical and biochemical characteristics of the various genotypes and phenotypes that affect cooking quality, nutrient availability, and protein quality; to study the mechanism of food legume seed hardening and the effects of storage upon cooking quality and nutritive value; to study the interaction of storage and processing on the nutritive value and quality of formulated and derived foods; and to train Latin American graduate scientists in the principles and techniques of legume evaluation, transformation, and improvement.

Background and Progress

Among food legumes there is a wide variability in the nutritional composition, digestibility, and nutritional quality among different genera, different strains of the same species, and among strains grown under different agroclimatic conditions. In general, very little research has been undertaken to determine the influence of genetic and agronomic factors upon nutritional properties, cooking quality, and other important charactertistics. While it is known that significant deterioration of pulses occurs during storage, resulting in impaired cooking quality, little is known about the mechanisms that lead to these undesirable postharvest changes.

Over 400 legume cultivars have been collected from various cooperating institutes in the region. The physical, chemical, and biological properties of a number of these samples are currently being determined. To date, no apparent relationships have been found between weight and grain volume, and seed coat percentage or cooking time and seed hardness. Within each colour, higher grain weight and volume contain less protein than cultivars with smaller weight and volume. Water hydration or rate of water uptake before 8–12 hours was related to protein content. Some relationship was found between protein digestibility and seed coat intake for red beans only.

Further studies on the chemical and biological properties of common beans are being developed by three students, and additional work on the utilization of various legumes is being done by the food and agricultural sciences staff.

Household Grain Processing (India)

IDRC grant: $72 500 — recipient contribution: in kind
3 years from June 1977 — file: 75-0045

contact: Dr P. Pushpama
Principal, College of Home Science
Andhra Pradesh Agricultural University
Khairatabad
Hyderabad 500 004, India

Objectives

To increase both the quantity and quality of traditionally processed cereal and legume foods available to the rural consumer by improving village methods of handling, processing, and utilization.

Background and Progress

In recent years the development of high-yielding cereals has far outstripped corresponding progress in legume research programs. In the southern part of India this has resulted in a decline in the production of traditional legume crops. Families who in the past depended on a mixture of sorghum, millet, and legumes to meet their protein requirements are now finding these crops less available. Before the availability, utilization, and nutritional quality of products made from these crops can be improved, information about the existing consumption of these crops is required.

During the first year of this project an extensive study was made of the utilization of sorghums, millets, and legumes in three regions of Andhra Pradesh. Homemakers in several villages were questioned regarding the usual production, consumption, storage, and processing of these crops, and their preferences for specific sorghums, millets, chickpeas, pigeon peas, black gram, cowpeas, and horse beans. Samples of the various grains were collected from home stores for subsequent analysis at the College of Home Science.

The data from the village studies are currently being analyzed and grain samples from the same home stores are being collected at periodic intervals. These samples are being analyzed for various physical and nutritional characteristics to determine the long-term effects of the different storage systems.

Postharvest Technology (India)

IDRC grant: $360 000 — recipient contribution: $108 950
3 years from September 1974 — file: 73-0148
(extended to March 1981)

contact: Dr M.S. Swaminathan
Director General, The Indian Council of Agricultural Research
Krishi Bhavan
Dr Rajendra Prasad Road
New Delhi, India

Objectives

To develop postharvest systems that reduce losses and improve the processing, distribution, quality, and availability of the principal cereal grains and legumes produced on small farms throughout India.

Background and Progress

In line with the priorities established by the Indian Government, the Indian Council of Agricultural Research (ICAR) has established a postharvest technology program. It involves ten of their centres in India in research on storage and processing of food crops in cooperation with the Council for Scientific and Industrial Research (CSIR), the Food Corporation of India (FCI), and others. This research, however, has been focused mainly on large producers, processors, and grain merchants. The needs of the small farmers, and the small rural communities, who collectively produce and consume most of the subsistence grains and legumes and also incur the greatest proportional losses, have received comparatively little attention.

This project was conceived to redress the imbalance, and through applied and adaptive research, development, and demonstration, arrive at a significantly improved postharvest system for the small farmer and rural communities. The project involves five centres carefully selected to take into account the important crops of the country and agroclimatic variations. Each centre is responsible for specific crops important to the area of its location. Additionally, each centre embraces an area of different climatic conditions and therefore the project covers not only most of the important cereal grains and legumes, but also a wide range of crop varieties and conditions of harvesting.

Fish Processing (India)

IDRC grant: $322 800 recipient contribution: $75 700
3 years from October 1979 file: 76-0086

contact: Dr G.K. Kuriyan
Central Institute of Fisheries Technology
Willingdon Island
Cochin, 682029
India

Objectives

To increase the availability of fish products in India and to improve and stabilize the incomes of rural fishing communities through development of processes for minced, smoked, dried, canned, and pouched fish products appropriate to the Indian market.

Background

India is one of the top eight fishing countries in the world, yet it does not process the fish it lands (except shrimp). The lack of processing results in enormous loss due to spoilage, particularly in the peak catching season, and in the underutilization of many species that are unacceptable in the fresh state. This situation means fluctuating prices in the market and lack of stability of incomes for the rural fishermen. The Central Institute of Fisheries Technology (CIFT) at Cochin in South India seeks to develop an industry to produce low-cost processed fish products, capable of distribution and consumption throughout the year, firstly in Kerala State and later spreading to neighbouring states, particularly inland areas. Several processes have been developed in the laboratory. In this project, the CIFT will work in the local factories of the Kerala Fisheries Corporation and utilize their excess processing capacity to develop and evaluate their processes at a small industrial scale. Products produced will be test-marketed through local markets and fish stalls in the area.

Legume Processing (Indonesia)

IDRC grant: $32 400
2 years from November 1976

recipient contribution: $12 610
file: 75-0136

contact: Ir. Hardiman
Head, Division of Food Technology
Faculty of Agricultural Technology
Gadjah Mada University
Yogyakarta, Indonesia

Objectives

To provide alternative legume proteins to soybeans in the domestic and commercial production of tempeh and tofu, and specifically, to determine and evaluate the essential processing and quality factors in the production of tempeh and tofu; to adapt these processing technologies to permit the total or partial replacement of soybeans by velvet beans and/or other legumes; and to determine the extent to which soybeans can be replaced by velvet beans and other legumes by conducting large-scale acceptability studies of comparable products.

Background and Progress

Tofu and tempeh are important legume foods in Indonesia. While they are generally made from soybeans, other legumes are also used in homes where soybeans are not available because of cost. Velvet beans, a comparatively high-yielding legume, grow well on marginal land and cost only a third the price of soybeans. Their protein content has been reported in the range of 24–30%, which compares favourably with locally cultivated soybeans. Like lima beans, velvet beans contain significant amounts of cyanogenic glucosides not found in soybeans. However, it is believed that these can be removed through adequate processing.

During the first year of this project a baseline survey of velvet bean tempeh and tofu processing was conducted in four areas of Indonesia. From these observations an in-home standard method and formula for producing velvet bean tempeh and tofu was developed. Laboratory experiments are presently in progress to determine the optimum conditions for soaking and heating the velvet beans to remove the HCN. Further studies will be done to determine the reduction in HCN under various storage conditions.

Postharvest Rice Technology (Indonesia)

IDRC grant: Phase I $200 000
3 years from 1976
Phase II $107 200
2 years from May 1979

recipient contribution: Phase I $163 900
Phase II $103 023
file: Phase I 74-0123
Phase II 78-0115

contact: Muslimin Nasution, Head, Research Department
Promotion of Rice Marketing Facilities
National Logistics Agency (BULOG)
10-12 Jala Tenku Umar, Jakarta, Indonesia

Objectives

To identify processes and equipment applicable to the various components of the postharvest system and to test their technical and economic suitability for use on small farms and/or crops; to modify the most promising equipment to meet local requirements; to evaluate the performance of the resulting equipment and its acceptance by the farmers; and to develop a framework for training engineering staff at BULOG and technicians in the farmers' cooperatives (BUUDs).

In Phase II, to develop and evaluate technically and economically a postproduction system for the BUUDs based on the improved technologies — the system is to operate in conjunction with grading and milling facilities owned and operated by the BUUDs; and finally, to assist the BUUDs in training manpower to ensure the implementation of the postproduction system.

Background and Progress

Most of Indonesia's rice production comes from small-scale farmers whose operating margins are small, as is their capacity for risk-taking. To promote new rice varieties and improved postharvest practices the government organized the farmers into cooperatives (BUUDs) and purchased several hundred models of three different dryers, which they were subsequently unable to introduce for farm use. Phase I of this project proved that dryers made of the components of the three existing types, manufacturable in Indonesia, could successfully dry paddy during the wet season harvest. During Phase II the economic viability of the dryers is being closely studied and detailed socioeconomic surveys and technical evaluations are being carried out on the other equipment used to harvest, thresh, dry, and store the grain. An optimum postharvest system will be developed and recommended for use by the BUUDs. The researchers will then assist the cooperatives in training the manpower necessary to ensure the successful implementation of the recommended system.

Vegetables (Kenya)

IDRC grant: $70 000 — recipient contribution: $14 736
2 years from October 1979 — file: 79-0019

contact: M.I. Gomez
Lecturer, Department of Food Science and Technology
University of Nairobi
P.O. Box 29053
Nairobi, Kenya

Objectives

To improve the nutritional intake of rural Kenyans by increasing the availability of accepted vegetables and fruits that provide good sources of essential micronutrients currently deficient in typical Kenyan diets.

Background and Progress

In many of the least developed regions of Kenya, micronutrient deficiencies of vitamin A, C, riboflavin, folic acid, calcium, and iron, together with protein-calorie malnutrition, are a common phenomenon. With the increasing use of land for intensive cultivation and the commercialization of the agricultural sector in Kenya, there has been a corresponding decline in the consumption and availability of noncultivated indigenous vegetables and fruits.

To date little information on the nutritional content of these plants is available and they remain inadequately developed and unexploited resources of essential micronutrients. In the meantime production of vegetables indigenous to many temperate zones have been introduced and their consumption encouraged. This project is in the start up year and much of the research being initiated is a follow-up to prior work conducted within the Food Science and Crop Sections of the University of Nairobi.

A field survey will be carried out in two different climatic zones to determine the production and consumption patterns for vegetables and fruits. Additional observations will be made in market and household visits to observe the methods used to grow, harvest, sell, store, process, and consume the vegetables and fruits. The micronutrient content of various end products will be determined as well as the potential for preserving these products. Species found to be rich sources for vitamin A, C, calcium, iron, etc. will be cultivated and processed to determine consumers' reactions.

Postharvest Rice Technology (Korea)

IDRC grant: Phase I $59 000
2 years ending September 1978
Phase II $103 200
2 years from September 1978

recipient contribution: Phase I in kind
Phase II $13 800 and in kind
file: Phase I 76-0047
Phase II 78-0053

contact: Dr Chang Joo Chung
Agricultural Engineering Department
College of Agriculture, Seoul National University
Suweon, Korea

Objectives

To develop a modified rice postharvest system that will reduce present high postharvest losses, particularly with the new high-yielding varieties, by solving the problem areas defined by Phase I. Specifically, to identify, modify as required, and test a field thresher capable of threshing wet paddy and barley, which can be easily moved from field to field; to identify, modify as required, and test a method of on-farm grain drying with alternative heat sources suitable for Korean farms; to analyze the feasibility of the modified system when supplemented by a new thresher and grain dryer as to economics, acceptance by farmers, and grain losses; and to improve field rice mills and their operational methods by isolating major factors affecting the milling quality of Tong-il (Indica-type) rice and implementing required modifications.

Background and Progress

The rapid increase in rice production in Korea, largely due to the introduction of new, high-yielding varieties, put tremendous pressure on existing handling, storage, and processing systems. The resulting heavy losses have, at least partially, offset the increased production.

Part of the capital costs of Phase I were borne by the local manufacturing industry. The objective was to determine the yields, losses, broken grains, and comparative milling yields from the traditional Japonica and newly introduced Indica varieties of rice when processed by both traditional and modified traditional postharvest methods. Phase I pinpointed three major constraints to the implementation of an improved, modified PPS, all of which are being dealt with in Phase II.

There is a need for a field thresher, capable of threshing wet paddy immediately after cutting, thereby reducing the time lapse between cutting and threshing and the resultant heavy grain losses. Immediate field threshing of high-moisture paddy would mean that the grain would have to be dried from about 24% down to about 15% moisture. Some type of inexpensive mechanical drying is required to achieve this efficiently. An economic cost-benefit analysis of the various components in the PPS as well as of the system as a whole is essential to ensure its acceptability.

Food from Grains (Lebanon)

IDRC grant: $127 200 — recipient contribution: $33 500
3 years from February 1974 — file: 73-0042

contact: Dr Abdul H. Hallab
Chairman, Food Technology and Nutrition Department
American University of Beirut
Beirut, Lebanon

Objectives

To develop and adapt improved technologies applicable to small-scale food industries of the region for processing sorghum, millet, and those legumes, that represent the main staples of the diet of the rural and poor urban communities throughout the Near East; to supplement imported and locally grown wheat with sorghum and millet flours in traditional and adopted cereal foods; to demonstrate improved technologies to small industries throughout the Near East region; and to study the influence of soil and environment on the properties, particularly the cooking quality, of certain important legumes.

Background

This project was just underway when civil strife and unrest forced the shutdown of activities at AUB. It is hoped that the project will resume as soon as circumstances permit.

Wet Paddy Handling (Malaysia)

IDRC grant: $96 300
2 years from 1979

recipient contribution: $63 424
file: 74-0121

contact: Dr Abdullah bin Ali
MARDI Rice Processing Station
Bukit Raya
Pendang, Kedah
West Malaysia

Objectives

To develop effective methods of handling wet grain at the farm level to substantially increase the time the grain may be held before final drying and still have only minimal losses. Specifically, cleaning of freshly harvested wet paddy (moisture content approx. 25%), sterilizing, conduction heating and partial or complete gelatinization, and flash-drying of the grain.

Background

Rice comes next in importance to rubber in the land-use pattern and also in terms of labour utilization in Malaysia. There is a steady increase both in acreage under cultivation and rice production, the latter mainly due to double-cropping and higher rice yields. The main, or first crop, is harvested in the first few months of the year, and the off-season, or second crop, is harvested in the second half of the year, which is the rainy season. During this rainy period, harvesting is delayed and the harvest cannot be moved fast enough to the drying plants. This newly threshed rice has a moisture content in excess of 20%, often 25–30%. Unless the moisture content is reduced to a maximum of 18% within 24 hours, deterioration begins and accelerates rapidly. Losses at this stage alone in the Muda Irrigation Scheme in Kedah are in excess of 10%, making it imperative to find improved methods of handling and treating the wet grain at the farm level.

Shea Butter (Mali)

IDRC grant: $52 400 — recipient contribution: $16 125
2½ years from 1979 — file: 79-0077

contact: Mr Dramane Zerbo
Directeur, Division du Machinisme Agricole
Ministère du Développement Rural
B.P. 155
Bamako, Mali

Objectives

To improve the method of shea butter extraction at the family and village level and more specifically: to develop a new process and to improve the components of the traditional system that are long and/or inefficient. The components to be improved include: removing the shell from the nut, grinding the pulp, and extracting the oil; training rural people who will use the equipment developed with the project; and training rural artisans to fabricate and repair the simple equipment in the rural villages.

Background

Shea butter is the primary source of cooking fat for the rural population of Mali. In addition, the high allantoin content in shea butter makes it valuable for use as a base for many pharmaceutical and cosmetic preparations. It is also used to make soap, and in the construction industry low quality shea butter is smeared on the banco walls of a house during the rainy season to prevent the wall from being washed away.

The traditional process of extracting the oil is long, tedious, and inefficient. This research seeks to lessen the time required to process the nuts, reduce the energy required, increase the percentage of oil recovery, and produce a higher quality product.

Millet Threshers (Mali)

IDRC grant: $41 875 — recipient contribution: $13 800
2 years from 1979 — file: 79-0082

contact: Mr Dramane Zerbo
Directeur, Division du Machinisme Agricole
Ministère du Développement Rural
B.P. 155
Bamako, Mali

Objectives

To develop a manually operated low-cost millet thresher, suitable for local fabrication, that can be purchased and used by a large rural family or a small village. Specifically: to develop and test a manually operated millet thresher based on the threshing principles of the existing tractor-driven millet thresher and considering available energy; to train local blacksmiths to repair the thresher; and to train villagers to operate and maintain the thresher for optimum efficiency.

Background

Millet accounts for 80% or more of the caloric intake from cereals for the rural population of Mali. Although large-capacity, commercial millet threshers have been developed, they have not met the needs of the small farmers in Mali due to their high purchase and operating costs, and the fact that the traditional postharvest grain system in Mali cannot accommodate the large quantities of threshed millet that would need to be processed to make the thresher's operation economically viable. Mali farmers prefer to store their grain unthreshed, as it is thought to be less prone to insect infestation. Threshing large lots of grain just to make the machine economically feasible forces the farmer and his family to disrupt their normal work schedule. This usually occurs at the time when cash crops need to be harvested, and since the farmer needs the money from these to pay back his debts and to purchase other goods, he cannot afford the time to thresh millet.

The traditional method of threshing is tedious, laborious, and inefficient. The introduction of this manually operated low-cost thresher will result in a saving of time and energy and will increase the efficiency of the operation.

Onion Drying (Niger)

IDRC grant: $80 700
2 years from 1979

recipient contribution: $70 450
file: 78-0051

contact: Mr A. Wright
ONERSOL
Office National de l'Energie Solaire
Niamey, Niger

Objectives

To develop methods for utilizing solar energy for the drying of onions to: facilitate transport to consumers in nonproducing areas, increase the storage life of such products, and eliminate periodic shortages and resultant high prices. Specifically, the objectives are: to evaluate the existing methods for onion drying; to design and construct multipurpose models of solar dryers with production rates suitable for a small village and capable of producing an acceptable, high-quality product; to test these dryers and optimize the design; to encourage the subsequent manufacture of the most suitable prototype; and to train one scientist at the MSc level.

Background

Onions are used daily in meal preparation (mainly sauces and stews) by most of the people in Niger. Traditionally, the only drying method has been to directly sun-dry them. The nearly ripe onion is opened and the leaves piled into a hole (silo) where they are allowed to ferment. This partially fermented product is then sun-dried. The resulting product is often insect-infested, sand-covered, and microbiologically unacceptable.

Onions of a high-solids content are grown extensively in the Maggia and Niger valleys of Niger. Although the majority of holdings are small, approximately 79 430 tonnes were harvested in 1976. Because of the lack of adequate storage facilities the postharvest loss in onions is 30%. To minimize this loss, the farmer sells what he can immediately after harvest at a reduced price. This leads to extremely high prices between July and January, the off-season.

Niger, a country with cloudless skies over 300 days of the year, is a natural place for the utilization of solar energy. The ONERSOL (national solar energy laboratory) in this project, which is only just getting underway, will hopefully develop a dryer that can produce a high-quality dried onion product.

Grain Milling and Utilization (West Africa)

IDRC grant Phase I $132 250
2 years from March 1972
Phase II $160 000
2 years from April 1974

recipient contribution: Phase I $66 000
Phase II $35 000
file: Phase I 72-0003
Phase II 73-0128

contact: Permanent Secretary
Federal Ministry of Agriculture and Rural Development
Private Mail Bag 12613
Lagos, Nigeria

Objectives

To develop a suitable system for milling Nigerian grains to produce basic and composite flours for local market and consumer demand; and to adopt and develop methods and technology for the production of bread, noodles, infant foods, and other products from these flours with special emphasis given to increasing the protein levels of acceptable food products.

Background and Results

The Maiduguri Mill Project was a joint venture of Nigeria's Federal Ministry of Agriculture and Natural Resources, Borno State's Ministry of Agriculture and Natural Resources, the Ministry of Co-operatives and Community Development, and IDRC.

The project was established in two phases, the first phase being devoted to the setup, operation, and management of a pilot flour mill. Associated activities included consumer grain preference and marketing studies, milled product evaluation, and new food development in the test kitchen attached to the mill. The second phase continued operation of the pilot flour mill, specifically quality control and product development testing. Additionally, the successful establishment, operation, and management of a bakery for the preparation of Nigerian style bread, containing sorghum flour produced by the mill, took place during this phase of the project. (IDRC publication TS2e, Maiduguri Mill Project: grain milling and utilization in West Africa, fully describes both the project and its results.)

Cowpea Processing (Nigeria)

IDRC grant: $16 000 recipient contribution: facilities and staff
18 months from December 1976 file: 76-0077
(extended to June 1979)

contact: Dr Carol E. Williams
Department of Agricultural Extension
University of Ibadan
Ibadan, Nigeria

Objectives

To test the acceptability of mechanically prepared cowpea flour as a substitute for cowpea paste in the preparation of preferred cowpea foods by housewives and small-scale food sellers.

Background and Progress

In many countries of the world legumes are dehulled and milled using a wet process. Because the resulting flour or paste has a high moisture content the product can only be stored for a few days. In 1974 a study in Nigeria indicated that the utilization of cowpeas in Nigeria is limited by the drudgery of dehulling the cowpeas into the paste ingredient used in many popular cowpea products.

Housewives and cowpea food sellers felt that cowpea foods prepared from dry flour did not have the same desirable qualities as those prepared from a paste. Further studies in the laboratory showed that a dry milled cowpea flour could make an acceptable paste that could subsequently be used to make customary cowpea products of comparable quality.

In this project a number of consumer studies were conducted with housewives and small-scale food processors in urban and rural Nigeria. As a result of these studies, a mixture of dry milled cowpea fines and middlings was found acceptable by consumers who were instructed to use it following their usual in-home procedures. The physical and nutritional properties and shelf-life of wet-milled and dry-milled cowpea flour have been determined and a final report is being prepared.

Potato Processing (CIP) (Peru)

IDRC grant: $156 000
2 years from December 1976 file: 74-0006

contact: Dr Roy Shaw
Physiology Department
Centro Internacional de la Papa
Apartado 5969
Lima, Peru

Objectives

To develop and evaluate a village-level potato processing method to produce dehydrated potatoes. An important criteria of the processing method is its applicability to developing countries.

Background and Progress

The bulk, high-moisture content, and perishability of the raw potato has long been a major constraint to its expanded production. The International Potato Centre (CIP) placed high priority on the development of applicable dehydration methods.

The project concentrates on adapting methods of using the most abundant available resource (solar energy) to produce a product of superior quality to that traditionally produced. Although progress has been made to date on the development of techniques, the field testing has not yet been carried through to the point where the process is optimized.

Fish Processing (Philippines)

IDRC grant: Phase I $78 400
2 years from October 1975
Phase II $70 000
18 months from April 1979

recipient contribution: Phase I $205 400
Phase II $22 000
file: Phase I 74-0079
Phase II 78-0110

contact: Dr Eduardo C. Sison
Department of Food Science and Technology
University of the Philippines at Los Banos
College, Laguna 3720, Philippines

Objectives

To field-test the dryer developed in Phase I in the port of Mercedes. Specifically: to determine the acceptability of fish dryers that use agricultural wastes (rice hulls) commonly available in rural areas; to establish the economic viability of nontraditional fish drying technology over traditional drying methods; and to establish a mechanism for the effective introduction of nonconventional dryers and for the training of village fish processors.

Background and Progress

Dried fish is a very important source of animal protein in the Filipino diet and increasing its availability, especially in the remote rural areas, would help alleviate malnutrition problems. It was shown in an earlier phase of this project that there is considerable room for increasing the stability of the traditional dried fish products through improved hygiene, improved brining procedures, and greater control of drying conditions.

A cabinet dryer, using rice hulls as the fuel source, has been designed and is being constructed for testing at the fishing village of Mercedes. The research staff is cooperating with local fishermen and the staff of the Department of Fisheries in the development and evaluation of a nonconventional, controlled drying system.

Legume Processing (Philippines)

IDRC grant: Phase I $21 000
2 years from October 1974
Phase II $49 650
2 years from 1 January 1978

recipient contribution: Phase I $12 900
Phase II $19 400
file: Phase I 74-0080
Phase II 75-0075

contact: Dr Ricardo R. Del Rosario
Department of Food Science and Technology
University of the Philippines at Los Banos
College, Laguna 3720, Philippines

Objectives

To promote increased utilization of legume-based products. Specifically: to continue studies on dehulling properties of legumes and compare the performance of the Maiduguri dehuller with that of a modified rice mill; to undertake further product development studies (using products prepared from identified equipment) based on information obtained by surveys of traditional utilization; to test the acceptability of legume-based products; and to continue determination of physicochemical characteristics of legume starches and proteins.

Background and Progress

During Phase I, it was shown that the dehulling of cowpeas is influenced by certain varietal characteristics. The dehulling performance of seven cowpea cultivars, using four different types of mills, was studied. In general, the dark-coloured seeds were more difficult to dehull. Among the mills tested, the abrasive cone mill was found most effective, and during Phase II of the project, these milling studies will be continued. The cone mill will be compared with a mill patterned on the Maiduguri dehuller. Modifications will be made and tested until the most efficient design for the largest number of common cowpea varieties, mung beans, and other legumes is determined.

Other studies being conducted during this second phase, include studies on the relation between drying conditions and dehulling properties, and pretreatment of the seeds to facilitate dehulling, specifically soaking and roasting. Product development will be done using milled products such as flour, splits, and dehulled beans. These studies will be carried out in cooperation with the Institute of Human Ecology. Studies on the chemical properties of the seeds will be continued, as well as work to determine the influence of legume starch on bread characteristics. The adaptation of equipment needed for home or community processing of legumes will be studied, including the technology and economics of fabricating this machinery.

Postharvest Rice Technology (Philippines)

IDRC grant: Phase I $241 000
3 years from February 1976
Phase II $135 000
2 years from July 1979

recipient contribution: Phase I in kind
Phase II $2 135 000
file: Phase I 74-0124
Phase II 78-0114

contact: Dr Ernesto P. Lozada
Agricultural Engineering Dept
UPLB, College, Laguna,
Philippines

Mr Frank Tua
National Grains Authority
1424 Quezon Blvd. East,
Quezon City, Philippines

Objectives

To study the alternative methods available to farmers and the cooperative associations and small-scale processors for handling and processing rice to maximize physical and economic benefits from production.

Phase II of the project aims to design and field-test a grain dryer and accessories, technically and economically suited to local conditions; to identify the design factors responsible for the more efficient operation of one particular mill identified in Phase I, and use these findings to improve other locally available rice mills; to develop and test a system for the effective technical operation of existing bulk-grain storage facilities and design a training program within NGA to implement the system; to develop and test a portable dockage tester; and to develop training procedures for farmers, technicians, and other people involved in the postproduction system in new and advanced practices.

Background and Progress

In the Philippines, as in much of Southeast Asia, the paddy for processing, storage, and distribution is produced on small farms and much of it is harvested under adverse weather conditions. Consequently, the quality of the rice crop deteriorates greatly between the farm and the rice mill. This project was the first in Asia to undertake a comprehensive study of the total postharvest system, from point of harvest through to the distribution and use of milled rice.

The thresher evaluation results from Phase I enabled recommendations to be made to farmer associations and equipment manufacturers. However, in the case of the dryers, not one of the presently commercially available models was considered adequate and during Phase II further dryer studies will be carried out to combine the efficiency of the centrifugal fan and heat recycling principle with the lower capital cost of the stationary wooden constructed dryer models. It is hoped that an efficient, economical unit with a variable capacity up to 0.5 tonne/hour will be developed.

Cereal Processing (Senegal)

IDRC grant: $118 000 — recipient contribution: $190 200
2 years from January 1978 — file: 77-0004

contact: Mme Thérèse Basse
Directrice
Institut de Technologie Alimentaire (ITA)
Dakar, Senegal

Objectives

To examine various varieties of sorghum and millet of West Africa, selecting those with highest nutritive value and best functional properties; to assess the preference of the rural population for these selected varieties; to inform research centres in West Africa involved in sorghum and millet improvement of the varieties with the best characteristics and those most popular with Senegalese farmers and consumers; to train a Senegalese technician in the use and maintenance of an amino-acid analyzer.

Background and Progress

Sorghum and millet are major cereal staples in India and many countries in Africa. As more research is conducted to improve the yields of these cereals, it has become increasingly important to ensure that the new varieties being developed retain their consumer-preferred characteristics. In the past, the functional properties of millet in yeast bread have been determined at the ITA. In this project, the functional properties of these crops in the products consumed by the majority of the Senegalese population are being determined. Often, agglomerated steamed products and dehulled and steamed products are served as staples along with various stews or sauces in Senegal and much of West Africa.

Staples of traditional and new varieties of sorghum and millet are being collected. The functional, physical, and biochemical properties of the new cultivars will be determined and compared to those of the traditional varieties. A related project is being supported in Upper Volta. The results of laboratory tests, in-field observations, and interviews will be compared to determine significant relationships. Based on this, an index of acceptability will be developed for use in crop improvement programs in Senegal and other West African countries.

Postharvest Technology (Senegal)

IDRC grant: Phase I $270 000
2½ years from November 1976
Phase II $113 600
2 years from October 1979

recipient contribution: Phase I $400 000
Phase II $71 850
file: Phase I 76-0026
Phase II 79-0066

contact: M Gora Beye
Directeur
Centre National de Recherches Agronomiques
Bambey, Senegal

Objectives

To establish suitable postharvest systems in two Senegalese villages; to study in detail the components of the systems, in particular, how they relate to each other; to study in detail the economic and technical efficiency of the systems as operated in the villages; and to train Senegalese research staff and extension workers to continue postharvest systems research and application in Senegal and elsewhere in the region.

In Phase II to continue the study of the technical and economic aspects of the introduction of a dehulling/milling system that can be used for the production of millet flour and "ris de maïs" in a large village or small town.

Background and Progress

In the past, comparatively little attention has been paid to the postharvest conditions for sorghum and millet on the farm, in the villages, in centralized stores, or distribution systems. The first phase of this project studied the individual components of the postharvest system, optimizing the variables to reduce loss. The second phase continues where the first left off, combining the components to develop the optimum system for existing situations.

Two systems were set up in different sized villages in the production areas. Each was designed to meet the specific requirements for collection, storage, processing, and distribution found in the representative villages. The economic and socioeconomic aspects of the introduction were studied and the results are now being analyzed.

Solar Crop Dryers (Sierra Leone)

IDRC grant: $46 800
2 years from May 1979

recipient contribution: $22 600
file: 78-0113

contact: Dr Michael Bassey
Department of Mechanical Engineering
Fourah Bay College
University of Sierra Leone
Freetown, Sierra Leone

Objectives

To reduce losses, improve product quality and encourage increased production of rice and other crops such as peppers and sesame seeds, by the development of low-cost, effective, solar crop dryers, suitable for use by the farmers in Sierra Leone. Specifically, to identify the production and climatic factors that dictate the size and type of dryers to be designed; to design and build dryers for specific crops, using solar energy as the heat source; to test the dryers under various conditions; to make recommendations on the selected dryers based on economic feasibility and consumer acceptance; to further improve or modify the design and operation of the dryers if indicated; and to disseminate and demonstrate the results among selected farmers and representatives of government agencies through workshops and other means.

Background

Rice is the most important food crop in Sierra Leone. It is grown by more than 80 percent of farmers. Production over the last 10 years has ranged between 260 000 and 295 000 tonnes of milled rice with a deficit of 10 000 to 50 000 tonnes per annum.

The National Development Plan of Sierra Leone places strong emphasis on reaching self-sufficiency in rice with production nearing 375 000 tonnes. To achieve this, the country must improve drying and storage facilities to accommodate the increase in production, as well as to reduce the losses that occur because of current poor postharvest techniques.

To reduce these losses and improve the quality of dried rice and other crops, this project will develop and test on-farm crop dryers. The criteria for these dryers are: construction from local materials, simple design, durable construction, and effective operation at a cost making their use by farmers economically justified.

Cowpea Storage (Sierra Leone)

IDRC grant: $70 000
3 years from September 1979

recipient contribution: $50 500
file: 79-0007

contact: Dr W.E. Taylor
Dean, Faculty of Agriculture
Njala University College
P.M.B.
Freetown, Sierra Leone

Objectives

To develop systems for storing cowpeas in the wet/humid zone of West Africa. Specifically: to determine the effectiveness and principal defects in existing systems of cowpea storage throughout Sierra Leone; assess the losses incurred with each system; reduce the storage losses by developing more technically and economically effective storage systems; and train both scientific and extension staff in the methods of improved systems of cowpea storage.

Background

The people of Sierra Leone eat primarily cassava, maize, and rice. Their diet is generally deficient in protein. Cowpea is an excellent source of protein, and the potential for increased production is excellent, as shown by agronomic and cultural practices developed at Njala University College. It is felt that improved storage techniques will provide the incentive to the farmers to increase cowpea production and make a source of protein available to the rural poor throughout the year by stabilizing the cowpea market.

Postharvest Rice Technology (Singapore)

IDRC grant: $38 000 recipient contribution: $37 280
2 years from March 1975 file: 74-0122

contact: Dr Lee Kum Tatt
Chairman
Singapore Institute of Standards and Industrial Research
P.O. Box 2611
Singapore 6

Objectives

To determine traditional storage conditions that critically affect the shelf life of milled rice; to develop an economic system of bag storage of milled rice that will ensure minimal change in grain quality; to test this alternative storage system under varying conditions and ensure the adoption of the most favourable system by industries in Singapore; and to make available the information for application in other countries of the region through workshops and study visits to the improved storage facilities.

Background and Progress

While rice is the main staple food for over two million people living on the 224 square mile island of Singapore, no rice is produced on the island due to the high cost of land. Because all rice must be imported, Singapore is severely affected by price fluctuations, which for instance escalated by 200 percent in 1973 due to poor harvests in Southeast Asia. The Government announced that Singapore would henceforth maintain stocks of 90 000 tonnes of milled rice (sufficient for 6–8 months) at all times.

This project was a direct result of this decision, as the food scientists at the Singapore Institute of Standards and Industrial Research, anticipating the problems involved in storing such a massive quantity of milled rice, proposed a research project to reduce grain losses, both quantitative and qualitative, and minimize costs in storing the rice.

The research determined the optimum conditions and methods for the storage of milled rice, and also clearly indicated that even under these conditions milled rice cannot be stored successfully for longer than six months under Singapore conditions.

Process Improvement (Singapore)

IDRC grant: $95 000 recipient contribution: $251 400
3 years from 1979 file: 79-0024

contact: Mrs Soon-Ong Meng Wan
Food Technology and Microbiology Section
Singapore Institute of Standards and Industrial Research (SISIR)
P.O. Box 2611
Singapore

Objectives

The overall objective is to develop optimal procedures for processing and control of traditional Asian food products in small factories. Specifically: to survey and document the common processing procedures for manufacture of dried noodles and soybean sauce in the small factories of Singapore; to investigate, using operations research methodologies, improvements to these procedures in specific operations and/or in the system and sequence of operations; to develop appropriate production control and quality control systems for operation of the improved systems and processes in each factory; and to implement and evaluate the improved process and control procedures in cooperating factories using appropriate operations research techniques.

Background

For the thousands of small family owned food factories in Southeast Asia there is significant wastage of food and human resources due to inefficient processing procedures and operational management. Additionally, the existence of these small businesses is being increasingly threatened by reliance of retailers and customers on the more secure supplies of processed foods from larger, more highly mechanized food companies, many of which are subsidiaries of foreign companies. These small processors are a vital link in the food chain for both the urban poor and the rural poor who depend on traditional foodstuffs as a part of their diet, and they provide employment in both urban and rural areas.

This project aims to develop methodologies for improving the operational management, processing, and control procedures used in these small factories. The adaptation of some of the quantitative operations research techniques used successfully in larger industries for this purpose, will be attempted to carry out this applied research most effectively in small factory situations. A research team from the Singapore Institute of Standards and Industrial Research (SISIR), an institute already successful in other areas of industrial research, will work with the small companies on a comparatively novel approach to their problems. Each cooperating factory will pay an acceptable proportion of the SISIR costs as an implementation fee and to ensure a demonstrable commitment to the research program. Several companies have already expressed their willingness to cooperate.

Southeast Asia Cooperative Postharvest Research and Development Program

IDRC grant: $50 000/annum
and one member of technical team
3 years from December 1976 file: 75-0073

Objectives

To help increase the availability of food grains, particularly rice, in Asia through postharvest technology and specifically: to promote cooperation in and coordination of postharvest research and development programs among countries having related problems; to enhance collaborative support for such research and development programs by multilateral and bilateral donors; to foster a more efficient and effective use of postharvest research facilities that exist in Southeast Asia; and to provide a means to facilitate the collection and transfer of available knowledge among appropriate institutions and organizations in the region.

Background and Progress

Developments in the postproduction sector of the rice industry in Southeast Asia have not kept pace with the breakthroughs in production that have been realized during the past decade. Extensive grain losses occur between the point of harvest and the consumer. The reduction of these postharvest losses has been declared a high priority by the governments in the region and by the international agencies in their continuing battle to increase food availability.

This Program was initiated by IDRC, USAID, and CIDA. A Policy Advisory Board was set up, composed of senior policymakers from each of the five developing countries in the area (Philippines, Thailand, Singapore, Malaysia, and Indonesia), together with representatives from the cooperating donor agencies. A Technical Research Advisory and Support Team (Technical Team), which reports to the Policy Advisory Board, was created to work with the national agencies of the participating countries. Because of its direct involvement in problem-oriented research and development activities, the team provides a very useful liaison for the donor agencies in identifying, defining, and developing projects.

IDRC is the Executing Agency for the first three years of this joint program. The Centre's contribution comprises $50 000 per annum plus the provision of one member of the technical team. In addition to the original three donor agencies, The Netherlands while declining full membership, also contributes one member of the technical team.

Sorghum Milling (Sudan)

IDRC grant: $137 700
2 years from October 1978

recipient contribution: $108 625
file: 78-0054

contact: Dr Sitt Badi
Project Leader
Food Research Centre
P.O. Box 213
Khartoum North, Shambat
Sudan

Objectives

To identify a dehulling system most suitable for village operation. Specifically: to compare the operating, technical, and economic efficiency and quality of products from various alternative sorghum dehulling processes; and to test the most acceptable dehulling system as judged by the FRC under village conditions in a sorghum-producing area of Sudan.

Background and Progress

During previous research conducted in various countries, several throughput and batch systems for dehulling sorghum and other grains have been developed and individually tested for reliability and performance. However, up to the present time few, if any, comprehensive studies have been made to compare the overall suitability of these systems within the context of village milling requirements.

At the Food Research Centre in Khartoum an industrial scale mill capable of dehulling and grinding sorghum into flour at an extraction rate of 80 to 90 percent has been introduced. This mill appears to be suited to large-scale commercial operations. Its relative efficiency has not been compared with other available dehullers. Because this industrial mill cannot meet the demands of rural families and village communities there is a need for smaller less complex and less expensive units.

In this project five dehulling systems are being compared and evaluated within the context of village dehulling and grinding requirements. Comparisons will be made among the traditional milling system used in most villages in Sudan, the Schule system, a modification of the continuous throughput system used at Maiduguri, a modification of the batch system tested in Botswana, and the SISCOMA dehuller. The system evaluated as being the most desirable overall will be tested in a nearby sorghum-consuming village to verify the results obtained in the comparative studies at the Food Research Centre.

Grain Storage (Swaziland)

IDRC grant: $7 000
2 years from May 1975
(extended to July 1978)

file: 75-0021

contact: Mr Ijoyi Fendru, Researcher
University of Botswana, Lesotho and Swaziland
P/Bag Kwaluseni
Swaziland

Objectives

To provide information on grain storage systems in Swaziland to suitably direct future research and outreach activities. Specifically: to determine the comparative costs and benefits of various existing storage systems being used on small farms; and to evaluate the costs and returns to small farmers of proposed new storage techniques, in comparison with traditional systems.

Background and Progress

Maize is the staple food of Swaziland. To make the country self-sufficient and to improve the income of small farmers, considerable efforts have been directed toward research into and promotion of improved maize production techniques. Postharvest losses in maize and other grains are known to be high, and several new systems of storage have been proposed. This project was to systematically assess the relative technical and economic merits of the alternative storage systems available to the small farmer in Swaziland.

A survey was conducted on small farms in the various ecological zones of Swaziland. After an initial interview using a questionnaire, farm stores were sampled at two-month intervals. The samples were analyzed by the Grain Storage Division of the Ministry of Agriculture for type and severity of loss. Data have been collected on the cost of the different storage systems.

Cassava Processing (Thailand)

IDRC grant: Phase I $16 800
1 year from October 1974
(extended to June 1976)
Phase II $57 000
from January 1977 (extended to October 1979)

recipient contribution: Phase I $8 900
Phase II $22 000
file: Phase I 74-0016
Phase II 76-0037

contact: Dr Nguyen Cong Thanh, Environmental Engineering Division
Asian Institute of Technology
P.O. Box 2754, Bangkok, Thailand

Objectives

To improve the methods of chipping and pelleting cassava, expanding the improved processes to a larger scale to permit an adequate technical and economic evaluation among Thai cassava processors. Specifically: to develop pilot-scale processes equivalent to about 10 tonnes/day of chips and pellets, embodying the improved features elaborated at the laboratory scale during Phase I; to study further the influence of chip dimensions upon chip and pellet qualities; to study and elaborate inexpensive yet more rapid systems of cooling pellets following compression; and to make cost comparisons of the various improved processes against the existing traditional technologies.

Background and Progress

During Phase I, a specific study was made of the effect of particle size and shape upon rates of drying. The findings indicated that cassava strips and slices, when cut to uniform dimensions, may be reduced to 12–14% moisture content after 12 hours of solar dehydration when scattered over a black surface, and in 13 hours when placed on perforated shelf dryers. The time required in the traditional random-size particle process is about 25 to 30 hours. Thus, a reduction of 40% in drying time appears feasible with the resultant improvement in the economics of the process. Limited field trials of the improved process were conducted in several plants in the Chon Buri area, and the laboratory results were confirmed by the findings.

The fine, even-sized chips resulting from the improved process developed in Phase I, have proved to be very successful in the field. A great reduction in drying time compared to the irregular-sized chips commonly produced is realized. This stage of the research involves a great deal of dialogue with major cassava importers and processors in an attempt to introduce them to this improved method. By controlling the moisture content with the regular, thinly sliced chips, much less power is required for extrusion, and the final extruded product is much firmer and has much less dust. This latter property is of great interest to importers of the pellets.

Food Processing (Thailand)

IDRC grant: $67 400
2 years from November 1978

recipient contribution: $109 000
file: 78-0078

contact: Aree Valyasevi, M.D.
Director, Institute of Nutrition
Mahidol University, Salaya Campus
Rama VI Road
Bangkok 4, Thailand

Objectives

To determine the convenience and acceptability within villages of a number of nutritionally adequate infant foods. Specifically: to determine the acceptability of the processing methods required to produce these foods within the villages; to determine the acceptability of the foods themselves; and to determine the operational requirements of a food processing centre that can be used by the villagers.

Background and Progress

Protein-calorie malnutrition in infants and preschool children is a major nutritional problem in many developing countries. In Northeast Thailand it has been established that caloric intake for preschool children is only about 60–80% of that required; 40–60% of the protein intake in this region is derived from cereal and vegetable sources. The diet is bulky and very low in fat, and protein intake is very dependent on the seasonable availability of food. To increase the fat intake and to stabilize and increase the protein intake, coconut, fish, and legumes that have undergone some primary processing, may be utilized.

In this project a food processing centre, housing equipment for grinding rice and legumes, extracting oil from coconuts, and drying or smoking fish and other commodities, will be constructed. For a small fee villagers will be able to bring raw materials they have produced or purchased in the village to the centre for processing into infant foods. The formulation of the foods will be based on five weaning food recipes previously developed and clinically tested in the metabolic unit at Ramathibodi Hospital. Instructions on food preparation, health, and nutrition will also be available at the centre through the cooperation of nutrition and agricultural extension agents. A village resident will be trained and hired to manage the facility. Records will be kept of the cost of operation, the number of persons using the facility, and the amount and type of materials processed weekly.

Home Processed Legumes (Thailand)

IDRC grant: $59 400 — recipient contribution: $57 000
2 years from March 1978 — file: 75-0135

contact: Mrs Tipvanna Ngarmsak
Head, Department of Agricultural Products
Faculty of Agriculture
Khon Kaen University
Thailand

Objectives

To develop methods for processing cowpeas (dehulling by soaking or splitting, wet or dry milling into a flour or paste, puffing, etc.) that can be performed by small vendors or villagers in their homes; to incorporate the processed materials (cowpea flour, paste, or dehulled, whole grains) into acceptable traditional snacks and main dishes; and, to develop an outreach program to implement the processes and products developed.

Background and Progress

In many parts of Asia, cowpeas have traditionally been utilized as green vegetables in the immature form as seeds, leaves, and pods. Storage of these foods is at best limited to a few days; therefore, the utilization and year-round availability of these foods is limited. At the same time in many marginal and semi-arid regions of Northeast Thailand cowpea production can be increased without extensive irrigation. If acceptable methods and uses for the higher protein form of cowpeas were available the utilization of this crop might well be increased. This would benefit farmers and consumers alike.

During the first year of this project a survey was conducted in Khon Kaen province to determine the prevailing dietary patterns and methods of utilizing legumes. Based on this study several recipes using dried cowpeas were developed. Dehulled cowpeas, whole cowpeas, and cowpea flour were used in these recipes and preliminary acceptability studies were conducted. Storage trials were conducted on one variety of cowpeas to determine the effects of light exposure, ash, oil, and bag type on the quality of the stored grain.

In the second year of the project further acceptability studies are being conducted using legumes dehulled on a batch dehuller tested in Botswana on sorghum. The shelf life of the resulting dehulled grain and flour will be determined under prevailing storage conditions and the effect of oil treatment on flour quality determined.

Postharvest Rice Technology (Thailand)

IDRC grant: $78 000 — recipient contribution: $20 200
4 years from August 1975 — file: 74-0120

contact: Mrs Sriwai Singhakajen
Chief, Storage and Processing Section
Department of Agriculture
Ministry of Agriculture and Cooperatives
Bangkhen, Bangkok 9
Thailand

Objectives

To analyze the rice postproduction system and practices among subsistence farmers in Thailand; to identify the nature and extent of grain drying problems experienced by small farmers especially for crops harvested during the rainy season; to test various available batch dryers and bin dryers to determine their potential adaptation to paddy, maize, and legume drying; to evaluate the efficiency and suitability of the most effective dryers on farms; to organize training and demonstration programs for farmers and extension workers; to determine optimum drying conditions such as air-flow patterns, time/temperature tolerance of various grains at different moisture contents, rates of evaporation, temperature gradients, etc.

Background and Progress

In Thailand, as in most tropical countries, the most common traditional method of grain drying is sun drying. The difficulties encountered in drying wet-season paddy and the enormous losses incurred are discouraging farmers from trying to raise their production by double cropping. In addition, improved drying would permit earlier harvesting of the initial crop, reducing its vulnerability to field pests, and permitting more time for land preparation in double-cropping areas.

This project, centred at Kasetsart University's Agricultural Engineering Department, successfully developed and field-tested a paddy dryer utilizing waste rice husks as a heating fuel.

This dryer has aroused international interest. The final stages of perfecting and optimizing the dryer design through a third series of harvest trials in various regions of Thailand is being done. One of the features of this project has been the excellent liaison established with the local manufacturing industry, which will ensure fabrication and availability of the dryer.

Solar Rice Drying (Thailand)

IDRC grant: $32 200
2 years from June 1978

file: 77-0162

contact: Dr R.H.B. Exell
Associate Professor of Applied Physics
Division of Agricultural and Food Engineering
Asian Institute of Technology
Bangkok, Thailand

Objectives

To develop a low-cost method of drying rice paddy from the second harvest, which takes place during the wet season. The drying system will be constructed from materials available locally, and will be powered by natural energy sources including the sun and wind.

Background and Progress

Several excellent small flat-bed dryers have been designed in the last few years. However, all these dryers use air heated, and distributed through the grain, by engine power. For the wet-season harvest, the poorest farmers need a simple, inexpensive, drying method which does not require an engine, yet is not subject to the drawbacks of the traditional method.

A prototype solar rice dryer has been designed to meet these needs. It is built on a mound of earth. The air heater consists of a layer of burnt rice husks to absorb solar radiation, and a clear plastic cover on a simple wooden framework to form an air duct. The entrance to the air heater faces south, the direction from which the prevailing wind blows during the wet season. Air from the heater passes through the rice, which rests on a wire mesh floor made of mosquito netting supported by a wooden lattice. The space above the rice bed is enclosed by clear plastic sheet walls to protect the paddy from rain and keep the air inside warm. Several prototypes of this dryer are now being tested on farms in close cooperation with the Ministry of Agriculture Department of Extension and modifications are being made to optimize its performance.

Village-Level Rice Milling (Thailand)

IDRC grant: $77 500
2 years from May 1979

recipient contribution: $32 000
file: 78-0055

contact: Mrs Sriwai Singhakajen
Chief, Storage and Processing Section
Department of Agriculture
Bangkok, Thailand

Objectives

To develop and test a village-level rice mill, suitable for local manufacture; to test and demonstrate advanced and suitable prototypes among the rural community; and to stimulate and encourage local industry to manufacture the unit developed, by provision (at cost) of design drawings and supporting information, thus promoting uniform production and securing interchangeability of maintenance parts.

Background

In Thailand, as in most other rice-producing countries, a large percentage of the paddy harvest is retained by the farmers to meet subsistence needs. The total quantity of paddy stored at farm and village levels is enormous, but is distributed in small quantities over millions of farmers and village families. When not hand-pounded, this paddy is normally processed in small milling units. In 1974, the Thai Department of Agriculture, initiated a research and development program to produce a single-pass village-level rice mill. This effort resulted in the construction of a prototype, single-pass, double-roll, abrasive milling unit. Although the first performance tests demonstrated the need for further research, they also indicated good prospects for success with further improvement.

The initial phase of this project consists of a survey of locally manufactured village-level rice mills currently available and used in Thailand. Based on the survey results, the design criteria for a single-pass rice mill will be determined. Based on these criteria, a prototype rice mill will be designed, manufactured, and tested on rice varieties popularly used for local consumption in the various areas. The project staff will cooperate closely with the local manufacturers and the resulting newly developed technology will be transferred to them.

Cowpea Storage (Upper Volta)

IDRC grant: $110 000 — recipient contribution: $43 000
2 years from January 1979 — file: 77-0159

contact: M.J. Kaboré
Directeur, Ministère du Développement Rural
Directeur des Services Agricoles
Ouagadougou
République de Haute-Volta

Objectives

To reduce losses in cowpeas during storage. Specifically: to determine what storage techniques can be applied successfully to traditional farm and village storage systems within the area; to improve traditional farm storage systems in the area by the introduction and adaptation of techniques found successful in other areas of the region; and to train local scientists in postharvest systems research.

Background

Like most of the rural population in West Africa, the people of Upper Volta depend for much of their protein intake on cowpeas. Much progress has been made by plant scientists in breeding drought- and insect-resistant varieties; however, the increased production made possible by these advances compounds the problem of storage losses experienced with traditional storage methods.

Sorghum/Millet/Cowpea Utilization (Upper Volta)

IDRC grant: $77 300 recipient contribution: $46 400
2 years from October 1979 file: 78-0116

contact: M. Georges Semporé, Directeur
Cellule d'alimentation et de nutrition du Secrétariat
permanent du Comité de coordination du développement rural
B.P. 7010
Ouagadougou, Haute Volta

Objectives

The overall objective of this project is to develop a procedure for evaluating the quality of sorghum, cowpea, and millet cultivars in Upper Volta. Specifically: to develop utilization tests for the three grains based on Upper Voltaic foods; to determine the standard physical and chemical characteristics of these three grains; and to determine the acceptability of various new cultivars in comparison with standard established types from these three grains.

Background

Because sorghum, millet, and cowpeas are widely grown and consumed in Upper Volta, research that determines the quality of new cultivars will have a significant impact on the lives of many of the producers and consumers of these crops. At the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) crop improvement programs are developing new varieties of sorghum, cowpeas, and millet. If the availability of these crops is to be improved by introducing new high-yielding varieties, the varieties must be suited to the customary end uses of these grains. Often researchers are faced with the problem of nonacceptability of varieties that, from a production standpoint, are very much improved over the traditional varieties. Thus it has become increasingly necessary to investigate the characteristics of traditional varieties associated with acceptability from a consumption standpoint. This information can then be transmitted back to the plant breeders for inclusion in their routine selection procedures.

Related IDRC Publications and Films

***IDRC-004e**
Osmotic dehydration: a cheap and simple method of preserving mangoes, bananas and plantains. G. W. Hope and D. G. Vitale. Ottawa, 1972, 12p.

***IDRC-016e**
Consumer food utilization in the semi-arid tropics of Africa: report of an interdisciplinary workshop, Zaria, Nigeria, 30 April–4 May 1973. IDRC. Ottawa, 1973, 16p.

***IDRC-020e**
Cassava utilization and potential markets. Truman P. Phillips. Ottawa, 1973, 182p.

IDRC-021e
Nutritive value of triticale protein. Joseph H. Hulse and Evangeline M. Laing. Ottawa, 1974, 183p.

***IDRC-022e**
Consumer preference study in grain utilization, Maiduguri, Nigeria. Jean Steckle and Linda Ewanyk. Ottawa, 1974, 47p.

IDRC-023e (revised edition)
Directory of food science and technology in Southeast Asia. E. V. Araullo, compiler. Ottawa, 1975, 267p.

***IDRC-031e**
Cassava processing and storage: proceedings of an interdisciplinary workshop, Pattaya, Thailand, 17–19 April 1974. E. V. Araullo, Barry Nestel, and Marilyn Campbell, editors. Ottawa, 1974, 125p.

IDRC-033e
Interaction of agriculture with food science: proceedings of an interdisciplinary symposium, Singapore, 22–24 February 1974. Reginald MacIntyre, editor. Ottawa, 1974, 166p.

IDRC-041e
Stable tropical fish products: report on a workshop, Bangkok, Thailand, 8–12 October 1974. Marilyn Campbell. Ottawa, 1975, 27p.

IDRC-053e
Rice: postharvest technology. E. V. Araullo, D. de Padua, and Michael Graham, editors. Ottawa, 1976, 396p.

IDRC-055e
Cowpeas: home preparation and use in West Africa. Florence E. Dovlo, Caroline E. Williams, and Laraba Zoaka. Ottawa, 1976, 96p.

***IDRC-058e**
Removing constraints to small farm production: the Caqueza project. H. G. Zandstra, K. G. Swanberg, and C. A. Zulberti. Ottawa, 1976, 32p.

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*Available in microfiche only.

***IDRC-062e**
Hidden harvest: a systems approach to postharvest technology. David Spurgeon. Ottawa, 1976, 36p.

IDRC-089e
Agriculture, Food and Nutrition Sciences Division: the first five years. Ottawa, 1977, 49p.

IDRC-114e
Cassava harvesting and processing: proceedings of a workshop held at CIAT, Colombia, 24–28 April 1978. E. J. Weber, J. H. Cock, A. Chouinard, editors. Ottawa, 1978, 84p.

IDRC-123e
Sorghum and millet: food production and use. Report of a workshop held in Nairobi, Kenya, 4–7 July 1978. Sally Vogel and Michael Graham, editors. Ottawa, 1979, 64p.

***IDRC-TS1**
Food legume processing and utilization (with special emphasis on developing countries.) Alvin Siegel and Brian Fawcett. Ottawa, 1976, 88p.

***IDRC-TS2**
Maiduguri mill project: grain milling and utilization in West Africa. IDRC. Ottawa, 1976, 16p.

***IDRC-TS7e**
Nutritional standards and methods of evaluation for food legume breeders. J. H. Hulse, K. O. Rachie, and L. W. Billingsley. Ottawa, 1977, 100p.

Films

When the Harvest is Over

Filmed and produced by Neill McKee, the film is a coproduction of the IDRC's Audiovisual Unit and the Kenya Ministry of Agriculture's National Agricultural Laboratory (1978), 34 minutes.

Pods of Protein

Filmed and produced by Neill McKee, the film is a coproduction of IDRC and IITA (1979), 23 minutes.

Publications and films may be obtained from:

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