

GRAIN MILLING AND UTILIZATION (NIGERIA):  
AN EVALUATION

Phase I - 3-P-72-0003

Phase II - 3-P-73-0128

RECIPIENT INSTITUTION: Federal Ministry of Agriculture  
and Rural Development  
North Eastern State  
Maiduguri, Nigeria

DURATION: Phase I - Feb. 1972 to Dec. 1973  
Phase II - Aug. 1974 to June 1978

IDRC CONTRIBUTION: Phase I - \$147,250  
Phase II - \$160,000

October 1978

## 1. THE RESEARCH PROBLEM

### 1.1 Background

Economic development in Northern Nigeria in the past ten years has resulted in a rapid increase in the size of its towns and cities, along with accompanying changes in the life style of the urban and semi-urban population. Parallel to this increase in the urban population is an anticipated increase in agricultural output as a result of the Federal Government's ambitious development program for Northern Nigeria.

The North Eastern State was the largest of the northern states, accounting for two-thirds of the land area of Northern Nigeria with a population of approximately 10 million (one-third of the Northern Nigeria population). The main crops are sorghum and millet for food grains; peanuts and cotton for cash export crops; and small amounts of rice, cowpeas and wheat. Wheat is gaining in popularity, costing as much as rice in the market place; the other grains less. There are approximately 1.3 million farmers cropping 9 million acres with holdings ranging from 2 to 50 acres, the average farm size being 5 to 7 acres. There are 3 million acres of sorghum and 2 million acres of millets planted annually. Eighty-five per cent of the output is either consumed at home or traded in the rural areas with the remaining 15 per cent entering market channels or a growing commercial grain industry.

A high percentage of all grains marketed in the urban areas are mechanically ground after they have been manually decorticated, and an increasing percentage of manual dehulling is being performed on a fee for service basis outside the home.

The small, rural plate grinders of Northern Nigeria are frequently overcrowded and an evident need exists for additional and improved capacity. The existing system of manual home decortication and machine grinding is unsanitary, wasteful, and time-consuming. The capacity of a typical plate grinder ranges from 10 to 20 bags of grain (i.e., 0.5 to 1 ton) per day depending upon the condition of the grinding plates, the drive belt, the engine and the general overall technical competence of the operators. Each grinder serves only 10 to 20 customers each day and losses are believed to be very high; consequently, the process is both wasteful and uneconomic. It was visualized that installation of a pilot research mill of improved technical efficiency and increased capacity, which would produce both packaged flour and grits as well as animal feed, would help satisfy the increasing demand for higher quality flours and would improve the efficiency of the rural milling industry and the general economy of the North Eastern State of Nigeria to a significant degree.

## 1.2 Project Development

The Permanent Secretary of the Federal Ministry of Agriculture and Natural Resources, Nigeria, approached IDRC with a proposal that it collaborate with the Government in developing an improved rural milling system. It was suggested that an experimental pilot mill be established at Maiduguri in the North Eastern State, with support from both the Federal and North Eastern State Ministries of Natural Resources.

A project was defined in which it was hoped that an improved milling system (based on the addition of a prototype dehuller, which had shown promise when tested at the University of Guelph) could be developed within the context of a total systems study of the grains and grain legumes produced, marketed and distributed within Northern Nigeria. It was recognized that no one institution possessed the capability to carry out such a program, but it was hoped to develop supporting projects at the University of Ife and with the Industrial Research and Development Unit of the Nigerian Ministry of Industry.

The project was established in two phases, the first phase being devoted to the development of a pilot flour mill. Associated activities included consumer grain preference and marketing studies, milled product evaluation, and new product development in a test kitchen. The second phase completed the development, with subsequent monitoring of the pilot flour mill operations, quality control and product development testing. In addition, the setup, operation, and management of a bakery for the preparation of Nigerian-style bread containing sorghum flour is a major activity of this phase.

The Nigerian Federal Ministry of Natural Resources agreed to pay for the initial construction of the mill; the provision of the site and maintenance costs would be the responsibility of the State Ministry of Natural Resources; and the equipment plus any consultancies required would be paid by IDRC. It was further agreed that the Federal Government would provide a revolving fund of \$15,000 which, along with the income received from the sale of the milled products, were expected to cover all operational expenses. After a minimum period of five years of mill operation, the mill would then be turned over to the State Ministry to be run on a continuing basis.

The State Ministry of Natural Resources was to take on the responsibility for running the entire project, with the Division of Agriculture responsible for the mechanical operation and maintenance of the mill, and the Cooperative Division (through the Cooperatives Union) responsible for the commercial aspects of the operation such as the purchase of grains and the marketing of the finished products.

It was proposed that the Cooperatives Union would pay to the Government a fee for the milling of the grains and the packaging of the finished products. This milling fee would be determined for each kind of grain during the running-in trials of the mill. However, it

was decided at the end of the first phase that the Cooperative Division would only supply grain to the mill with the mill management being responsible for marketing the processed grain itself. This was a more realistic procedure since it allowed the development and testing of a marketing and pricing system for the mill.

### 1.3 Objectives

The objectives were not specifically defined in Phase I, but the problems associated with an inadequate milling system in the semi-arid tropics were well understood. The general objective was to look for ways and means to improve the rural milling system in the North Eastern State through the development of a suitable mill and ancillary equipment producing basic and composite flour for the local market. Since the proposed milling process could mill both cereal grains and grain legumes, leaving a high protein layer with the endosperm, a distinct possibility existed for the production of inexpensive high-protein foods and new simple rural technologies which could eventually be demonstrated and repeated across the entire sub-Sahara zone of Africa and through certain parts of Southeast Asia.

In August 1974, a Phase II of this project was implemented with the following objectives:

- a) to investigate the traditional post-harvest grain system in the Northeast region;
- b) to develop a suitable system for milling Nigerian grains to produce basic and composite flours for local markets;
- c) to adopt and develop methods and technologies for the production of bread, noodles and infant foods to increase the protein content of foodstuffs; and
- d) to conduct economic analyses of grain processing and consumer preference studies for new products generated by the project.

## 2. PROJECT PERFORMANCE

### 2.1 Personnel and Resource Use

In addition to the resource inputs listed in Section 1.2 above, IDRC granted a \$15,000 supplement near the end of Phase I. This was to allow for major modifications to the milling system for the removal of stones and other foreign objects, and to pay for shipment of grains to the University of Saskatchewan, where IDRC subsequently developed a supporting project to this project.

The project personnel have been recruited from the State Ministry of Natural Resources, and at the time of their being

seconded they had very little experience in the running of test trials or managing commercial operations. The Nigerian input consisted of a manager, accountant, mechanic, casual staff and test kitchen personnel (two home agents). IDRC provided three CUSO advisors, a number of other consultants and a relatively high level of IDRC Program Officers' input as a result of the lack of qualified Nigerian personnel.

## 2.2 The Research Program

It had been originally hoped to develop a mill producing a throughput of 3 to 5 tons of finished products per 9-hour working day. Very shortly after the original dehuller was installed, it became apparent that the actual production potential was only one-tenth this desired rate, far too low to warrant this type of investment. Moreover, the mill would only process millet, sorghum and maize, and not cowpeas, the most common legume in Northern Nigeria.

To solve this problem, the Prairies Regional Laboratory (PRL) in Saskatoon modified an existing thresher which appeared to have ten times the capacity of the original dehuller. In a series of tests conducted in Maiduguri, the capacity of the various components was determined, and it was found that no combination of existing equipment produced a sufficiently high percentage of fine flour which a Consumer Preference Study (1973) indicated was required. A series of grinding trials were conducted comparing the percentage of fine flour produced by a hammer and plate grinder. It was found that the hammer mill gave the highest percentage but that it tended to clog. The problem was solved by PRL identifying an existing model hammer mill which produced the quality of fine flour required.

In Phase II, following this success with the mill, a bakery was constructed and installed, producing bread at a higher rate than expected though the percentage of sorghum incorporated into the bread is not as high as originally planned.

## 2.3 Technical Achievements

The first objective of investigating the traditional post-harvest grain system in the Northeast region led to an economist's survey in April 1972, on food grains production, marketing and consumption. It was this survey that produced the earlier estimate of only 10 to 15 per cent of grains entering the commercial market channels. The survey also showed that most of the grain moved from the original market place to secondary and terminal markets for further sale.

The second objective of developing a suitable milling system for Nigerian grains to produce basic and composite flours for local markets has been achieved although this required an additional year in a second phase. During the first nine months of 1975, the average number of kilograms of grain processed per milling day increased

from 606 kilograms to 944 kilograms (an increase of 56 per cent). By the end of the first nine months of 1976, the average daily weight of grains milled per milling day was 1800 kilograms (an increase of 90 per cent in one year).

The average composition of the milled product is 34 per cent flour, 46 per cent grits and 20 per cent middlings, with an average milled extraction rate of 75 per cent of grain used. Sorghum and maize are being packaged in 2-kilogram plastic bags which are heat sealed. Bran (dussa) is also sold in sacks of 68 kilograms.

Results obtained from the pilot mill during the first nine months of 1976 showed an average production of 1.43 tons per 8 hour milling day (the actual machines run separately for 6 hours per day) and a profit of ₦1.76 per 100 kilograms whole grain, giving a return of 8.62 per cent (see Appendix A).

The significance of the new technology examined in Maiduguri lies in the dry nature of the entire processing cycle, particularly in the decortication stage. This dry process has been able to extend the product shelf life to a minimum of two weeks, from the one to three days maintained by the traditional manual method of wet milling. The problem with the traditional method is that the wet-milled product becomes moldy very quickly. Water added to the grain during the process results in fermentation taking place - the higher the moisture content of flour, the quicker the fermentation.

The present system of manual decortication leads to exceptional losses with only a 65 per cent recovery rate of usable grain. The pilot mill can achieve a recovery rate of up to 80 per cent. With sorghum production estimated at 800,000 tons in North Eastern State the improved mill could result in an increase of usable sorghum grain of 60,000 tons per year assuming half of the sorghum grain is milled in the new milling system.

The third objective of adopting and developing methods and technologies for the production of bread, noodles and infant foods to increase the protein content of foodstuffs has only been partially met.

The bakery originally designed to produce 500 loaves of bread per day is operating at full capacity and producing 700 small loaves or 400 large ones. The population has readily accepted the bread which is produced with a sorghum flour component varying from 5 to 20 per cent. The percentage of sorghum incorporated into the bread is not as high as originally planned due to the additional labour required to develop the sorghum dough.

The bread appears to sell well, but it is difficult to tell whether it is due to consumer preference for the taste of sorghum or because, at present, the private bakeries must often buy their flour on the black market (unlike the government mill) and produce a loaf

below the government stipulated minimum weights.

A test kitchen was established at the mill with a Nigerian home economist in charge. The work program of the test kitchen involved: milled-product quality control; traditional food-product recipes; development, testing and consumer acceptance of recipes; and demonstration to home agents.

IDRC supported a parallel project for two years at the College of Home Economics at the University of Saskatchewan. The physical and chemical properties of the flours were analysed to determine how the properties affected the preparation and quality of traditional foods. The development of new high-protein products containing sorghum, millet and cowpea flours also received attention. A technique for preparing fried snacks containing various blends of these flours was established. Nutritional evaluation of the product blends confirmed their high-protein composition (approximately 15 per cent). Another important research area was the preparation of Nigerian-style homemade noodles (taliya) with a partial replacement (up to 50 per cent) of wheat flour by various blends of sorghum, millet and cowpea flours. These noodles resembled regular all-wheat noodles with respect to cooking quality and texture, and contained between 12 to 16 per cent protein (14 per cent moisture basis). The techniques developed in this project have been tested and demonstrated through the Maiduguri test kitchen to small processors, including housewives, and have resulted in several modifications to the University of Saskatchewan recommendations.

The fourth objective of conducting economic analyses of grain processing and consumer preference studies for new products generated by the project has also been met. The project has kept careful records on the profitability of the mill, and a major study will be carried out through the National Grains Production Company (NGPC) to determine where and how new mills could be beneficially introduced in Northern Nigeria.

The baseline Consumer Preference Study which was undertaken in 1973 covered 1,100 urban households. This was the first time such a study had been carried out on such a large scale in Northern Nigeria. The study revealed an increase in the use of packaged flours for preparing traditional staple cereal foods and a shift to processed foods. The potential for developing nutritious foods from cereal and legume flours was evident. The survey also indicated that nontraditional foods derived from prepared flours are gaining popularity as part of the Nigerian food pattern with bread becoming a popular breakfast food. At the time of the survey, 64 per cent of the households were purchasing bread, more than half of which was being purchased daily.

The results of this study have been used by FAO and other agencies such as the Group for Assistance of Stored Grains in Africa (GASGA) who are also active in this field in Africa.

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## 2.4 Institutional and Human Development

IDRC realized during the initial negotiations on this project, that the Nigerian State Ministry of Natural Resources had no research capability, nor were they likely to undertake any major research programs on integrated post-production systems such as an appropriate grain mill design. Therefore, it was anticipated that IDRC would have to provide substantial technical support through the use of consultants. Failure by the University of Ife and the Food Research Institute in Lagos to maintain their initial interest in the project presented a disadvantage in that it greatly increased the amount of support and guidance required by IDRC. In Phase I, IDRC had to hire outside consultants in the form of engineers, economists and one cereal technologist. Again in Phase II, engineers were required for the installation of new equipment and an economist's services were required along with those of a home economist.

The personnel development program was limited to technical training in specific operational activities. Three people have been trained outside of Nigeria: a mill mechanic, one accountant and one home economist.

The turnover of mill managers has been a continuing problem. There have been five to date making an effective training program difficult. The mill managers have been selected from regular Ministry of Agriculture staff, and the present Permanent Secretary and Chief Agricultural Officer have freely admitted that those people generally have no commercial experience and are not capable of managing a mill without outside support.

While the project has not contributed greatly to improving the research and top management capabilities of Northern Nigerians, IDRC project officers feel that the permanent mill and bakery staff have developed considerable experience in operating the technical equipment available. It should also be added that a mill management system with management records, purchasing policy, and other elements have been developed which should allow the Cooperatives' personnel who are experienced in commercial operations to take over and run the operation without having to develop a management and accounting system for the mill.

## 2.5 Management and Coordination

It was originally planned that a Mill Management Committee would be established with representatives from both the State Divisions of Agriculture and Cooperatives. While a Management Advisory Committee was established, it functioned as an advisory board only, making recommendations to the Permanent Secretary of Agriculture. This resulted in a lack of flexibility in mill policy and operating procedures. One example has been the mill's pricing policy. Selling prices were determined by the Advisory Committee in mid 1977, but market prices for grains and flours have risen



dramatically since then, due apparently in part to farmers withholding grain from the market. This has significantly reduced the margin between input and output prices for the mill with the wholesalers able to increase their makeup from 8 cents per kilogram to nearly 50 cents.

## 2.6 Administrative Problems

IDRC staff believe that one of the most serious problems encountered in this project was the continuing lack of Nigerian Government support in terms of providing qualified technical and managerial staff. One of the reasons for this was that the Federal Ministry of Natural Resources which developed the project decided to place the project in Maiduguri with the State Ministry of Natural Resources responsible for providing management, staff and other support to the project. The State Ministry of Natural Resources was not very large and did not have any capable staff. The ability of the State Ministry to provide adequate support to this project was also seriously affected by a number of administrative changes, particularly the transfer of the Cooperative Division out of the Ministry of Natural Resources into its own Ministry. IDRC staff encouraged the Government to transfer the pilot mill to the Cooperative Ministry since Cooperatives had more expertise in running commercial enterprises, but it was decided to leave the mill project with the Division of Agriculture in the Ministry of Natural Resources. IDRC staff felt that the Cooperative Ministry would be able to provide better management to the mill as they operated a number of commercial operations, including large-scale purchasing and sales of grain and a number of consumer cooperative retail stores throughout the State.

In operational terms, the major problem was a lack of close mill supervision after the CUSO advisor left in early 1976. This occasionally resulted in a severe shortage of spare parts with nobody below the level of Permanent Secretary able to accept any responsibility for the mill. This, coupled with the fact that the management wished to have a consistent supply of flour being packaged even during the experimental trials, led to several operational problems in running the trials.

IDRC's financial contribution has been predominantly (70 per cent) Centre administered. The remaining 30 per cent which has been recipient administered has been used for operating costs and minor equipment purchases. IDRC administered a large proportion of its contribution since there were few experienced personnel in either the Government or private sector at the time who could act as a purchasing agent on behalf of the project. It was also due to the nature of the project itself which used milling equipment available in Canada. The earliest and simplest procedure was to have IDRC purchase it in Canada and ship it to Nigeria.

### 3. NATIONAL LINKAGES AND DELIVERY SYSTEM

The University of Ife, the Food Research Institute in Lagos, and the Industrial Research and Development Unit of the Nigerian Ministry of Industry had all expressed some interest in undertaking supporting research for this project by using the products of the mill together with starch and flour from cassava and other root crops to make a variety of cereal products. None of these institutions could be encouraged to develop adequate proposals. The Industrial Research and Development Unit was primarily interested in wheat milling and not sorghum and millet, the primary cereal crops of Nigeria. However, Ahmadu Bello University (ABU) and the University of Ibadan both provided some support for this project. ABU was very interested and a number of staff visited the project and provided advice on storage, sanitation and development of the test kitchen to test the acceptability of different mill products. A project to examine the utilization of cowpea flour at the University of Ibadan was subsequently developed.

The Nigerian Federal Government indicated, during the initial development of this project, that as soon as an improved cereal and legumes milling system could be developed they would provide the resources to ensure its widespread utilization throughout Northern Nigeria. However, the Government had no firm policy at that time of how these mills would be developed and whether the private sector, co-ops, or a government agency would be the primary agent for operating these mills. In 1975 the Federal Government established the National Grains Production Company (NGPC), a quasi-government corporation, with a mandate to develop programs on grain production, storage and processing. As a first priority, the NGPC concentrated on the development of storage facilities. With the subsequent creation of a National Grains Board responsible for normal market operations and eventually price stabilization, the NGPC has concentrated on the development of a strategic storage system. The NGPC has now developed its storage program (82,000 tons stored in nine states with an eventual objective of 250,000 tons kept as strategic capacity) and is planning to begin development of commercial production and processing operations.

The NGPC requested IDRC to provide consultants familiar with the Maiduguri project to undertake a major feasibility study on the establishment of commercial mills throughout Northern Nigeria based on the Maiduguri system. The NGPC has committed 42,000 Naira (U.S. \$63,000) to cover all Nigerian costs. (NGPC was originally under the impression that IDRC was a commercial consulting firm which NGPC could contract to undertake this study.) This study is a logical follow-up to the work undertaken at Maiduguri since the operational efficiency of the milling system has been clearly established. This study, which is expected to be completed in the fall of 1978, will examine the effect of introducing the Maiduguri mill system on the present production, marketing and processing system, as well as

undertaking a detailed study on the commercial feasibility of these new mills in different locations with recommendations on the size, equipment and management required for each mill. The study will not be restricted to recommendations only for NGPC's use since the NGPC has indicated it is prepared to cooperate with, or promote, these mills in the private sector or with the Co-ops. NGPC's capability to establish and operate a number of such mills appears to be limited at present and it is expected that the study will recommend a carefully phased expansion of these mills to allow the development of management and operational expertise.

Recently, the Home Economics Division of the State Ministry of Local Government has been actively involved in disseminating some of the tested recipes to the surrounding communities, in developing educational material, and in writing articles for the local magazine. The Home Economics Division is also now engaged in the preparation of a booklet to be used by extension people and in the schools. Most secondary schools in Maiduguri have visited the mill, the bakery and the test kitchen.

#### 4. THE BENEFICIARY

This project was developed on the assumption that an improved milling system could have important benefits both for the consumer in terms of a more assured supply of sanitary, convenient and processed grain products, and for the producer in terms of an increase in effective demand for his cereal and legume crops. The existing mills in the region can only grind and not dehull grain and are regarded as inefficient and unsanitary, and probably unable to handle increasing grain production in the North. The limited information available indicated that while up to 90 per cent of the grain produced in the region was still processed completely in the household, there was an increasing market for mill products in the urban and semi-urban areas due to the rapidly changing social and economic structure in Northern Nigeria.

The main advantage of the new mill is the addition of a mechanically dry decorticated grain. Other advantages are: reducing the real losses from cereal processing; increasing consumer choice and responding more effectively to the changing conditions in traditional consumer markets; and opening new markets for domestic cereal and legume crops. These factors have largely been confirmed by the various studies undertaken during the project.

a) The increased shelf life of mill products, due to dry mechanical decortication, provides an opportunity for cooperatives or other organizations to enter the market since they are unable to handle and distribute the present product with its short shelf life. The entry of co-operatives and other commercial organizations into the distribution system may help to reduce the present monopoly

situation in processing that exists in many towns in the North and to reduce price fluctuations caused by hoarding and other factors. The first study under this project carried out by a Canadian consultant in 1972 indicated that speculators are active at each step of the post-producing system with resulting instability in prices over the crop year and between markets at the same point in time. Thus, crop prices for the Maiduguri market increased fivefold in 1971, while price differentials between four market centres in the area showed a difference of 30 to 40 per cent at the same point in time.

b) The pilot mill provides a better response than the existing system to the changing market requirements of consumers in the urban population in the region. The Consumer Preference Study, carried out in 1973 as part of the project, showed that the compound household style, with large families and a number of wives able to share the labourious daily job of grain processing, is disappearing and being replaced by single family units. The study indicated that 30 per cent of the urban population now live in rented rooms which are inconvenient for grain processing and grain storage. More women are being employed outside the home and an increasing number of children are going to school, making them less available for household work. At the same time, 40 per cent of the children performed the task of carrying manually dehulled grain to an existing mill for grinding.

Thus, the practice of pounding grain to prepare flour in each household is disappearing and more households are having their grain dehulled as well as ground outside the home. This trend to increased commercialization of grain processing is matched by an increased use of convenience food products and the purchase of packaged flour.

c) The establishment of these mills in Northern Nigeria should increase the utilization of cereal and legume crops produced in the North. The only commercially milled and packaged flour available in the region is wheat or maize flour milled either in Lagos or Kano. The Consumer Preference Study indicated that 50 per cent of the Maiduguri households purchased this kind of packaged flour at least once a month. It is expected that this market will grow rapidly. There is an increase in movement of people from different regions of Nigeria into the cities with food preferences for products not readily available and an increase in high-income consumers who wish to purchase only commercially milled products.

One of the adverse effects of this new milling system could be a reduction in employment opportunities for women processing grain in the home for sale, particularly the dehulling operation since the Consumer Preference Study indicates that the existing grinding mills have already taken over much of the flour milling in Maiduguri. It appears that this improved mill can produce flour and other products as cheaply as the existing system of home dehulling and grinding in the small mills. However, it is expected that these new mills will compete, at least in the initial stages, most directly with the similar products produced by the large automated mills in

Lagos and Kano which are primarily using imported wheat. There is even some direct importation of wheat flour into Nigeria. The planned NGPC study will provide a better data base on which to assess the markets and competitive impact of the Maiduguri milling system.

## 5. REGIONAL LINKAGES

The experience gained in this project and the equipment developed have formed the basis for two other projects: one in Senegal and another in Botswana. These are attempting to develop milling systems appropriate to the specific individual requirements of these areas.

While the mill has been able to readily produce a cowpea flour, the Consumer Preference Study indicated that housewives prefer a wet-milled flour. This information led to the development of a cowpea utilization network involving the University of Ibadan, the Food Research Institute in Ghana, the Maiduguri Mill and the University of Saskatchewan Home Economics Department which is analysing cowpeas processed at the mill to examine the differences between dry-milled flour, as produced in the mill, and wet-milled flour as traditionally produced by the housewife. The purpose is to determine the possibilities of substituting the mechanical dry-milled flour for the manual wet-milled type.

## 6. IDRC'S ROLE AND INVOLVEMENT

As originally conceived, IDRC's role was to oversee machinery installation and provide on-site advisory services on machinery operation, milling system trials and general mill management with consulting experts advising on specific project functions as the need arose. An effort was made from the start to keep a low profile on this advisory function and have the mill managed and run by local staff. Due to the problems experienced by the State Division of Agriculture in providing experienced management personnel, IDRC has had an active role in providing support staff and outside consultants and in administering project funds.

As Nigerian involvement was limited, the Nigerians tended to conceive of the mill as somewhat of a "turnkey" operation, with IDRC responsible for implementation and direction of the project. It was difficult to correct this misconception of IDRC's role because of the frequent change in Ministry structure and senior Ministry personnel. The only real concern expressed by the Nigerians was the lack of spare parts which had occasionally led to the shutdown of mill operations. The lack of efficient spare parts maintenance and purchase system that can be operated by mill staff is still a problem, requiring continued IDRC support.

While IDRC's staff input appears to be quite heavy, much of it was directed, in whole or part, towards ancillary research.

## 7. BROADER DEVELOPMENT IMPLICATIONS

The development of this efficient milling system at Maiduguri could have a substantial impact on the economy of Northern Nigeria through reducing post harvest losses, imports and increasing consumer choice, although most of the grain being produced in this region will continue to be processed in the household for some time. The results achieved with the more recent projects in Botswana and Senegal, based on the experience derived from this project and the similarity of crops, processing systems and economic conditions elsewhere in Africa, indicate that this milling system could have a wide regional application. IDRC staff are exploring CIDA's interest in helping to finance the development of a number of these mills in other African countries.

An equally important result of this project was that it served as a model for the development of an integrated approach to a post-production systems program in Africa, providing a practical example of how research on such components as consumer preferences and market research, processing and new product development, can be effectively linked.

The use of this project as a model justified the extensive management input that was required by IDRC staff. IDRC staff have been unable to identify many research institutions which are sufficiently broad based to be able to carry out an integrated systems approach to post-production research or which have the interest or resources to maintain a research program from the initial research through to correcting all the operational problems of a pilot unit tested under typical market conditions.

APPENDIX A

Cost and Returns from Own Operation\*

	<u>Total Mill ₦N</u>	<u>Per 100 kg Whole Grain ₦N</u>
<u>Sales</u>		
Flour	18,420.00	
Grits	23,988.90	
Middlings	9,454.50	
Dusa	3,491.16	
<u>Total Value of Production (A)</u>	65,354.56	22.38
<u>Whole Grain Costs</u>		
Sorghum	21,600.00	
Maize	21,027.00	
<u>Total Cost of Grains (B)</u>	42,627.00	14.60
<u>Gross Margin (A-B) = (C)</u>	22,727.56	7.78
<u>Mill Operation Costs</u>		
- <u>Variables</u> -		
Milling labour wages	4,183.18	1.43
Fuel, Oil and Grease	642.60	0.22
Packaging Supplies	2,840.37	0.97
<u>Total Variable Costs (D)</u>	7,666.15	2.62
<u>Margin above Variable Costs (C-D)</u>	15,061.41	5.15
- <u>Overhead Costs</u> -		
Mill Management Salaries	7,556.30	2.58
Guardian Wages	1,272.75	0.43
Depreciation	1,125.00	0.38
<u>Total Overhead (E)</u>	9,954.05	3.40
<u>Total Mill Expenses (D+E) = (F)</u>	17,670.20	6.02
<u>Margin above Total Costs (C-F)</u>	5,107.36	1.76
<u>Profit %</u>		<u>8.62%</u>

\* Depreciation charges are excessive by approximately 30 per cent, given the presence of equipment not required in the operation of a commercial mill. Furthermore, both capital and labour charges are higher than need be in comparison to a regular commercial operation.

# APPENDIX B

## Budget and Actual Expenditures

### GRAIN MILLING (NIGERIA)

#### PHASE I

#### PHASE II

	YEAR 1			YEAR 2			YEAR 3			YEAR 4			CUMULATIVE		
	<u>Budget</u>	<u>Actual</u>		<u>Budget</u>	<u>Actual</u> *	<u>% Spent</u> *	<u>Budget</u>	<u>Actual</u>	<u>% Spent</u>	<u>Budget</u>	<u>Actual</u>	<u>% Spent</u>	<u>Budget</u>	<u>Actual</u>	<u>% Spent</u>
Salaries & Allowances	4,000	-		4,000	8,208	102.6	-	-	-	-	-	-	8,000	8,208	102.6
Research expenses	8,000	-		11,000	19,587	103.1	15,000	14,636	97.6	15,000	10,960	73.1	49,000	45,183	92.2
Capital expenses	23,750	-		15,000	49,961	128.9	51,000	15,242	29.9	5,000	34,044	680.1	94,750	99,247	104.7
Training	3,000	-		-	5,643	188.1	5,000	-	-	5,000	1,388	27.8	13,000	7,031	54.1
Travel	1,500	-		2,010	886	25.3	-	141	-	-	-	-	3,500	1,027	29.3
Publications	-	-		5,000	1,208	24.2	4,000	-	-	4,000	-	-	13,000	1,208	9.3
Consultancy	16,000	-		11,000	51,553	190.9	20,000	9,827	49.1	20,000	20,058	100.3	67,000	81,438	121.5
Contingency Recipient	2,000	-		2,000	1,121	28.0	-	70	-	-	10	-	4,000	1,201	30.0
TOTAL	58,250	-		50,000	138,167	127.6	95,000	39,916	42.0	49,000	66,460	135.6	252,250	244,543	96.9

\* Both Years



APPENDIX C

GRAPH 1: GRAIN MILLING (NIGERIA)

