

**COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
(CSIR)**



**FOOD RESEARCH INSTITUTE
(FRI)**

2000 ANNUAL REPORT

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February 2001

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CHAPTER 1 EXECUTIVE SUMMARY

The Food Research Institute (FRI) is one of the 15 institutes of the Council for Scientific and Industrial Research (CSIR). FRI's vision is to be recognised nationally and internationally as an S&T Institution that is playing a key role in the transformation of the food processing industry to be internationally competitive with particular reference to product safety, quality and presentation. The FRI's mission is primarily, to conduct market oriented applied research and provides technical services and products profitably to the private sector and other stakeholders.

The overall goal of the Institute is to assist in poverty alleviation through the creation of opportunities for generating and increasing incomes within the micro, small, medium and large scale food industry; contribute to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly.

A year after the completion of the National Agricultural Research Project (NARP), most of the projects carried out were donor-assisted projects. Some of these are the Capability Building for Research into Traditional Fermented Food Processing in West Africa, Improving the Utilization and Commercialisation of Soy Processing Technologies and Farmer Participatory Testing of Technologies to increase Sorghum Production in the Sahel.

Among the new projects were those sponsored by the Department for International Development (DFID) and Natural Resources Institute (NRI) of the United Kingdom which includes, *inter alia*, "Marketing and Processing of Bambara Groundnuts (W. Africa)" and "Enhancing the Livelihoods of the Urban Poor through Improvements of Street-vended foods".

During the year many of the scientific staff continued on the PhD programmes and other graduate programmes whilst others returned to post after completing. Many senior and other support staff also pursued their training programmes.

The year under review saw the Institute organising several extension and training services, workshops and conferences. Among these were awareness programmes in the utilisation of cassava and cassava products, processing of pepper and ginger for local food exporters, a workshop of major stakeholders in the street food sector, and a training programme in mushroom cultivation. Some scientific staff attended several conferences, courses, seminars and workshops.

The commercialisation programme in line with the Private Sector Development Project was vigorously pursued. The implementation of the PSDP ended in June 2000. The Business Development and Information Division, which coordinated the income generation activities of the institute, reported a gross income of about ₦203,836,612.00 from various commercial activities and a total expenditure of about ₦150,341,791.70, giving a net income of ₦53,494,820.30. In 1999, of a gross income of ₦116,508,125.00 that was generated net income came to about ₦58 million.

During the year, the Institute received a Chinese delegation led by Professor Han Deqian, Deputy Minister of S & T. Among the Institute's visitors were: Professor M. Jakobsen of the Royal Veterinary and Agricultural University of Denmark, Mr. Moses Mengu of the World Association of International Research Organisations (WAITRO), Dr. R. Myburg, T. Greenhalg, A. Graffam, Mr. Keith Tomlins and Ms. Lynda Hammond from the NRI of the University of Greenwich. Also among the visitors was Professor W. S. Alhassan, Director-General of the CSIR.

PART I GENERAL MATTERS

CHAPTER 2

GENERAL AND ADMINISTRATIVE MATTERS

2.1. Establishment

The staff strength of the Institute as at December 2000 stood at 173.

2000 FRI Staff Strength

	Category of Staff	1999	2000
1.	Research Staff	35	33
2.	Senior Staff	30	36
3.	Junior Staff	104	104
	TOTAL	172	173

Please see Appendix II for the list of scientific and senior staff.

2.2. New Appointments

Dr. W. A. Plahar, Chief Research Officer was appointed Acting Director with effect from May 1, 2000. This follows the retirement of Mrs. Abigail Andah in August 2000.

2.3 Resignations

Two members of staff resigned their appointments during the year.

	NAME OF STAFF	DIVISION	DESIGNATION	DATE OF RESIGNATION
1.	Mr Ernest Ablorh	Processing and Engineering Division	Senior Technical Officer	August 2000
2.	Mr. Kafui Ameh	BDID	Chief Technical Officer	October 2000

2.4 Promotions

Twelve promotions were announced in the course of the year, with retrospective effect from January 2000. Please see Appendix VIII for details.

2.6 Upgrading

The upgrading of three members of staff was announced. Mr. L. Codjoe, Snr Clerk, was upgraded to Snr. Administrative Assistant with effect from 1999, after his completion of Institute of Chartered Secretaries and Administrators (ICSA) certificate course at the Management and Financial Training Institute. Ms. Diana Kuwornu and Ms. Doris Mienye, both skilled labourers were appointed to the position of Telephonists/Receptionists Grade II after they have undergone private training.

2.7. Training

Several members of staff continued on their various training programmes, and others returned to post after completion of their courses. Others embarked on new courses.

2.8 Resumption of Duty after Completion of Studies

A number of staff returned to post after completion of their various courses. Mr. S. B. Noamesi also returned to post after his PhD programme at the Natural Resources Institute (NRI) and the University of Ghana. Mr. Kenneth Aidoo of the Accounts Division has returned to post after his B.Comm. Degree at the University of Cape Coast. Mr. Leslie Codjoe, Senior Administrative Assistant returned to post after completion of the ICSEA certificate course at the management and Financial Training Institute. Please see Appendix III for full details.

2.9. Meetings

Four Management Board meetings were held. The last one was in November where all the staff had the opportunity to interact with the Board members. Three Heads of Division meetings were held during the year. The Internal Management Committee of the Institute was constituted.

2.10 Conferences/Seminars/Workshops

Several Members of Staff participated in a number of conferences, workshops, training programmes and short courses whilst the Institute organised a number of workshops and seminars during the year. See Appendix IV for the details.

2.11 Accounts

The FRI received a total amount of 1,437,944,082 as subvention from the government. Subvention for Administrative Expenses for December 2000 amounting to 14,761,904 was not received. Please refer to Appendix VII for the Statement of Accounts.

PART II DIVISIONAL REPORTS

CHAPTER 3 BUSINESS DEVELOPMENT INFORMATION DIVISION (BDID)

3.1 Introduction

The BDID continues to play an important role in developing commercially effective bridges between the knowledge and expertise of scientists of FRI and the needs and opportunities of the private sector. Internally generated income amounted to about 53 million cedis. The BDID reported Gross Income of about c203,836,612.00 from various commercial activities and a total expenditure of about c150,341,791.70, giving a net income of c53,494,820.30. One hundred and twenty (120) requests were made for technical guidance on food-related subjects.

3.2 Staff Strength

There are 14 permanent staff of which 5 are Research Grade (2 of the research grade staff are on study leave). There are 7 Technical Staff and 2 Junior Staff.

3.3 Client Service Unit

The Client Service unit serviced 224 client requests. Among the major clients were Ghana Agro-Food Company (GAFCO), Cadbury Ghana Ltd, Starwin Products, Food and Drugs Board, and Pioneer Food Canner. These companies brought about 750 samples for analysis. Net income from analytical services amounted to about c40 million.

3.3.1 Training

The Institute organized several training workshops. These included two mushroom training workshops, a workshop on the Processing of Ginger and Pepper for Export, training for an entrepreneur as well as training of polytechnic students. Net income from training activities amounted to more than c20 million.

3.4 Library and Publications Unit

3.4.1 Public Relations (PR) Section

FRI as in previous years maintained good relations with the press especially the private press. Several activities were undertaken to promote the understanding of the CSIR and the FRI. These include:

A. Image of the CSIR

In connection with the PR image enhancement effort, some proposals and comments were made on the document "Strategies and Action Plans to Promote and Enhance the Image of CSIR" that was written by Professor A. Ayensu and Mr. K. Yiborku. In support of the science popularisation objectives of the MEST\CSIR, the PR section wrote newspaper feature articles including one on the "Scientific and Industrial Research in Ghana: The Role of CSIR", "Regional Integration: A must for the 21st century" and "Water Resource Management in Ghana". "A Millennium Free from Hunger: Food Security in Ghana: and Scientific Cooperation for Africa's Food Security" which were published in the major daily newspapers, the Daily Graphic and the Ghanaian Times.

B. Exhibitions

The PR unit helped coordinate CSIR activities in connection with the Day of Scientific Renaissance of Africa activities, which this year consisted of a Symposium, a durbar and an Exhibition. FRI took part in a durbar and an exhibition to mark the day. This was organized by MEST in collaboration with the CSIR. PR also participated in a private sector exhibition called "U Can Do".

C. Seminars

The PRO also gave support to the symposium to mark the Day of Scientific Renaissance of Africa and for the Training of Trainers workshop held by the Root and Tuber Improvement Programme (TRIP) in January, the Fifth International Seminar on Fermented Foods and the Workshop for stakeholders, policy makers and regulators on street food vending.

3.4.2 **Library Section**

A. Stock

One hundred and thirty-eight (138) books were added to the book stock. These were acquired under the Private Sector Development Project (PSDP), the Technical Centre for Agricultural and Rural Co-operation (CA), and the Food and Agriculture Organisation (FAO). Journals acquired under the PSDP included Trends in Biotechnology, Cereal Chemistry, Food Technology and Journal of Food Science. A CD-ROM on Perry's Chemical Engineers Handbook was also acquired under the Private Sector Development Project (PSDP).

A number of publications were donated to the library. These included 27 copies of Tropical Stored Products Information, 9 copies of Tropical Products Institute, 5 copies of the Onion Newsletter for the Tropics and copy each of the ODNRI Bulletin, proceedings of the Ghana Science Association Seminar, and Food Technology International.

B. Users:

Seventy (70) persons used the library. They included students, lecturers, teachers, self-employed persons, entrepreneurs, consultants, agricultural engineers, and policy makers.

3.5 Food Economics and Utilisation Unit

Activities of the Food Economics and Utilisation Unit included the following:

- After Training of Trainers for the Root and Tuber Improvement project (TRIP), the staff of the Test Kitchen began a countrywide awareness creation of the utilisation of cassava flour, by mounting demonstration of prepared bakery products using cassava flour.
- Food Product development using sorghum and formulation trials using sorghum and wheat flour in bread biscuits and cakes. The test kitchen staff developed initial composite formulations using wheat flour and sorghum flour with the objective of coming out with prototype products that can be marketed to consumers.
- The Unit also organised an exhibition of Sorghum feed products in April 2000 for participants of ICRISAT meeting. The test kitchen prepared cassava flour products for an international exhibition in Rome, Italy.

Chapter 4

FOOD CHEMISTRY DIVISION

4.1 Introduction

The Division continued with its arduous task of providing the necessary analytical support to both research and industry during the year, under the prevailing conditions of scarce inputs and inadequate infrastructural facilities.

4.2 Staff

During the year under review, the Division maintained staff strength of twelve regular members and two service personnel. The regular staff is made up of one principal scientific officer, one senior scientific officer and one scientific officer in the research grade. The others are two chief technical officers, three principal technical officers, one senior technical officer, one technical officer, one senior technical assistant and one technical assistant grade III. Ms J. Arko and J. Owusu Boakye, graduates in chemistry from KNUST and the University of Cape Coast respectively were attached to the division as service personnel during the year. Ms J. Bonaparte, a diploma holder in Laboratory Technology from the University of Cape Coast started her National Service on December 2000.

4.2 Industrial Service Unit

During the year 25 different food commodities and 102 samples were analysed by the Industrial Service Unit. These samples included cotton pellet, turkey tails, Shea butter, fish meal, yam flour, palm oil, ginger, soy meal, cocoa butter, biscuits, potatoes and potato chips, tiger nuts, Cowbell milk, fruit drinks etc. The clients included Agricales Ltd., Food and Drugs Board, UNHCR, Nsawam Cannery Co. Ltd., Sotrec Ghana Ltd., Wonder Foods, Faj Ltd. and Cocoa Processing Company.

4.2.1 Training

Forty-five final year HND students for the Science Laboratory Technology Department of Accra Polytechnic received five day practical training in food analysis between June and July

4.3 Mycotoxins Unit

One hundred and fifty-six samples were analysed for aflatoxin. Most of the samples were maize and kenkey from the Greater Accra Region and from Kumasi, Tamale, and Wenchi. Other samples analysed included soybean, soybean dawadawa powder, soy meal peanut snacks (Nkatie Burger), canned tuna, waakye, soup, tufu, fishmeal, copra cake and groundnut. A sample of canned tuna was analysed for histamine content. Clients included DANIDA project, Street Food project, University of Ghana, Sam and May Enterprise, Ltd, Food and Drugs Board, Burger Food Industries, Tierbet Farms, Love and Joy enterprise, Myroc Food Products Processing company and Asamoah and Yamoah farms Ltd.

Chapter 5

FOOD PROCESSING AND ENGINEERING DIVISION

5.1 Introduction

The three main units of the Division, Pilot-Scale Production, the Cassava Processing Demonstration, and Engineering Units continued to render normal services to the public. The several sections independent from these Units working on specific commodities including Cereals, Roots & Tubers, Fruits & Vegetables, and Fisheries continued with their various research activities.

5.2 Staff Situation and Movements

Two officers, namely Messrs. L. D. Abbey and J. C-T Tettey continued with their PhD study programmes at the University of Ghana. Mrs. G. Nerquaye-Tetteh and Mr. Joseph Gayin continued with their respective Master of Philosophy and Science programmes at the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi and the University of Gent, Belgium. Mr. S. K. Noamesi was transferred to the Division after completing his PhD thesis. Mr. D. Bly, Head of Engineering Unit started a one-year leave without pay on December 1, 2000.

5.3 Pilot-Scale Production Unit (PPU)

The Unit rendered services mainly in drying, roasting and milling. Among commodities dried for clients include cassava (both chips/slices and fermented dough), fermented maize, onion, garlic, mushroom, yam, plantain, cocoyam, pineapple and papaya. Coffee and groundnut were the items brought in for roasting.

5.4 Cassava Processing Demonstration Unit (CPDU)

The CPDU continued with its services of producing the various lines of FRI products. A total of 44,454 kg of cassava was processed in the course of the year. The breakdown of products obtained from this is as follows:

2000 CPDU Cassava Products Produced

	Product	Quantity (kg)
1.	Kokonte	5,421
2.	Agbelima	1,444
3.	Starch	1,240
4.	Cassava flour	70
5.	Gari	389

As at December 31, 2000, the Unit had a number of items in stock. Due to problems the Unit was facing with the use of the old FRJ-designed hot-air electrical dryer, a new diesel-operated dryer has been constructed using the generator of the old Awila dryer that used to be in the main processing plant. The dryer measures 770 x 450 x 210 cm. A section of the roasting shed at the CPDU was reconstructed and modified into a drying room. The dryer is expected to dry up to two tons of products per batch. It is hoped that this new dryer will considerably help reduce the cost of drying cassava to about half when compared with the electrical hot-air dryer. The main constraint facing the Unit was shortage of labour. With the retirement of three staff members and the resignation of a few staff members, the workload on the remaining members is becoming unbearable.

5.5 The Engineering Unit

The Engineering Unit continued to maintain a number of equipment in the institute as well as fabricate simple machinery for clients of the FRJ. During the year the Unit constructed a 68-tray hot-air cabinet dryer for Reiss and Co, a private consultancy firm in Accra for the Private Sector Development Project. The new drier has been relocated inside the main processing hall. To facilitate the movement of the dryer into the main building two changes had to be effected at the Pilot Plant. The outer gate of the Processing Hall towards the Mushroom Project site had to be redesigned. The construction of the new set of door for part of the building is yet to be completed by the Estate Section of the Administration Division. The second change was the movement of the plate attrition mill had to be moved out of the main processing hall to be relocated in a room inside the "Winged bean Project" building.

During the last quarter of the year, the unit became very busy with the fabrication of number of machinery for the IDRC/ARCT/FRI Agro-Food enterprises Project. The engineering Unit is constructing five 800 kg/h screw presses and two cassava graters, each with capacity of 750 kg/h. routine maintenance of a number of equipment by the unit continued. Notable among them was the Polls Royce dryer. The outside mild steel was changed, the electrical motor was replaced and the whole spray dryer was sprayed anew.

The Electrical Section also undertook a number of minor repairs for equipment in the Institute. These include serving all air conditioners in the various offices and labs, checking and replacing all security lighting systems and repairing defective refrigerators.

5.6 Training for Food Exporters

The division organised a three day training workshop on processing of pepper and ginger for local food exporters from November 14 -16, 2000. The objectives of the workshop were to provide some basic information on the underlying principles, methods and techniques involved in the production of high quality dried pepper and ginger for export, to demonstrate appropriate methods and techniques involved in the production of high quality exportable dried pepper and ginger. To create the awareness of the local food exporters that the FRI has the potential of assisting them to produce high quality dried pepper and ginger for export. The course included drying techniques, hygiene and food safety, procurement of and storage of pepper and ginger, preparations for drying, operations of dryer, product quality, management of processing operations, business records and expansion. Thirty-six people attended the workshop.

5.7 Short Courses and Research Workshops.

Drs. P. N. T. Johnson, P. Adu Amankwa, K. Vowotor and Mr. C. Gyato, scientific officers from the Division attended a number of short courses under the Private Sector Development Project at the CSIR Human Resources Development Centre as part of the commercialisation of the CSIR. In October Drs. P. N. T. Johnson, P. Adu Amankwa and Messrs. N. Dziedzoave, J. T. Manful and S. K. Noamesi attended a one-day research workshop on project proposal writing.

Chapter 6
FOOD MICROBIOLOGY DIVISION

6.1 Introduction

The Division has two Units, namely the Industrial service Unit and the Mushroom Unit. The Division continued with its task of providing analytical support to both research and industry during the year. Research activities during the year included studies on food fermentation and mushroom cultivation.

6.2 Staff

During the year under review, the Division maintained staff strength of eleven. The staff is made up of two senior scientific officers and 4 scientific officers in the research grade. The others are technical grade staff. Three of the research grade staff are on study leave and one on leave of absence.

6.3 Industrial Unit

During the year, a total number of 1,015 samples were received for quality assessment and safety analysis.

6.4 Mushroom Research Unit

The unit continued with its series of research work with Dr. Johnson of the processing and engineering division. Three training programmes were conducted to popularise the mushroom technology and the consumption of mushrooms. The reactivation of cultures in the National Mycelium Bank continued.

6.5 Research Activities

The immensity of the research activities carried out during the course of the year under review formed part of the PhD work of some of the project team members.

6.5.1 PhD Programmes

Mrs. Kafui Kpogo

The study is on *Fusaria* and *Fumonisms* in maize and maize products. The candidate is currently in the final stages of the programme.

Ms Mary Halm

The overall objective of the programme is to investigate the effect of pH and organic acids on the microbial successions and microbial stability of fermented maize dough (kenkey)

Mrs. Nana Annan

The study is on aroma components in fermented maize meal.

Mrs. Hodare-Okai

The study is on the effect of fortification with soybeans on the microbiological and biochemical changes associated with the fermentation of cassava dough into Agbelima.

PART III - RESEARCH ACTIVITIES

CHAPTER 7

DONOR-FUNDED PROJECTS INITIATED IN 2000

7.1. DFID/FRI/NRI Project on Marketing and Processing of Bambara Groundnuts (W. Africa)

7.1.1. Objectives

This two-year collaborative project between the FRI and Natural Resources Institute (NRI) of the United Kingdom is funded by the Department for International Development (DFID) through the Natural Resources International Ltd. It was initiated in March 2000 and is aimed at developing methods for reducing cooking time of Bambara for small scale farm families and assessing production and market potential for the crop.

7.1.2. Activities and Achievements

Activities undertaken were to define the processing methods for Bambara and to estimate the cropping and marketing potential of the crop in Ghana, Africa and elsewhere. Surveys were therefore conducted in the Southern and Northern sector districts of the country on traditional methods of Bambara processing and utilization. Detailed data was collected on Bambara production, processing, marketing and utilization. The procedures involved were documented.

The surveys in the southern sector involving purposely selected Bambara farmers, processors and traders indicated limited scope of processing and utilization of the crop in the area. The basic traditional processing, preservation and utilization techniques used were established in the survey. The constraints limiting the increased utilization of the crop have also been identified.

In terms of Bambara production, the average acreage per farmer was estimated at 2.6 acres. Production was undertaken predominantly by women, mainly for subsistence purposes, while processing was found to be time-consuming. From interviews conducted with 88 producers and processors, traditional Bambara for the Northern sector of Ghana were also established and the products were found to be mainly in the form of flours and pastes. Five major traditional Bambara dishes were identified and procedures involved documented. Desk and field research has been undertaken to review the production of Bambara and its market

potential. The desk research involved a literature review, telephone interviews and detailed discussion with participants involved in a related CPHP-funded project dealing with the utilization of Bambara in southern Africa. In addition, data on the production, processing and markets for Bambara were collected on field visits to Zimbabwe. Globally secondary data search were concluded on 12 African, one South American and four Asian countries. No major markets were identified in the industrialized countries. Key features of Bambara marketing were the informality and relative simplicity of marketing structures. In contrast to many commodities, no traders were identified who specialized solely in Bambara. Also, there appeared to be no contract or forward purchasing of Bambara from growers. Some degree of aggregation of supply was established in the study.

Primary data collected from interviews with a total of 153 Bambara traders in both the Southern and Northern sectors of Ghana helped to establish the marketing structure, constraints, trends and expectations. Six actors identified to be involved in Bambara marketing were producers, itinerant traders, truckers, merchants, wholesalers, retailers and the consumer. Major constraints to the marketing system were found to include storage losses, lack of funds, poor road transport services and lack of standardization.

Activities undertaken within the last quarter of the year were aimed at developing improved methods to reduce cooking times for Bambara through laboratory evaluation and adaptation. A method, involving the use of low concentrations of a locally-available natural rock salt, *kawe* ($\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$) for pre-soaking and cooking, has been established as an effective means of reducing cooking times of the most difficult-to-cook varieties of Bambara. *Kawe* is commonly used in Ghana for culinary and other purposes and the promotion of its use in enhancing the cookability of Bambara is highly feasible. The studies conducted to test the use of *kawe* as a tenderiser in the cooking of Bambara groundnut revealed that soaking and/or cooking in solutions of rock salt caused significant reductions in the cooking time of hard-to-cook maroon variety of Bambara from two hours to one and a quarter hours (a reduction of about 40% cooking time). At 0.5% concentration within the quarter included the establishment of the water absorption-enhancing effects of different concentrations of *kawe* on five distinctly different local varieties of Bambara with varying degrees of water absorption capacities. From interviews conducted with 88 producers and processors, traditional Bambara processing methods for the Northern sector of Ghana were also established and the products were found to be mainly in the form of flours and pastes. The average acreage per farmer was estimated.

7.2 DFID/NRI/FRI Project on Enhancing the Livelihoods of the Urban Poor through Improvements of Street-Vended Foods (First Phase)

7.2.1 Objectives

The purpose of this project was "to develop strategies that can improve food security of poor households through increased availability and improved quality of horticultural foods and better access to markets. The project outputs were to assess and prioritise the economic and social importance and safety and quality constraints of street-vended foods in peri-urban locations and to make recommendations on quality and safety risks associated with street vended foods and to identify areas where new knowledge is required.

7.2.2 Activities and Results

A socio-economic survey of 354 street food vendors and a mini census indicated that street-vended foods make an important contribution to the economy of Accra. It employs over 60,000 people with an estimated annual turnover of more than US\$100 million and an annual profit of US\$24 million. Most (94%) of the vendors in Accra were found to be women who had minimal or no education. A majority did not belong to vendors associations or pay taxes. A food safety study screened 96 case-study street-vended food samples (waakye, fufu and salad from Accra for heavy metals, pesticides and micro-organisms and mycotoxins and 48 raw material samples from primary and secondary markets for heavy metals and mycotoxins. The project found that 45% of waakye samples contained the heavy metal lead above the draft code recommended maximum limit of 0.2 mg/kg and 70% contained the organophosphorus pesticide *chlorpyrifos*. No mycotoxins or heavy metals were detected in the raw materials from primary and secondary markets. The survey found that the hygiene of street-vended food had deteriorated since the last survey sponsored by FAO between 1994 and 1995. Waakye, in particular, had high counts. While 2,000 vendors had recently been trained in basic food hygiene with commercial sponsorship, this number falls well short of the 60,000 vendors estimated to be working in the sector. A two-day workshop was organized for 40 major stakeholders in the street-vendors food sector in Accra. The major concern was the need for further research to identify the sources of heavy metals and pesticide contamination and methods for reducing the hazards. A working group comprising the MEST, Accra Metropolitan Assembly (AMA), Ghana Education Service (GES), Ministry of Health (MOH) and Food Research Institute was formed to implement improvements in the safety street-vended foods and help develop its tourism potentials. A priority is to establish a pilot study to improve access to water, sanitation and refuse disposal for street food vendors.

CHAPTER 8

ON-GOING DONOR-FUNDED PROJECTS

8.1 Capability Building for Research into Traditional Fermented Food Processing in West Africa

8.1.1 Objectives

The immediate objectives comprise capability building and the establishment of appropriate environments for research in food fermentation to support collaboration between West African countries and provide assistance to local industries at various levels in the production of uniform and safe fermented African foods of defined quality.

8.1.2 Research Activities

The project undertook the following research activities:

- Batch culture production and preservation of *Candida krusei* and *Saccharomyces cerevisiae* as starter culture for fermentation of maize
- Studies on the microbiological changes associated with millet fermentation into Hausa koko
- Collection of isolates of *Lactobacillus plantarum* and *Candida krusei* were collected from different traditional Ghanaian fermented foods
- Studies of fermentation of Nixtamalised maize dough
- Investigations on inactivation of Gram Negative bacterial pathogens during maize fermentation and in fermented maize products (PhD programme: Microbial interactions in kenkey fermentation)
- Modelling the effect of lactic acid on inactivation of some *L. coli* strains (PhD programme: Microbial interactions in kenkey fermentation)
- Studies in model systems to determine the effects of pH and organic acids on the succession of *Saccharomyces cerevisiae* and *Candida krusei* in maize fermentation (PhD programme: Microbial interactions in kenkey fermentation)
- Dynamic studies and measurements of intracellular pH in *Saccharomyces cerevisiae* and *Candida krusei* to explain the mechanisms of microbial succession maize fermentation (PhD programme: Microbial interactions in kenkey fermentation)
- Nutritional fortification studies of Agbelima under PhD programme "Effect of fortification of cassava dough with soybeans and cowpeas on the fermentation of Agbelima"

- Isolation of microorganisms from soybeans and cowpeas fortified cassava dough at different fortification levels and different time of fermentation. (PhD programme: Effect of fortification of cassava dough with soybeans and cowpeas on fermentation of Agbelima)
- Molecular typing of *Lactobacilli*, *Bacillus* spp. and yeast predominant in cowpeas and soybeans fortified cassava dough. (PhD programme: Effect of fortification of cassava dough with soybeans and cowpeas on fermentation of Agbelima).
- Completion of experimental work on occurrence of fumonisins in fermented maize products with emphasis on strategies for reducing the content of fumonisins. (PhD programme: Thesis to be completed next year)
- Aroma analysis and identification of aroma components in fermented dough by GC-MS (PhD programme).

8.1.3 MPhil programmes in collaboration with the Nutrition and Food Science Department, University of Ghana

The University of Ghana awarded one MPhil Degree that was completed in the previous year. Two MPhil programmes with the university were completed. The theses submitted were the "Development of a starter culture for the fermentation of soybeans into dawadawa" and "antimicrobial interactions during the fermentation of cassava dough, Agbelima". Two MPhil programmes on "Microorganisms involved in the fermentation of cassava into akveke" and "Suitability of the indigenous microflora of palm wine for the production of vinegar" were initiated.

8.1.4 Training

The following training activities were carried out during the year:

- Training of one scientist of the University of Development Studies (UDS) on Enumeration, isolation and identification of yeasts involved in the fermentation of sorghum into Pito.
- Training of a scientist of the UDS on Enumeration, isolation and identification of lactic acid bacteria from fermented maize and millet.
- Training of a PhD student from the Food Research Centre, Sudan on aroma analyses by GC-MS and extraction and identification of aroma components of some fermented milk products.
- Training of two scientists from FIRO, Nigeria on HPLC analysis of mycotoxins.
- Training of two technicians from FRI at AJL in microbiological quality assurance procedures and routines.
- One-week training course for four technicians from FRI on internal auditing for ISO 9000 at the Ghana Standards Board.
- Training of two scientists from FIRO, Nigeria on HPLC analysis of mycotoxins.

8.1.5 Visits and Exchange of Staff between Project Partners

Professor Leaf Pol of the Royal Veterinary and Agricultural University (KVL) paid a week's visit to install additional equipment for the GC-MS.

The Project leader, Professor Mogen Jakobsen paid four visits to the institute during the year. Professor Jakobsen, accompanied by Mr. Moses Mengu of WAITRO and two scientists from FRI also went to inaugurate the project at the UDS. A student from KVL visited the FRI to conduct experimental work on the breakdown of cyanogenic glycosides in cassava.

8.1.6 Conferences and Seminars

An African seminar was held at Sogakope, Ghana, that attracted 58 participants from 16 African and European countries. Thirty-two scientific papers were presented including eight from project members.

8.1.7 Constraints

The main constraint was delay in clearance of equipment and materials from the airport. The departure of the microbiologist who was to have played a significant role in the preparation for the accreditation of the Microbiology and Chemistry laboratories disrupted the schedule planned for the year. Fluctuations in electricity supply and breakdown of pilot plant equipment at the Kenkey plant were other major constraints.

8.2 FRI/SAFGRAD Project on Improving the Utilization and Commercialisation of Soy Processing Technologies

8.2.1 Objectives

This project was initiated under the Technology Transfer and Commercialisation Program of the Semi Arid Food Grain Research and Development (SAFGRAD) programme to facilitate the transfer of small-scale soy processing technologies to two private entrepreneurs in Accra. The objective of the project is to upgrade the operations of these enterprises through research and training in processing and marketing of soy products as well as advise on appropriate machinery and efficiency in unit operations. The project also aims at improving the utilization and commercialisation of soybean technologies developed at the FRI by small and micro-scale entrepreneurs and to assist these entrepreneurs in improving their expertise and the quality of these products.

8.2.2 *Activities and Results/Output*

Monitoring the qualities of soymilk, soy flour and soy powder from Darkruby bakeries was undertaken during the year. The first three quarters of the year showed a fairly constant nutrient composition of the soymilk for different batches processed. The entrepreneur was able to maintain a low level of trypsin inhibitor activity in the milk indicating that adequate heat treatment as directed by the project team was being used. Results for the last quarter showed some contamination of the soymilk and soy flour with coliforms, indicative of poor handling and sanitation techniques during processing. Sensory assessment showed a slightly bitter after taste. Other sensory properties of aroma, colour and consistency were within acceptable limits. As part of its objectives the project will establish a HACCP system for the processing of products by Darkruby Enterprise. Follow-up visits are planned to establish which areas of processing need critical monitoring to maintain good and reproducible product quality.

With funds from the project, the enterprise constructed a concrete building in which was housed soymilk processing equipment. The purchase and installation of this equipment was undertaken during the third quarter. Equipment included a grinding mill for soy mash, a milk press and other packaging and seeding equipment. The project team also advised in the making of labels, providing nutritional composition values among others. An evaluation team from the United States visited the project during the third quarter and requested improvement in handling and final and upgrading the product labels.

8.3 **IFAD/ICRISAT/FRI/SARI/ARI/MOFA/ACTIONAID Sorghum Project on Farmer Participatory Testing of Technologies to Increase Sorghum Production in the Sahel**

8.3.1 *Objectives*

This sorghum project aims at increasing the productivity of sorghum in Ghana. This is part of the broader project by ICRISAT titled "Farmer participatory testing of technologies to increase sorghum and Pearl Millet in the Sahel". The project was conceived as one of the projects that could improve the food availability, incomes and the well being of smallholder farmers and artisanal processors in Ghana as well as the whole of Africa. Farmers would be helped to get access to good quality seeds and in particular case of Ghana operators in sorghum malting sectors would be helped with improved technologies to improve their practices. The International Fund For Agricultural Development (IFAD) is funding the project.

8.3.2 *Activities and Results*

The project began with a two-day planning workshop in Accra from 1st to 2nd June 1999. Subsequent meetings were held at Savannah Agricultural Research Institute (SARI) at which specific objectives, outputs and activities were planned. Following that a PRA was carried out to gather baseline information on production patterns, processing, utilisation and marketing of sorghum in selected areas of the Northern region. In April 2000 the first annual stakeholders meeting was held at the FRI at which further activities were drawn to meet the set outputs and activities for the project. As at December 2000, the specific outputs/activities expected to have been completed/begun include:

Output 1 Increased yields of sorghum

Activities

- i. Participatory collection and characterisation of sorghum varieties
- ii. Distribution of seeds of suitable varieties and training of growers

Output 2 Greater availability of improved seeds of varieties produced by farmers (including malting sorghum in Ghana)

Activities

- i. Participatory evaluation of sorghum varieties at processors level
- ii. Laboratory evaluation of sorghum varieties
- iii. Evaluation and improvement of the processing in each unit operation

8.4 **IDRC/ARCI Agro- Food Enterprises Project**

8.4.1 *Activities and Results*

The main activities carried out under the project were the construction of processing units, fabrication and installation of processing machines. Work on the Cassava Processing Plant at Manchie progressed steadily throughout the year. The project and the Ga District Assembly were jointly funding this. The building is near completion and installation of the processing machines has begun. This is expected to be completed by the first week of February 2001.

Installation of processing machines at Doblo Gono Cassava Processing Plant has also started and this is expected to be completed by the first week of February 2001. The building at Doblo Gono was constructed by an NGO, "Africa 2000 for the Community".

The buildings for the two processing plants at Brotovedra in the Central Region and Bepose Nkran in the Western Region are being constructed concurrently. These are being jointly funded by the project and an NGO "Global Non-Traditional Exporters and Producers Association (Global NTEPA). The buildings at these two places are at the super structure level.

Three 800-kg/hr capacity cassava press was constructed during the first half of the year. Additional two 750-kg/hr capacity cassava-grating machines and two 800 kg/hr capacity cassava presses are under fabrication at the FRI workshop. These are to cater for the two more communities that are to benefit from the Agro-Food Enterprises Project. The fabrication of the machines is 90% complete. Commissioning of the processing plants is expected to take place during the last week of February 2001.

8.5 Developments and Improvement of Local Millet Processing Methods and Products

8.5.1 Project Objectives

1. To improve postharvest handling practices of millet with the view of improving grain quality.
2. To develop new and appropriate processing equipment for millet processing.
3. To compile millet characterisation methods in the sub-region to harmonise research activities of sub-regional scientists.

8.5.2 Progress Report

It has been established that millet is the cereal with the most diversified usage in the north of Ghana but handling is the most difficult because of its small size among other reasons. A draft handbook for millet quality evaluation in the sub region has been prepared and is undergoing editing by the Network.

Currently the Institute's main activity under the project is on the packaging and shelf life studies of millet grains and flours. This activity monitored some of the physico-chemical and microbial changes, which occurred during a 6-month storage of fine millet meal in three different packages. Storage conditions were 30 ± 2 °C at 75 %RH and 37 ± 2 °C at 75% RH. Physical changes monitored were moisture gain, extent of browning, evidence of caking; chemical changes were total soluble sugars, pH, titratable acidity, rancidity and alcoholic. Data collection was completed in November 1999. Analysis of data is continued throughout the year under review.

8.6 Effect of Peanut Consumption on Hunger Ingestive Behaviour Energy Expenditure and Coronary Heart Disease Risk

8.6.1 Introduction

There is evidence that regular peanut consumption may hold health benefits. The objective of the above study therefore is to document these benefits and the findings should yield important insights on the health effects of peanut consumption.

The general objectives are to:

1. Examine the effects peanuts on hunger satiety, food intake, and salivary secretions
2. Assess the effect of peanut consumption on body weight, body composition, energy expenditure and whether peanuts will improve serum lipid profiles and therefore reduce coronary heart disease risk.

8.6.2 Work done so far

Objective one is completed. Through this study, the satiating value and dietary response to peanut consumption was determined. In general, peanuts were found to have a strong satiety value and elicit a dietary compensation response. However, other energy bearing preloads tested with peanuts (almonds, chestnuts, chocolate, peanut butter) did not differ significantly from peanuts.

Objective two involved the participation of nineteen screened subjects. Each subject took part in three different peanut treatments, which took a total of 30 weeks to complete. There was a one three-week study and a two eight-week study periods, where the subjects consumed approximately 100 grams of peanuts every day. Additionally the subjects adhered to a low fat diet for one of the eight-week periods and a weight maintenance diet for the three-week period. There was a four-week rest between each study period. Energy expenditure was measured by indirect calorimetry on three occasions over the study period. The body composition was measured on three occasions by electrical impedance method. A sample of blood was collected about ten times during the study period. The body weight was measured on each of these occasions. A 24-hour dietary recall of food intake was measured on six occasions. Plasma levels of total cholesterol, LDL-cholesterol HDL-cholesterol, and triglycerides were determined on the blood samples using an auto analyzer.

8.6.3 Data Analysis and results

Preliminary results obtained, using statistical package for Social Sciences- SPSS showed that chronic consumption of peanuts did not significantly change the weights of the subjects. $P < 0.05$. It did not also have any significant effect on the blood lipid profile.

8.6.4 Future work

Continuation of data analyses and thesis write up

8.7 EU Project on the Biological Degradation of Aflatoxins in Fermented Maize and Sorghum Products

8.7.1 Introduction

This is a EU funded collaborative project aimed at improving the safety of traditional African fermented foods by developing detoxification measures against aflatoxins particularly in maize and sorghum products. The project is being co-coordinated by the World Association of Industrial and Technological Research Organizations (WAITRO). Collaborators in this Project are the Food Research Institute of the CSIR of Ghana, Federal Institute of Industrial Research (FIRO) in Nigeria, Federal Research Centre for Nutrition (Germany), Royal Veterinary and Agricultural University (Denmark) and the University of Stellenbosch (South Africa).

8.7.2 Major Specific Objectives

- Identification and collection of cultures of bacteria and yeasts capable of transforming or degrading aflatoxins as starter cultures.
- Design maize and sorghum fermentations using the identified bacteria and yeasts capable of degrading aflatoxins as starter cultures.
- Development of a routine screening method for monitoring aflatoxin degradation during maize and sorghum steeping and fermentation suitable for use in industrial production sites.

8.7.3 Research Activities and Achievements

The Project is in its second year and major activities undertaken so far include the screening of bacteria and yeasts for their ability to degrade the aflatoxin molecule. A total of around a 1000 strains found to be actually degrading the aflatoxin molecule. Several yeasts were however found to possess the ability to bind to the molecule. Food Research Institute concentrated on the screening of various isolates of yeasts (*Saccharomyces cerevisiae*) *Bifidobacteria* and the confirmation of the ability of *Flavobacterium aurantiacum* to degrade the aflatoxin molecule.

The Food Research Institute team undertook a survey and compiled a report on aflatoxin contamination of foods in West African countries. This is to provide background information on the extent of the aflatoxin problem in the sub-region. This report is to be published by WAITRO into a monograph for wider distribution.

By way of training, two scientists from FIRO have been trained at the FRI Mycotoxin Laboratory in the methods for the analysis of aflatoxins in maize and sorghum to be able to carry out the analytical aspects of the project in Nigeria.

8.7.4 Current Work

As indicated earlier, only one microorganism was found to possess the ability to breakdown the aflatoxin molecule. Unfortunately this organism for several reasons cannot be used directly in foods. In consultation with the funding agency, the direction of the project is to be changed slightly to concentrate on the use of enzyme extracts of this micro-organism to break down the toxin instead of the organism itself. These studies are to be conducted in Laboratory model systems after which optimal conditions for their production and activity are to be defined. These studies are to be accompanied by chemical characterization and toxicity tests of the various degradation products. Depending on the success of these studies the results are to be transferred to the Industrial maize and sorghum processing sites.

CHAPTER 9

DONOR-FUNDED PROJECTS COMPLETED IN 2000

9.1 FRI/SADAOC Project on Household Food Availability and Food Consumption Behaviour in Ghana

9.1.1 Introduction

This project was funded under the Sustainable Food Security in Central West Africa (SADAOC) and coordinated by the Ghana national network, Réseau Ghanéen at ISSEK, Legon. The activities of SADAOC aim at improving food security policy formulation and implementation in West Africa through institutional and research capacity building, enhancing the interface for dialogue between researchers and policy makers, and coordinating the activities of participants in its programmes. The project studied the efforts of rural households to have access to adequate amounts of food on a sustainable basis and to be able to utilize the food for their well being. This implies a focus on linkages between food security at household level and the nutritional outcome at the individual level. The project ended in March 2000.

9.1.2 *R&D Activities and Achievements*

A series of surveys were undertaken using a combination of standardised conventional survey questionnaires, Participatory Rural Appraisal/Assessment techniques and secondary data sources to obtain both qualitative and quantitative data on the household food availability and food consumption behaviour in the Southern Sector and Middle Belt districts of Ghana. The main focus was on linkages between food security at household level and the nutritional outcome at individual level. Specifically, issues that were investigated include: general factors influencing food availability and food consumption at household level; variability and trends of access to and consumption of food; economic activities of household members and the effect on food availability and consumption pattern; resource base, gender issues and decision making processes in the household; food processing, preservation and storage techniques; as well as the nutritional status of women and children in the household. It was concluded from the studies that although efforts are being made by the rural communities in the Southern Sector and Middle Belt districts to produce and to have access to food on sustainable basis, lack of adequate processing, preservation and storage methods and facilities, militate against the achievement of food security. Inadequate nutritional knowledge also has adverse effects on the nutritional status of the people in spite of the relative abundance of food in some of the areas. Policy issues have been proposed for more emphasis to be placed on promoting the growth and development of the micro- and small-scale food processing enterprises and to provide adequate research support for the effective operations of these enterprises.

9.2 OAU/STRC-SAFGRAD Project on Promotion of Appropriate Household and Small-Scale Soybean Utilization Technologies

9.2.1 Introduction

This was a USAID-funded project under the Semi-Arid Food Grain Research and Development programme of the Technical and Research Commission of the OAU. It was a multi-institutional and multi-disciplinary project aimed at developing and encouraging the adoption of soybean utilization technologies appropriate for household and small-scale enterprises in selected rural communities. This is to stimulate soybean production, encourage small enterprise development and make available more utilization technologies to improve economic and social benefits to primary producers, processors and rural communities in Ghana. The Project, which is being coordinated under the Technology Transfer Grant Programme of the CSIR (AFFS) has the Food Research Institute, the Agriculture (Extension Services) as the collaborating institutions. The project is on schedule and will end in June 2000.

9.2.2 R&D Activities and Achievements

Under the major activities undertaken, soybean products and recipes were developed and evaluated in terms of their nutritional advantages and sensory characteristics, based on the traditional staple foods of the people at the two project villages, *Samsam-Odumase* and *Mimpemihoasem*. Training and demonstration activities were undertaken for participants in the two farming communities on household preparation and use of soy products in traditional dishes to improve the nutritional quality. This was after a baseline socio-economic studies were carried out. A total of seventeen recipes with desirable nutritional and sensory characteristics were developed and promoted in the two project villages through training and demonstration activities using the participatory approach. The recipes adequately covered a range of traditional status. Two major and six minor training and demonstration sessions were held for the extension of the products and recipes in the farming communities. The minor training sessions involved mainly small groups of mothers at a time, while the major sessions were held for the whole village. Of the 201 adult participants from the two villages that were trained in household utilization of soybeans, 71% were women and 29% were men. Forty-five children participated mainly to partake in the meals after the demonstration.

In a second set of activities, soybean production training and demonstration activities were undertaken for farmers in the product villages. Two demonstration farms set up for the purpose were used alongside farmers' own experimental farms for the training. A total of 39 farmers benefited from the training and gained expertise in soybean production. The gender distribution of participants showed more male participation (64%) over their female counterparts (39%).

The different stages of soybean cultivation covered in the training include planning and site selection, land preparation, planting and refilling, plant protection (especially weed control and protection from pests), harvesting, drying, threshing and storage. The training and demonstration activities facilitated the successful transfer of soybean production technology to the two project villages to help enhance the socio-economic and nutritional status of the people.

Based on the success of the technology transfer for production and household utilization of soybeans in the villages, it has been recommended that micro-enterprise development in soybean processing should be promoted to further enhance household food and nutrition security in the area. The project ended in May 2000.

GOVERNMENT OF GHANA FUNDED PROJECTS

10.1 TRINational Mushroom Project

10.1.1 Objectives

The objectives of the project are;

- (i) Collect, identify, characterise and preserve local and exotic edible and medicinal and mushroom strains with the view of developing varieties of commercial cultivation.
- (ii) Define the appropriate procedures and conditions for use of various agro-industrial by-products in mushroom spawn and fruit-body production.
- (iii) Select efficient methods for processing, preservation and packaging of different cultivated mushrooms.
- (iv) Design appropriate growing houses for small and medium scale mushroom farms.
- (v) To transfer new technologies developed to local farmers and provide consultations.
- (vi) Research into all areas of mushroom growing techniques, mushroom biotechnology, environmental applications etc.

10.1.2 Activities

a. Strain Multiplication

From January to December 2000, the Unit produced 1,725 bottles of oyster spawn, 62 bottles of Abalone spawn, 49 bottles of *Ganoderma*, 17 bottles of *Agaricus spp.*, 34 bottles of *Auricularia spp.*, 151 bottles of Straw Mushroom Spawn, 134 bottles of master cultures and 91 bottles of other medicinal mushrooms for sale to growers throughout the country.

b. Bamaf Industries

During the period under review, the unit received samples of dry oyster mushrooms from BAMAF Industries for the determination of fungal deterioration during six-month period of storage.

c. Training

A total of thirty-two (32) participants were trained during the year 2000 for 5 days and 2 weeks respectively. Eleven (11) participants were trained for 5 days and twenty-one (21) participants including one Ivorian were trained for 2 weeks.

Mr. Richard Takli also travelled to China under UNDP sponsorship package through TCDC of the Chinese Government to undergo training in Jancac Technology at the Fujian Agricultural and

Forestry University Fuchou in China. Four strains of mushrooms were purchased from the Juncas Laboratory for multiplication and sale to growers throughout the country. One training programme was organized at Abokobi in the Greater Accra Region of Ghana for the people in that community at the request of Friends of Earth an Accra based Non-Governmental Organisation.

d. Supervision of Project work

Four (4) HND students from the University College of Education Winneba/Mampong were supervised to carry out their project works at the Mushroom Research Laboratory.

10.2 Root and Tuber Improvement Project

10.2.1 Participatory Rural Appraisal.

The FRI/RTIP conducted a participatory rural appraisal at Afram Plains District on 7th to 8th June 2000 and at Techiman District on 22nd to 25th August 2000. The purpose was to obtain quick detailed but qualitative information on the production, marketing and utilization of sweetpotato in the districts. This will document the problems as well as indigenous knowledge of the people in handling of sweetpotatoes and involve the farmers into the project as participants rather than end users. At Afram Plains towns visited include Ekve Amantroni, Donkorkrom and Maame Krobo. In the Techiman District the team visited Fiaso and Forikrom.

A participatory rural appraisal was conducted at Asebu Ekroful in the Asebu Kwamankese District of the Central Region on 28th February to 2nd March 2000. The purpose was to obtain quick detailed but qualitative information on the production, storage, processing and utilization of sweet potato in the district. This will document the problems as well as indigenous knowledge of the people in handling of sweet potatoes and involve the farmers into the project as participants rather than end users. Asebu Ekroful was selected based on an earlier exploratory exercise conducted in December 1999 to be a major sweet potato production area.

Recommendations

Adaptive trials based on the following are recommended:

1. Storage structures for sweet potatoes should be constructed on pilot bases.
2. Ekve Amantroni should be selected as a model town for the RTIP project.
3. PRA should be conducted at Kwahu Adawso and Kwahu Amaten.
4. Marketing should be source for sweetpotato in the district.

10.2.2 Awareness Creation

FRI/RTIP provided resource persons during the sweetpotato awareness creation conducted in June and August by the RTIP Kumasi Office.

10.2.3 Sweetpotato Recipes

Sensory evaluation of some sweetpotato recipes formulated at FRI was conducted to optimize the formulations. The recipes are:

1. Sweetpotato cake
2. Sweetpotato chips
3. Sweetpotato bread
4. Sweetpotato biscuits
5. Sweetpotato pancake
6. Sweetpotato mash

10.2.4 Visit

A 5 member Monitory and Evaluation Team from Kumasi visited the Food Research Institute in August. The team was conducted round the storage structures constructed at the premises of the Food Research Institute, Okponglo.

10.3 Private Sector Development Project (PSDP)

10.3.1 Introduction

A final report on the FRI's component of the Private Sector Development Project (PSDP) was prepared. The FRI's component of the PSDP was initiated with a clear objective of re-orienting FRI from a subvention-oriented institute to a partly self-financing organisation able to operate and survive in a commercial setting. Thus the report reviewed among others the background of the PSDP, the original tasks targeted at project initiation, tasks accomplished, impression on project management, other impressions on the PSDP, and suggestions for management of similar project in the future.

The Private Sector Development Project (PSDP) was a culmination of the renewed commitment of the Government to accelerate the pace of development of Ghana's private sector. The project was also a direct result of the Business Community's own assessment of Lingering issues which impeded growth of the private sector. These issues were confirmed and consolidated during a series of roundtable between the Private Sector and key members of Government and the Donor Community in 1994.

10.3.2 Operational Strategies

As a result of opportunities and threats posed by the environment within which FRI operates and FRI's strengths and weaknesses, FRI formulated appropriate strategies for the successful implementation of all the various options for commercialisation identified under the project. At the project initiation various applied researches and projects undertaken/being undertaken by the Institute were evaluated and assessed for their potential for commercialisation. This was achieved by going through the array of research activities and projects and trying to find means of marketing each activity, whether at prevailing intermediate stage or whether the activity should be carried to a further product stage for commercialisation to be possible. The Institute set up for itself market oriented goals as a response to inadequate funding problems.

10.3.3 Task Accomplished

Most of the strategic framework for commercialisation adopted under the Private Sector Development Project with the aim of re-orienting FRI from a subvention-oriented institute to a partly self-financing organisation was partially achieved.

Based on an Act of Parliament, CSIR Act 521 1996, and the new thinking by the Institute's top management under the PSDP, private sector involvement in planning, designing and implementing research and development activities have reached about 60%. Currently, the Private Sector has about 50% representation on FRI's Management Board. CSIR ACT 521 1996, re-establish the Council for Scientific and Industrial Research to promote, encourage and regulate research and the application of science and technology in development and to provide for related matters.

In line with the institutional strengthening and restructuring to provide framework for commercialisation and to lift FRI from total preoccupation with research to commercialisation of its activities, four new Divisions were created.

10.3.4 Tasks Outstanding

The institute pursued the following key commercially oriented targeted tasks under the PSDP:

- FRI market-oriented and partially commercialised
- Linkages with food and agriculture sectors strengthened
- S&T services generated and transferred to the food and agriculture sectors
- FRI image enhanced

Some key objectives under these targets have been partially achieved. There is therefore the need to pursue these objectives. The most outstanding are FRI's ability to generate 30% of its recurrent expenditure and for its laboratories to be accredited to ISO standards.

10.3.5 impressions

The PSDP has created awareness in the Institute to engage in self-sustaining and income generating activities. However, changes in project management in the course of project implementation adversely affected achievements of targets, but with the establishment of the Project Management Team after the Mid Term Review, there was a considerable improvement in Project Management.

10.3.6 Suggestions

For future projects of this nature, it has been suggested that a management structure similar to the one established for the National Agriculture Research Project (NARP) under CSIR should be put in place and also project planning should involve all stakeholders.

10.3.7 Conclusion

In conclusion, the FRI's part of the PSDP was well executed, however the project was not very successful. There is the need for post project activities and programme sustainability to accomplish the outstanding tasks. A greater impact could be made towards achievement of the set goals if certain follow-up activities are pursued.

APPENDIX I FRI MANAGEMENT BOARD - 2000

- | | | | |
|-----|--------------------------------------------------------------------------------------------------|---|----------|
| 1. | Prof. A. Avenstri
Dep. Director-General
INSS/CSIR
P. O. Box M.52, Accra | - | Chairman |
| 2. | Dr. J. A. Otoo
Director, Crops Research Institute (CRI)
P. O. Box 3785
Kumasi | - | Member |
| 3. | Professor S. Sefa-Dadeh
Head, Dept. of Nutrition & Food Science
University of Ghana, Legon | - | Member |
| 4. | Mrs. Rosetta Annan
Women In Agricultural Development (WIAD)
P. O. Box M.57, Accra | - | Member |
| 5. | Mr Timothy Osei
Oduro, Adiya, Osei & Co
SEDCO House
P. O. Box 5712, Accra-North | - | Member |
| 6. | Mr. Kwasi Nkansah
Director, Ghana Standards Board
P. O. Box M.245
Accra | - | Member |
| 7. | Ms. Sherry Avitor
31 st December Women's Movement
P. O. Box 065, Osu-Accra | - | Member |
| 8. | Mrs Leticia Osafo-Adde
Processing Foods & Spices Ltd
P. O. Box 186
Community 2, Tema | - | Member |
| 9. | Mr. Ebenezer Barnes
P. O. Box 295
Mamprobi - North | - | Member |
| 10. | Dr. Esther Ocloo
Sustainable End of Hunger Campaign | - | Member |
| 11. | Dr. W. A. Plaha
Director, Food Research Institute (FRI)
P. O. Box M.20 Accra | - | Member |

APPENDIX II FRI SENIOR STAFF LIST (2000)

W. A. Plahar - Ag. Director
 BSc (Gen.), BSc (Hons) MSc Fd. Sci. (Ghana)
 PhD (Washington)
 (Chief Scientific Officer)

R. M. Yawson - Scientific Secretary
 BSc. (Hons) M. Phil. (Biochem)
 (Scientific Officer)

Food Microbiology Division

W. K. Amoah-Awuah - Senior Scientific Officer
 BSc (Ghana) MSc. App. Sci. (New South Wales)
 PhD (Ghana)
 (Head of Division)

M. Halm (Mrs) - Senior Scientific Officer
 BSc (Gen.) BSc (Hons), MSc Botany (Ghana)
 Post Grad. Dip. Rural Fd. Tech (Netherlands)
 (Substantive Head of Div.)
 (On Study Leave)

M. Hodari-Okae (Mrs) - Scientific Officer
 BSc Microbiology, MSc Fisheries (ABU, Zaria)

A. E. Hayford (Ms) - Scientific Officer
 BSc (Hons) Biol. Sci. (UST), MSc (Biotech.) Monash
 PhD (Denmark)

M. Obodai (Mrs) - Scientific Officer
 BSc (Hons), MPhil. Botany (Ghana)

Charles Tortoo - Scientific Officer
 BSc (Hons), MPhil. Botany (Ghana)

D. K. Asiedu - Chief Tech. Officer
 E. Amoako - Prin. Tech. Officer
 J. Anlober - Prin. Tech. Officer
 Peter Adde - Prin. Tech. Officer
 D. K. Baisel - Technical Officer

Food Chemistry Division

E. K. Ankrang - Prin. Scientific Officer
 B.Sc. (Gen.) Ghana
 MSc Food Quality Control (Reading)
 (Head of Division)

K. Kpodo (Mrs) - Senior Scientific Officer
 BSc (Gen.) BSc (Hons) Ghana
 MPhil. (West Indies)

N. T. Annan (Mrs.)	-	Scientific Officer
BSc (Hons) Fd. Sci. (Ghana), MSc Fd. Sci. (Nova Scotia)		
N. A. Asate	-	Chief Tech. Officer
E. A. Allotey	-	Chief Tech. Officer
S. Antwi	-	Prin. Tech. Officer
W. K. Amedor	-	Prin. Tech. Officer
P. A. Adoo	-	Prin. Tech. Officer
Mensah Toku	-	Senior Tech. Officer
D. N. A. Ankrah	-	Technical Officer
N. Y. Amedor	-	Technical Officer

Business Development & Information Division

A. Osei-Yaw (Mrs.)	-	Senior Scientific Officer
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MSc Biochem (Ghana.) Dip. Fd. Sci. & Nut. (The Netherlands)		
B.A. Mensah	-	Scientific Officer
MSc. Fd. Press. Tech. (Kransnodar, USSR)		
W. Quaye (Mrs.)	-	Asst. Sci. Officer
B.Sc. (Hons) Agric. Econ. (Ghana)		
P. Larweh (Mrs.)	-	Asst. Sci. Officer
B.Sc. (Hons) Home Sci. (Ghana)		
A. Andoh	-	Chief Tech. Officer
J. A. Tamakloe (Mrs.)	-	Prin. Tech. Officer
B. Awotwi	-	Prin. Tech. Officer
R. Kavi	-	Senior Lib. Assistant
S. A. Garbrah	-	Admin. Assist.
B. P. Osae	-	Technical Officer
P.O. Baidoo	-	Technical Officer

Food Processing & Engineering Division

P. N. T. Johnson	-	Scientific Officer
BSc (Hons), Biochem. (UST) MSc, Agric. Eng. Tech. (Cranfield)		(Ag. Head of Div)
PhD Food Tech. (Reading)		
G. Nerquaye-Jetteh (Mrs)	-	Snr. Scientific Officer
BSc (Gen.) BSc (Hons) Ghana		

D. Bly MSc Chem. Eng. (Moscow)	-	Scientific Officer
P. Adu-Amankwa (Mrs) BSc (Hons) Biochem (UST) MSc. Fd. & Mgt. Sci., PhD Post-Harvest Physiology (Lond.)	-	Scientific Officer
E. C. Tettey BSc (Hons) Agric (UST) Post-Grad. Dip. Fd. Tech., MPhil. (Humberside, UK)	-	Scientific Officer
N. T. Dziedzoave BSc (Hons), Biochem. (UST) Post. Grad. Dip. in Fd. Sci. & Nut., (Gent, Belgium) MSc Fd. Sci. & Tech. (UST)	-	Scientific Officer
L. D. Abbey BSc (Hons), Biochem. (UST) MSc. App. Sci. (Fd. Tech.) New South Wales	-	Scientific Officer
C. K. Gyate Nat. Dip. in Agric. Mech. (Ghana) MSc Agric. Eng. (Bulgaria)	-	Scientific Officer
J. T. Manful BSc (Agric), Dip. Ed. (Cape Coast) MPhil Biochem. (UST)	-	Scientific Officer
K. A. Vowotor B.Sc. Zoology Dip. Ed. (Cape Coast) M. Phil. PhD Crop Science (Ghana)	-	Scientific Officer
S. K. Noamesi BSc (Agric) MSc Fd. Sc. (Ghana)	-	Scientific Officer
Mr. J. Gavin BSc (Hons) Biochem (UST)	-	Asst. Sci. Officer
Charlotte Oduro-Yeboah (Mrs) BSc (Hons) Biochem (Ghana)	-	Asst. Sci. Officer
J. K. Magbo	-	Chief Tech. Officer
S. A. Sampah	-	Chief Tech. Officer
K. Opoku-Acheampong (Mrs)	-	Prin. Tech. Off
J. R. Addo	-	Snr. Tech. Off
E. Ablor	-	Snr. Tech. Off

S. A. Tagoe	-	Snr. Technical Officer
J. A. Asafu-Adjei	-	Prin. Works Supt
R. Y. Anthonio	-	Snr. Works Supt.
C. T. Yeboah	-	Works Supt.
G. K. Akleih	-	Works Supt.
R. M. Mawuli	-	Works Supt.
J. L. Lamptey	-	Works Supt.

Accounts Division

M. E. K. Amenu	-	Prin. Accounting Asst (Ag. Head of Accounts)
C. Aikins Tutu	-	Snr. Accounting Asst.
S. Y. Nkansah	-	Prin. Stores Supt.
S. O. T. Oddoye	-	Snr. Stores Supt.
J. Mintah Nakotey	-	Prin. Stores Supt.
G. O. Gyamfi	-	Stores Supt.

Administration Division

E. Atta-Sonno BA Hons. (Cape Coast) Specialist Teachers Cert. in English	-	Snr. Admin. Off. (Head of Division)
J. F. Asigbey	-	Chief Admin. Asst.
E. A. Larbi	-	Prin. Works Supt.
J. Aggrey -Yawson	-	Snr Admin Asst.
L. Codjoe	-	Snr Admin Asst.

APPENDIX III FRI STAFF TRAINING - 2000

	NAME OF STAFF	DESIGNATION	COURSE	INSTITUTION OF STUDY	DURATION
1.	M. Halm (Ms.)	Snr. Sci. Officer	PhD (Microbiol.)	UG / KVL, Denmark	Oct. 1998 -June 2001
2.	P. Lokko (Mrs)	Snr. Sci. Officer	PhD (Nutrition)	University of Ghana	1998 - 2003 (Part-time)
3.	G. Nerquaye-Tetteh (Mrs)	Snr. Sci. Officer	MPhil. (Agroforestry)	KNUST, Kumasi	Sept 1997 - June 1999
4.	M. Hodari-Okae (Mrs)	Sci. Officer	PhD (Food Microbiology)	University of Ghana	June 1997 - June 2000
5.	L. D. Abbey	Sci. Officer	PhD (Fd. Sc.)	University of Ghana	May 1997 - June 2000
6.	N. T. Annan (Mrs)	Snr. Sci. Officer	PhD (Fd. Sc.)	UG / KVL, Denmark	Sept. 1999 June 2002
7.	W. Quaye (Mrs)	Asst. Sci. Officer	MPhil. Agric. Econs	University of Ghana	Oct. 199 June 2001
8.	J. Gayin	Asst. Sci. Officer	MSc Fd. Sc.	Univ. of Gent, Belgium	Oct. 199 June 2001
9.	K. Kpodo (Mrs)	Snr. Sci. Officer	PhD (Fd. Sci)	UG / KVL, Denmark	Sept. 1996 - June 2001
10.	M. Amoo-Gyasi	Snr. Tech Asst	HND Lab. Tech	Univ. of Ghana, Legon	June 1998 - June 2000
11.	S. K. Noamesi	Scientific Officer	PhD (Fd. Sci)	UG/NRI	Completed Oct. 2000
12.	E. C. T. Tettey	Scientific Officer	PhD (Fd. Sci)	Univ. of Ghana,	August 1998 - June 2001
13.	N. T. Dziedzoave	Scientific Officer	PhD (Fd. Sci. & Tech.)	NRI	Feb. 2000 - Feb. 2003
14.	C. Tortoe	Scientific Officer	PhD (Fd. Sci. & Tech.)	NRI, Univ. Of Greenwich	Sept. 2000 - Sept 2003
15.	A. Antonio	Snr. Tech. Officer	HND Microbiology	Univ. Of Ghana	Completed June 2000
16.	B. Amoako	Snr. Tech. Officer	HND Microbiology	Univ. Of Ghana	Completed June 2000
17.	N. Amey	Technical Officer	HND Lab. Tech.	Univ. Of Ghana	June 1998 -June 2001
18.	R. Takli	Snr. Tech. Asst	HND Lab. Tech.	Univ. of Ghana, Legon	June 1998 -June 2000
19.	K. Aidoo	Snr. Aect. Asst.	B. Comm. Degree	Univ. of Cape Coast	Completed June 2000
20.	L. Codjoe	Snr. Clerk	ICSA	Mgt. & Financial Tr. Inst.	Completed June 2000

21	G. Akeo	Tech. Asst.	Junior Tech Supervisors Course	Institute of Tech Supervision, Weija	Oct. 1999- March 2000
22	J. Akoto	Tech. Asst	Junior Tech Supervisors Course	Institute of Tech Supervision, Weija	Oct. 1999- March 2000
23	M. Delabor	Tech. Asst.	Junior Tech Supervisors Course	Institute of Tech Supervision, Weija	Oct. 1999- March 2000
24	Mr. J. Hammah	Painter Gd. II	Junior Tech Supervisors Course	Institute of Tech Supervision, Weija	Oct. 1999- March 2000
25	V. Alambire	Clerk Gd. I	MIS	Atlantic Computer Training	Jan 2000 - Jan.2001
26	C. Reynolds	Snr. Tech. Asst.	HND Lab. Tech.	Univ. of Ghana, Legon	Oct. 1999 - June 2002
27	Emmanuel Allorsey	Snr. Tech. Asst.	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon	June 2000 -June 2003
28	K K Essel	Univ. of Ghana, Legon	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon	June 2000 -June 2003
29	A. L. Nyarko	Tech Asst. Gd. I	HND Biochemical Lab. Tech.	Univ. of Ghana, Legon	June 2000 -June 2003
30	L. Botchie (Mrs)	Snr. Accts. Clerk	BSc (Admin) Acct. Option)	Univ. of Ghana, Legon	June 2000 -June 2003

APPENDIX IV

CONFERENCES, COURSES, WORKSHOPS AND SEMINARS ATTENDED BY IRI STAFF IN 2000

Conferences/ Courses/ Workshops/Seminars	Participants	Designation	Venue	Date/Duration	Organisers
Training of Trainers of the RTIP Workshop	Mrs P.M. Larweh Ms C. Boateng Mrs A. Padi	Asst. Sci. Officer Catering Asst. Catering Asst.	IRI	Jan. 17 - 21, 2000	MOFA, FRI and IITA
INCO-Yam Workshop on Yam postharvest and consumption	Dr. W. K. Amode-Awuda	Sur. Sci. Officer	Abidjan	14-18 Mar., 2000	CSRS, Cole d'ivoire
West & Central African Millet Research Network Meeting	Mr. J. T. Maulid	Sci. Officer	Namney	22-28 Mar. 2000	W/A Miller Network
Course on Time Management	Mrs A. Osei-Yaw	Sur. Sci. Officer	CSIR	April 10 - 11, 2000	Unitas Congress Centre, Helsinki, Finland
Course on Proposal Writing	Mr. E. K. Ankrah Dr. P. N. T. Johnson Dr. P. A. Adu-Antankwa Dr. K. A. Yawtor Mr. C. Gyau	Principal Sci. Officer Sci. Officer Sci. Officer Sci. Officer Sci. Officer	CSIR	April 17 - 20, 2000	Private Sector Development Project (PSDP)
Course on Management Information Systems	Dr. W. A. Pliatar Dr. W. K. Amode-Awuda B. A. Mensah R. M. Yawson	Ag. Director Sur. Sci. Officer Sci. Officer Sci. Officer	CSIR	May 15 - 19, 2000	Management Development and Productivity Institute (MDPI)/PSDP
Workshop on Policy Dialogue on Food Processing, Food Consumption Patterns and Food Security in Ghana	Dr. W. A. Pliatar	Ag. Director	Bay View Hotel, Accra	May 18, 2000	SAD/AOC
Course on Senior Executive Development	Dr. W. A. Pliatar Mr. E. K. Ankrah Dr. W. K. A. Amode-Awuda Mrs A. Osei-Yaw Dr. P. N. T. Johnson	Chief Sci. Officer Principal Sci. Officer Senior Sci. Officer Senior Sci. Officer Sci. Officer	CSIR	May 8 - 12, 2000	Private Sector Development Project (PSDP)
Course on Managerial Leadership Skills	Dr. W. A. Pliatar Dr. W. K. A. Amode-Awuda Dr. P. A. Adu-Antankwa Mr. M. E. K. Anemua Mr. J. F. Asigbey	Chief Sci. Officer Senior Sci. Officer Sci. Officer Prin. Account. Chief Admin. Assist.	CSIR	May 29-June 2, 2000	Private Sector Development Project (PSDP)
Meeting of the Institute of Food Technologists	Mrs. P. Lokko	Sur. Sci. Officer	Dallas, Texas	10-14 June, 2000	IFT

Course on Financial Management	Dr. W. A. Plahar Dr. W. K. A. Amoah-Awua Dr. P. A. Adu-Amankwa Mr. M. E. K. Amenu Mr. Aikins Tutu	Chief Sci. Officer Senior Sci. Officer Sci. Officer Prin. Account.	C/SIR	June 12-23, 2000	Private Sector Development Project (PSDP)
The 5th African Regional Seminar on Traditional Fermented Foods Processing	Dr. W. A. Plahar Dr. W. K. A. Amoah-Awua Mrs. K. Kpode Mr. C. Tortee	Chief Sci. Officer Senior Sci. Officer Senior Sci. Officer Sci. Officer	Villa Cisneros Sogakope	3 - 4 July, 2000	FRI/ DANIDA
SAFGRAD 3 rd Regional Technical Committee Workshop	Dr. W. A. Plahar.	Ag. Director	Palm Beach Hotel, Ouagadougou	2-3 August, 2000	SAFGRAD
Training workshop on Internet as an information Resource for Information Professionals	Mrs A. Osei-Yaw R. M. Yawson	Snr. Sci. Officer Sci. Officer	Dept. of Library and Archival Studies.	September 15, 2000	Dept. of Library and Archival Studies
Workshop on Enhancing the Livelihoods of the urban poor through improvements of Street foods	Dr. W. A. Plahar, Dr. P. N. T. Johnson D. Asiedu R. M. Yawson	Ag. Director Sci. Officer Chief Tech. Sci. Officer	Miklin Hotel	Sept. 2000	NRI/FRI
Training in Microbiological Lab work and good lab practice	Mr. J. M. Y. Anlohe Mr. M. Amoo-Gyasi	Prin. Tech. Officer Snr. Tech. Assist.	KVL, Copenhagen	Sept. 18- Oct. 13, 2000	DANIDA
International Food and Nutrition Conference	Dr. W. A. Plahar.	Ag. Director	Tuskegee, Alabama, USA	6-12 Oct. 2000	IINC
Sorghum Processing and Unitisation	Dr. P. N. T. Johnson	Sci. Officer	Mali	October 12 -16	W/A Sorghum Research Network (ROCARS)
Seminar on Microsoft [®] Small & Medium Business Solutions for Information Professionals and Decision-Makers.	Dr. W. K. Amoah-Awua Mrs A. Osei-Yaw R. M. Yawson	Snr. Sci. Officer Snr. Sci. Officer Sci. Officer	Golden Tulip Hotel.	17-18 Oct., 2000.	Microsoft [®] West Africa
International Training Course on Mushroom Technology	Mr. R. K. Takli	Snr. Tech. Assist.	Fuzhou, China	Nov. 5- Dec. 1, 2000	Asia-Pacific Edible Mushroom Training Centre
International Workshop on Food Safety Management in Developing Countries	Dr. W. A. Plahar.	Ag. Director	Montpellier, France	8-15 Dec. 2000	FAO/CIRAD

Conferences and Workshop Presentations

1. Addy M. E. and **Yawson, R. M.** (2000) "Scientist Must Communicate" Paper presented at the Faculty of Science Colloquium, University of Ghana.
2. **Dziedzoave N.J.**, Graffham A.J. and deGraft-Yartey, J.W. (2000). Preliminary Evaluation Of Cassava Flour Flour As An Extender For Urea-Formaldehyde Glues. Paper Presented At the Third International Symposium On Tropical Root and Tuber Crops (ISOTUC III), 19-22 Jan., 2000. Thiruvananthapuram, India.
3. **Dziedzoave N.J.**, Graffham, A.J., Mensah, B.A. and Gyato, C. (2000). Use Of Cassava Flour In Paperboard Adhesives. Paper presented at the 12th Symposium of the International Society For Tropical Root Crops (ISTRC 2000), 10 - 16 Sept., 2000. Tsukuba, Ibaraki, Japan.
4. **Halm, M.**, Daalsgaard, A., Rasch, M. and Jakobsen M. (2000) Inactivation of Gram-negative bacterial Pathogens during Maize Fermentation and in Products of Fermented Maize. Proceedings of the Fifth Biennial Seminar on African Fermented Foods, Sogakope, July 3-4, 2000. In press.
5. **Kpodo, K.**, Hald, B., Thrane, U. and Jakobsen, M. (2000) Fusaria and Fumonisms in Maize Kernels from Ghana. Proceedings of the Fifth Biennial Seminar on African Fermented Foods, Sogakope, July 3-4, 2000. In press.
6. **Larweh, P.M.** (2000) Diversification and Utilisation of Root and Tuber Crops. Paper presented at the awareness creation programme on utilization of Root and Tuber Crops
7. Mante, E., Sakyi-Dawson and **Amoa Awua W. K. A.** (2000) Antimicrobial interactions during fermentation of cassava dough, agbelima. Proceedings of the Fifth Biennial Seminar on African Fermented Foods, Sogakope, July 3-4, 2000. In press
8. Nartey, N. N., Sakyi-Dawson and **Amoa Awua W.K.A.** (2000) Development and Evaluation of Starter culture for the alkaline fermentation of soybean dawadawa. Proceedings of the Fifth Biennial Seminar on African Fermented Foods, Sogakope, July 3-4, 2000. In press.

9. **Plahar, W. A.** and J. Amoah (2000) "Adding Value to Agricultural Raw materials" Presentation at MEST/CSIR symposium to mark Day of Scientific Renaissance of Africa, June 2000. STEPRI, Accra
10. Sakyi-Dawson, E., Mante E., and **Amoa Awua W. K. A.** (2000) The occurrence of antimicrobial interaction during fermentation of cassava dough (agbelima). Submitted for poster presentation 1999 Annual Meeting of Institute of food Technologist (IFT) meeting, USA
11. Sefa-Dedeh, Cornelius, B. and **Amoa Awua W.K.A.** (2000) Fermentation of Nixtamalised dough. Poster presentation 2000 Annual Meeting of Institute of Food Technology (IFT) meeting, USA

Technical Reports

1. **Dziedzoave, N. T., Gyato, C., Larweh, P.,** Krampah, L., Aduko, M. and Fiasidey. (2000). A Participatory Rapid Appraisal of the Status of Cassava and Various Cereals in Watro - A Farming Community In The Atebubu District of the Brong Ahafo Region. Report on Project Activity 1.1 of the NRI/FRI Collaborative Project on "New Markets For Cassava"
2. **Dziedzoave, N. T., Osei-Yaw, A., Mensah, B.A. and Gyato, C.** (2000). Expanded Markets for Cassava Flours and Starches In Ghana. Final Technical Report on the FRI/NRI/DFID Collaborative Project for the year 1996-1999.
3. Greenhalgh, P. (2000) The market potential of bambara groundnut. FRI/NRI/DFID Project Report. NRI, University of Greenwich, UK.
4. **Larweh, P.M. and Plahar, W. A.** (2000) Production, Processing, Storage and Utilization of Bambara in Ghana. FRI/NRI/DFID Project Report. Food Research Institute, Accra, Ghana.
5. **Noamesi, S. K.** (2000) Storability of cultivars of *Discoria Rotunda* Poir. Yams (2000). PhD Thesis Submitted to the University of Ghana
6. Obeng-Asiedu, P., Greenhalgh, P., **Johnson, P-N. T.,** Tomlins, K.I., & Myhara, R. M. (2000) Socio-economic survey of street-vended foods in Accra DFID/NRI/FRI Project No. R7495

7. **Johnson, P-N. T & Obodai, M.** (2000) Some physical and microbial changes in *Pleurotus* *eous* and *Termitomyces* spp. Mushrooms in different plastic packages.
8. Myhara, R. M. Tomlins, K. J., **Johnson, P-N. T.**, Obeng-Asiedu, P. and Greenhalgh, P (2000) Implementation of HACCP system to control moisture content and mycotoxin contamination in Ghanaian maize: A case study. DFID/NRI/FRI Project No. R7493.
9. Obeng - Asiedu, P., **Larweh P.M.** and **Plahar, W. A.** (2000) Marketing of Bambara in Ghana. FRI/NRI/DFID Project Report. Food Research Institute, Accra, Ghana.
10. **Obodai, M.** and **Tortoe, C** (2000). Preliminary studies on the microbial deterioration of sweetpotato (*Ipomea batatas*) under different storage structures.
11. Tomlins, K.J. Myhara, R. M., **Johnson, P-N. T.**, Obeng-Asiedu, P. and Greenhalgh, P (2000) Safety of street vended foods-heavy metals, aflatoxins and pesticides. DFID/NRI/FRI Project No. R 7493.
12. **Tortoe, C.**, Fordjour, K., Tandor, M. and **Amoa-Awua, W.** (2000). Appraisal of the production, marketing and utilization of sweetpotatoes in the Asebu Kwamankese and Twifo Hemaa lower Denkyira Districts of the Central Region.
13. **Tortoe, C.**, **Vowotor, K** and **Anlobe, J.** (2000). Appraisal of the production, marketing and utilization of sweetpotatoes in the Afram Plains
14. **Tortoe, C.**, **Obodai, M.**, **Oduro-Yeboah, C.**, **Vowotor, K** and **Amoa-Awua, W.** (2000) Studies on three storage structures for sweetpotato in Ghana.

Reference/Journal Papers

1. **Dziedzoave, N. T.**, Ellis, W. O., Oldham, J. H. and Oduro, J. (2000). Optimizing Agbelima Production: Varietal and Fermentation Effect On Product Quality. Food Research International, **33**, 867-873.
2. **Johnson, P-N. T & Brennan, J.G.** (2000) Moisture sorption characteristics of plantain (*Musa. AAB*). *J. Food Engineering*, **44**, 2, 79-84.

3. **Johnson, P-N. T & Brennan J. G.** (2000) Kinetics of moisture absorption by plantain flour. *J. Food Engineering*, **45**, 1, 33 -36.
4. **Johnson, P-N. T** (2000) Effect of crib orientation and initial moisture effects on the rate of drying of maize (var. *Okomasa*) in an improved crib. *Ghana Journal of Agricultural Science*, **33** (in press)
5. **Johnson, P-N. T & Brennan J. G. & MacDougall. D. B.** (2000) The effects of pre-treatment the reconstitution and physical properties of hot- air dried plantain. *J. Sci of Food & Agric.* (in press)
6. **Johnson, P-N. T & Obiri. H. A.** (2000) Some problems with the food packaging practices in Ghana. *J. Ghana Science Association (in press)*
7. **Johnson, P-N. T., Adjei. R.K. & Quaye. W.** (2000) Post-harvest practices and perception of loss among tomato retailers at five marketing centres in Accra. *J. Ghana Science Association (in press)*
8. **Obodai, M. Sawyerr, L. C. B. & Johnson, P-N. T.** (2000) Yield of seven strains of oyster mushrooms (*Pleurotus* spp.) grown on composted sawdust of *Triplochiton scleroxylon*. *Tropical Science*, **40**, 2, 95-99
9. **Oduro, I., Ellis, W. O., Dzedzoave N.T. and Nimako-Yeboah. K.** (2000). Quality of Gari From Selected Processing Zones In Ghana. *Food Control*, **11**, 297-303

APPENDIX VII STATEMENT OF ACCOUNTS

2000 RECURRENT EXPENDITURE

EXPENDITURE ITEM	AMOUNT RELEASED	ACTUAL EXPENDITURE
1. Personal Emolument	1,282,705,984.00	1,228,379,763
ITEMS 2 - 5		
2. Travelling & Transport		
3. General Expenditure		
4. Maintenance, Repairs & Renewals		
5. Other Expenditure		
Sub Total Items 2-5	155,238,098.00	236,523,999
GRAND TOTAL	1,437,944,082.00	1,464,903,762

INTERNALLY GENERATED INCOME FOR 2000

PARTICULARS	INCOME JAN. - DEC. (A)	EXPENDITURE JAN. - DEC. (B)	SURPLUS (DEFICIT) (A-B)
Sale of Products	65,155,300.00	83,755,947.00	-18,600,647.00
Hire of Facilities/Fabrication	31,380,970.00	22,653,389.00	5,525,890.00
Analytical & Technical Services	67,995,342.50	29,546,180.00	38,449,162.00
Training	39,305,000.00	14,386,275.00	24,918,724.30
TOTAL	203,836,612.00	150,341,791.70	53,494,820.30

DONOR-ASSISTED PROJECTS

		INCOME	EXPENDITURE	EXCESS
1.	Dollar Projects	\$10,488.90	4,037.50	6,451.40
2.	Pounds Projects	£2550.40	-	2550.40

Total Income from Overheads paid to the Institute and Bank Interests

Vehicle Maintenance		
INCOME	EXPENDITURE	EXCESS
8,622,900.00	17,948,248.00	-9,325,345

Deficit accounted for from the Project dormant Account

Appendix VIII 2000 Promotions

	Name	Promoted from	Promoted to
1.	Mrs N. T. Annan	Scientific Officer	Snr. Scientific Officer
2.	Mr S. A. Sampare	Principal Technical Officer	Chief Technical Officer
3.	Mr. A. Andoh	Principal Technical Officer	Chief Technical Officer
4.	Mr. E. A. Larbi	Principal Works Supt.	Chief Works Supt
5.	Mr J. M. Nakotey	Prin. Stores supt	Chief Stores Supt
6.	Mr. C. A. Tutu	Snr. Acct. Asst.	Prin. Acct. Asst.
7.	Mr. J. L. Lamptey	Technical Officer	Snr. Technical Officer
8.	Mr. Peter Delabor		Foreman
9.	Mr. M. Torgbui	Technical Asst	Snr. Technical Asst.
10.	Mr. C. Y. Sogbe	Technical Asst	"
11.	Ms. F. Somuah		Snr. Clerk
12.	K. Essel	Tech. Asst	Snr. Tech. Asst.