COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

FOOD RESEARCH INSTITUTE

ANNUAL REPORT 2012

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF ACRONYMS

AGORA	-	Access to Global On-line Research on Agriculture
AGRIS	-	Agriculture Research Information System
BFGs	-	Business Focus Groups
C: AVA	-	Cassava: Adding Value in Africa
CAFPAG	-	Cassava Flour Producers Association of Ghana
CID	-	Commercialization & Information Division
CPC	-	Cocoa Processing Company
CRI	-	Crops Research Institute
CSIR	-	Council of Scientific and Industrial Research
CSU	-	Clients Service Unit
CTA/SDI	-	Technical Centre for Agriculture and Rural Cooperation/ Selective Dissemination
EU	-	Engineering Unit
FAO	-	Food and Agriculture Organization
FAPAS	-	Food Analysis Performance Assessment Scheme
FCD	-	Food Chemistry Division
FDB	-	Food and Drugs Board
FMD	-	Food Microbiology Division
FNSED	-	Food Nutrition and Socio-Economics Division
FPED	-	Food Processing & Engineering Division
FRI	-	Food Research Institute
GIMPA	-	Ghana Institute of Management and Public Administration
GIZ	-	German International Cooperation

GoG	-	Government of Ghana
GPCs	-	Good Practice Centres
HQCF	-	High Quality Cassava Flour
IGF	-	Internally Generated Funds
INSTI	-	Institute for Science and Technological Information
IPS	-	Institute of Professional Studies
KNUST	-	Kwame Nkrumah University of Science and Technology
LPPRU	-	Library, Publications and Public Relations Unit
MiDA	-	Millennium Development Authority
MOAP	-	Market-Oriented Agriculture Project
MoFA	-	Ministry of Food and Agriculture
MU	-	Mushroom Unit
PSPU	-	Pilot Scale Production Unit
RTPDU	-	Root and Tuber Products Development Unit
SANAS	-	South African National Accreditation System
SMEs	-	Small and Medium Scale Enterprises
STEPRI	-	Science and Technology Policy Research Institute
TBSU	-	Technological Business Service Unit
TEEAL	-	The Essential Electronic Agricultural Library
UNICEF	-	United Nations International Children's Education Fund
WFP	-	World Food Programme
WAAPP	-	West African Agricultural Productivity Programme

CSIR-FRI MANAGEMENT BOARD MEMBERS

1.	Dr. OseiBoeh-Ocansey	Director-General, PEF	Chairman
2.	Dr. NanamTayDziedzoave	Director, FRI	Member
3.	Mr. Herbert A. Obiri	Ag. Director, IIR	"
4.	Dr. (Mrs.) R. Entsua-Mensah	Deputy Director-General, CSIR	"
5.	Mr. Timothy A. Osei	Chartered Accountant	"
6.	Prof. Josephine Nketsia-Tabiri	Director-General, BNARI, GAEC	"
7.	Mr. Charles Debrah Asante	Deputy Managing Director, CPC	"

MEMBERS OF THE CSIR-FRI INTERNAL MANAGEMENT COMMITTEE

1. Dr. Nanam Tay Dziedzoave	-	Director	-	Chairman
2. Dr. (Mrs.) Kafui Kpodo	-	Deputy-Director/Head/FCD	-	Member
3. Dr. (Mrs.) Margaret Ottah Atikpo	-	Head/FMD	-	"
4. Dr. Kwame Vowotor	-	Head/CID	-	"
5. Dr. Lawrence Abbey	-	Quality Manager	-	"
6. Dr. (Mrs.) Mary Obodai	-	Head/Mushroom Unit	-	"
7. Dr. Charles Tortoe	-	Head/FPED	-	"
8. Mrs. Wilhelmina Quaye	-	Head/FNSD	-	"
9. Mr. Cletus Gyato	-	Head/Eng. Unit	-	"
10. Mrs. Mary Glover-Amengor	-	Head/Nutrition Unit	-	"
11. Mr. Gregory Komlaga	-	Ag. Head/PSPU/President, RSA	-	"
12. Mr. Elvis Baidoo	-	Ag. Head/RTPDU	-	"
13. Ms. Janet Aggrey-Yawson	-	Ag. Head/Admin	-	"
14. Mr. Coffie Aikins Tutu	-	Ag. Head/Accounts	-	"
15. Mr. Charles Diako	-	Head/ISU-FCD	-	"
16. Mr. George Anyebunu	-	Head/Toxicology Unit	-	"
17. Mr. David Asiedu	-	Chairman, Staff Welfare	-	"
18. Mr. Benedict Awotwi	-	Chairman, SSA	-	"
19. Mr. Michael Amoo-Gyasi	-	Chairman, TUC	-	"
20. Mr. Stephen Nketia	-	Scientific Secretary	-	"
21. Mr. Eric Ofori	-	Prin. Admin. Asst.	-	Recorder

EXECUTIVE SUMMARY

Food Research Institute (FRI) is tasked to provide technical, analytical services, contract research and consultancy services to governmental agencies, micro-medium and multinational agro-food processing industries and international development agencies. Technologies generated by conducting market-oriented applied research are aimed at meeting the demands of the private sector and socio-economic development. The targeted goal of the Institute for the past year is to assist in poverty alleviation through the creation of opportunities for generating and increasing incomes within the micro, small, medium and large-scale agro-food industries, which also contribute to food security, foreign exchange earnings and the application of cost-effective food processing technologies that are environmentally friendly.

The year 2012 saw a new Director for the Institute in the person of Dr. Nanam Tay Dziedzoave, he assumed office on 16th January 2012. Ten long-serving staff either voluntarily or compulsorily retired. They included Dr. P.N.T Johnson, Dr. John T. Manful, Mr David Asiedu and Ms. Christiana Ketsie all of them had served more than 30 years at the institute. About 30 research projects were being executed in 2012. These included Cassava: Adding Value for Africa (C:AVA), West Africa Agricultural ProductivityProject (WAAAP) Alternative Flours Project, WAAPP Yam Processing Project, Improving Post-Harvest Quality and Packaging of Rice, Sorghum/Millet and Cassava Products to Enhance Marketability in West Africa, World Food Programme (WFP)-Community Based Cereal Milling and Fortification Programme, Africa Rice Project, Rice Sector Support Project (RSSP), Cassava G-market Project, Gratitude Project, WAAPP 2A, and AFTER Project. Internal research projects carried out included the "Micronutrient enrichment of meals fed to pupils using highly nutritious and low-cost underutilized fish under the school feeding programme in Ghana", "Development of high yielding strains of Pleurotus species through hybridization ", "Growth and yield performance of exotic species and strains of Pleurotus cultivated under Ghanaian conditions part 2", "Growth and yield of three Pleurotus species on rice straw", and "Edible and medicinal mushrooms as functional foods in Ghana".

The Institute still maintained its accreditation status to ISO 17025 test methods under the South African National Accreditation System (SANAS). Both the chemistry and microbiology divisions continued to provided analytical services to industry. The Chemistry division analysed 549 samples.The Toxicology Unit of the Chemistry Division analysed 233 samples for aflatoxin against 262 samples for the year 2011. The microbiology division analysed more than 2000samples for clients in 2012 as against 1,728 samples in 2011. Ten research reports, ten journal papers, two conference posters, five consultancies and a numbers of media reports and a book were produced in the year.
Major collaborators of the different projects carried out at the Institute included the United Nations-Food and Agricultural Organization (UN-FAO), the Ministry of Food and

Agriculture (MoFA), Natural Resources Institute (NRI) of the UK, University of Science and Technology, University of Ghana, Legon and Agriculture and Industry related CSIR Institutes.

The total income for the period amounted to three million, five hundred and fifty four thousand, seven hundred and forty –one Ghana cedis (GH¢3,554,741.00) of which 86% represents income from government sources.

1.0 ADMINISTRATION DIVISION

Introduction

The Administration provides administrative support for the Research and Technological programmes of the Institute. It is also responsible for identifying professional and managerial training needs and opportunities for staff; assessing, maintaining and improving all Institute's infrastructures; maintaining and repairing Institute's vehicles and monitoring their use.

Staff Strength

The staff strength of the Institute stood at 182. The breakdown is as follows:

- Senior Members 43
- Senior Staff 70
- Junior Staff 69

Directorship Appointment

Dr. Nanam Tay Dziedzoave, Principal Research Scientist and former Head of Food Processing and Engineering Division (FPED) was appointed Director of the Institute. This took effect from 1st January, 2012; however, he assumed office on 16th January 2012.

Division/Unit Headships

Dr. Charles Tortoe, Senior Research Scientist was appointed Head of FPED with effect from 1st February, 2012. Also Messrs. Gregory A. Komlaga and Elvis A. Baidoo, Research Scientists with FPED were appointed Acting Heads of Pilot Scale Production Unit (PSPU) and Root and Tubers Product Development Unit (RTPDU) respectively. The appointments took effect from 1st February and 1st April 2012 respectively.

Appointments

Within the year, five (5) staff were given temporal appointments. The appointees were made up of three (3) Research Scientist and three (3) Senior Staff. Also, the temporal appointments of thirteen (13) staff consisting of two (2) Research Scientist and eleven (11) Senior Staff were confirmed and regularized during the year as shown in Appendix II

Upgrading

Messrs. Kwabena Asiedu Bugyei, Assistant Scientific Information Officer with the Commercialization & Information Division (CID) and Desmond Mensah, Senior Technical Officer with FPED were upgraded after acquiring an MBA and BSc degrees respectively.

Promotions
Five (5) Senior Staff and four (4) Junior Staff had their promotions as shown in table 1.3 of *Appendix II.*

Human Resource Development/Training
The Institute continued to grant training opportunities to staff to enable them acquire skills and expertise needed to enhance their performance. The list of staff on study leave and the list of staff who resumed from study leave within the year under review is as shown in *Appendix III.*

Retirements
Ten (10) long-serving staff of the institute either retired compulsorily or voluntarily. Please see *Appendix II* for details.

Resignations
Mr. Foster Yao Mensah, Assistant Research Scientist with the Food Chemistry resigned from the Institute with effect from 9th September 2012.

Deaths
The Institute sadly lost two of its staff who were stationed at its Root and Tuber Processing Demonstration Unit, Pokuase. They were Mr. Solomon Godome, Supervisor Grade I and Mr. Ebenezer Asare, Security Assistant Grade I.

Institute Visitors
The Institute hosted few visitors among whom were the University of Ghana Graduate Student who visited the Sorghum Malting and Brewing Pilot Plant in March, 2012; Educational Trip on 5th March, 2012 .

Transport
A Nissan double cabin pick-up was donated to the Institute by WAAPP Secretariat to support the implementation of the WAAPP project which was on-going.

2.0 ACCOUNTS DIVISION

Introduction

Main responsibilities of the Accounts Division

- To ensure the effective and efficient management of institute's revenue expenditure, assets, liabilities and other resources in accordance with the Financial Administration ACT 2003.
- To ensure that procurement for the institute is done in accordance with the Public Procurement ACT 2003
- To ensure that the institute comply with the provisions under the Internal Revenue ACT 2001

Major Activities

In order to fulfill the above responsibilities, the following major activities are carried out in the Division.

1. Preparation of Annual Budget for the Institute.
2. Cash receipts and banking transactions
3. Payroll processing and the preparation of related reports
4. Procurement and store supplies for all the division in the Institute.
5. Recording and keeping of financial transactions of the Institute.
6. Keeping of Assets Register of the Institute
7. Provision of annual financial statements.
8. Provision of monthly, quarterly, semi-annually and annual reports to the government agencies and the ministries.
9. Oversee both internal and external auditing of our books, review and analyze reports and give recommendations when appropriate.

The following activities of the division were accomplished within the period under review;

1. The completion of the 2011 final Accounts was done within the first quarter of the year, audited and signed by the end of the second quarter of the year.
2. All statutory reports to the ministries, CSIR and other state agencies were made.
3. Entries of the 2012 transactions were made to October 2012.
4. 2012 salary arrears were paid within December 2012.
5. The Institute's financial records for the 2010 and 2011 years were audited by the Internal Audit of C.S.I.R
6. Management Reports were made quarterly to aid management in its decision making.

Financial Review

	Subvention	**Actual Expenses**	**Variance**
	GH¢	GH¢	GH¢
Personal Emoluments	3,066,729.00	3,134,005.00	(67,276.00)
Use of goods	-	216,398.00	(216,398.00)
IGF	488,012.00	383,100.00	104,912.00
Total	**3,554,741.00**	**3,733,503.00**	**(178,762.00)**

The total income for the period amounted to three million, five hundred and fifty four thousand, seven hundred and forty –one Ghana cedis (GH¢3,554,741.00) of which 86% represents income from government sources

3.0 COMMERCIALISATION AND INFORMATION DIVISION

Introduction

The Commercial and Information Division (CID) coordinates the commercial activities of all the other Divisions in the Institute in order to enhance the income generation capacity of the Institute. The Division has three (3) Sections namely the Client Services Section (CSS), Technological Business Service Section (TBSS) and the Information Management Section (IMS).

Client Service Section (CSS)

The Client Service Section (CSS) is the interface between the Institute and its clients for services in Chemistry, Microbiology, Toxicology and Processing. For the year 2012, the Microbiology, Toxicology, Chemistry and Processing laboratories received a total of 2,715 samples from 740 clients. The details are shown in Table 3.1.

Table 3.1

Details of actual income generated from clients

Lab.	No. of Client	No. of Samples
Microbiology	124	2142
Chemistry	549	158
Mycotoxin	45	233
Processing lab	22	182
Total	**740**	**2715**

Out of 2715 clients, 100 of them were new thus (36.8%) of the total client. Some of the major clients were Cadbury Gh. Ltd., Pioneer Food Cannery Ltd, Ghana Standard Authority, Promasidor Ghana Ltd. etc.

Table 3.2
Actual volume of workdoneon products by the different Cost Centres

Cost Centre	Volume of work
Spawn bottles	10800
Compost bags	7500
Sale of products	1910kg
Fabrication	10 par boil vessels
Primary Processing of raw materials for clients	2000kg

Technological Business Service Section (TBSS)
The TBSS activities were mainly based on consultations and trainings. Within the year, 51 requests were received thirty-four (34) of the requests were executed. This formed 66.67% of total requests received. Nine (9) of pending requests, forming 18% of all request received, and 52.94% of pending ones, are tied to Council for Technical and Vocational Education and Training (COTVET's) Skills Development Fund (SDF) funding. The Institute is yet to hear from them.

Information Management Section (IMS)
The Food Research Institute library is one of the most distinct libraries that provides and disseminates information in the field of food science and technology, nutrition, food microbiology, aflatoxins and mycotoxins, agricultural economics and food engineering in the country. The library has a total book stock of over four thousand books (4000) and over 200 back issues of food science and technology journals. The library also has over one thousand four hundred (1400) soft copies of books in the area of food science and technology and other related subject areas that can be accessed on the FRI-SERVER.
The library has access to numerous electronic databases and journals such as AGORA, OARE, SCIENCEDIRECT, HINARI, EMERALD, TEEAL and so on. Also the library has an in house database known as AGRIS database that contains about 600 records.

The clientele of the library has extended beyond the institute's research scientists and technical staff to include students from the various Polytechnics and Universities in Ghana. The library is also patronized by lecturers, farmers, industrialists, Journalist, Civil Servants and Public Servants, Consultants and many others.
A total of one hundred persons used the library during the period under review. On the whole, the clientele's acknowledge that the information provided was useful and relevant

that met their various information needs.
The library continued to enjoy the availability of Internet Connectivity making it possible for the Institute's research scientists and technical staff to browse the net, access their electronic mails and access full text articles and other relevant information for their work.

a) Information Request

Information sought for during the period under review included publications on fermentation of African traditional foods, fish and fish processing, post-harvest losses of fish, Nutritional enhancements of food, food fortification, Gelatinization of starch, Heavy metals in food, Waxing treatments of root and tuber crops, Sweet potato, Nutritional value of Cowpea and Solanum torvum, Coconut processing, Food product development, Mushroom cultivation, Fruits processing , Determination of fructose in honey, Ginger processing, Pepper processing, Food product development, Aquaculture, Browning reaction on cacao, Food Microorganisms, Shelf life studies on pepper, Lactic acid fermentation on maize, Fish texture analysis, Sour sap and Nmada drink, Physcochemical and functional properties of wheat flour were provided for the library users.

b) Referrals

The library directed some clientele's to CSIR-INSTI during the period under review.

c) Usefulness of information provided

During the period under review the users noted that the information provided was useful but remarked that there was the need to replenish the stock of the library with more up to date publication and improve access to e-resources available in the library. Users who visited the library personally to source for information had various information materials provided for their perusal. These included soft and hard copies of books and full text journal articles that were acquired from the various Electronic databases like AGORA, SCIENCEDIRECT, CTA/SDI Service and also others made use of the TEEAL Collection and Ghagri database.

In the area of publicity of services, the research scientists and technical staff were informed by word of mouth of certain information resources available in the library. The library also during the period under review sent e-mails to research scientists to inform them of journal articles and publications available in the library.
The users of the library during the period under review recommended the acquisition of current publications to replenish the library stock and the acquisition of computers to enable the library operate an internet café.

Public Relations

Public Relations duties cover communication Research; Compilation of annual/quarterly reports; Preparation of exhibition materials, posters, brochures and fliers, video and photographic exhibitions, etc. For the year under review, the Institute organized three seminars, participated in four exhibitions and one trade fair. The Institute received 60 dignitaries from foreign and local governments, about 300 Students from Universities, Polytechnics, and Secondary Schools also came for excursion.

The news media and the internet were monitored. Some newspaper articles that were published in the Daily Graphic including, "*Genetically Modified Foods*" by Mr. Augustine Andoh & Dr. Margaret Atikpo and "*Why women are important to the future of Africa's Agriculture*" By Dr. L.D. Abbey & Augustine Andoh.

4.0 FOOD PROCESSING AND ENGINEERING DIVISION

Introduction

The Food Processing and Engineering Division (FPED) comprises of three operational units as Engineering Unit (EU), Pilot Scale Production Unit (PSPU) and Root and Tuber Products Development Unit (RTPDU). The Division had 43 staff members comprising of 8 Senior Members, 21 Senior Staff and 14 Junior Staff. The Divisional Head is Dr. Charles Tortoe, who assumed duty on 1st February, 2012, when Dr. Nanam Tay Dzied-zoave was appointed Director. The Head of Division was assisted by three unit heads: Mr. Gregory Komlaga for PSPU, who assumed duty on 1st February after Mr. Joseph Gayin proceeded on study leave, Mr. Cletus Gyato for EU and Mr. Elvis Baidoo, who acted for Mrs. Charlotte Oduro-Yeboah when she also proceeded on study leave.

Five Performance Improvement Teams led by other senior members in the Division were created to support the management of the Division for efficiency. The teams are: Research and Development Management Team, Quality Management Team, Information Management Team, Market Development Team and Equipment Installation and Maintenance Management Team.

The major activities undertaken in the Division during the period under review were:

- Research and Development activities
- The production and sale of research by-products
- Technical and analytical Services, and
- Training

Research and Development Activities

Senior Members and Senior Staff were involved in eleven (11) projects within the Division as follows:

*(i) **Cassava:*** Adding Value for Africa [C:AVA] Project – FRI Technical Services

- 20 additional senior high schools trained in the use of HQCF for bread-making.
- Capacity and Capability building in improved Cassava Processing and Utilization in Coastal Communities in Ghana.
- Annual report for April, 2011 to February, 2012 was prepared and submitted to the C: AVA country office.
- Monitoring visits to end users of HQCF conducted in the Volta and Greater Accra regions.

*(ii) **WAAPP Alternative Flours Project:*** Capacity and Capability building in improved Cassava Processing and Utilization in Coastal Communities in Ghana.

- A documentary was developed at the request of CORAF Senegal through WAAPP-CSIR on some success stories of some of the beneficiaries of the WAAPP who are successfully using the alternative flours in their operations.

(iii) WAAPP Yam Processing Project

- 2 convenient yam products developed
- 2 pre-treatment methods established for yam processing
- Conducted shelf life studies of pre-treated yam in storage

(iv) ***Improving Post-Harvest Quality and Packaging of Rice, Sorghum/Millet and Cassava Products to Enhance Marketability in West Africa.***

- Monitoring and evaluation of SMEs trained on improved Gari and HQCF processing.
- Trained rice processors on improved rice post-harvest technologies.

(v) WFP-Community Based Cereal Milling and Fortification Programme

- Technology transferred to 27 communities in the three Northern regions of Ghana on food fortification with micronutrients using a manually operated mixer
- Thirty (30) mixers designed and fabricated by the Division

(vi) Africa Rice Project:

- Baseline studies conducted for rice in two regions in Ghana
- Conducted baseline surveys in all the three northern regions of Ghana and the northern part of the Volta Region. Conducted a needs assessment for rice farmers and processors in order to establish benchmarks for monitoring purposes.
- Questionnaire for survey in the rice hubs have been prepared and confirmed.

(vii) KAFACI Tomato Project: Developing and Transforming Vegetable Technologies in Ghana: The Case of Tomato. (CRI, FRI, PGRRI)

An MOU was sign between partners for commencement of baseline studies on tomato processing.

(viii) Rice Sector Support Project (RSSP)

Training was organized for rice farmers and processors in three Districts of the Upper-West Region.

(ix) Cassava G-market Project

A meeting of staff participants to brief members on roles was conducted. A report on review of previous experiences in new product development with HQCF and studies into the functional properties of cassava flour was started.

(x) Gratitude Project

Value chain analysis on cassava and yam completed. Key yam varieties identified and the use of cassava and yam peel waste in mushroom cultivation are under investigation

(xi) WAAPP 2A

Annual work plan presented and submitted to WAAPP Office for commencement of work in 2013. Staffs were involved in other projects domiciled in other Divisions such as the AFTER Project Client requested training conducted on fruit juices, fufu flours, fermented maize meal, groundnut paste etc.

Production and Sale of Research By-Products

Production and Sales

Research by-product production quantities over the period were as presented in *Tables 4.1 - 5.*

Table 4.1: **Production Sales of Research By-Products in the PSPU**

Type of Product	**Quantity Produced (kg)**	**Total gross amount (GHc)**
Groundnut	427.5	2259.00
Fermented Maize Meal	133	483.00
Yam Fufu	254	774.00
Cocoyam Fufu	76	456.00
Plantain Fufu	154	1287.00
Banku Mix	766	1344.00
TOTAL	1810.5	6,603.00

Table 4.2: **Production Sales of Research By-Products in the RTPDU**

Product	**Quantity Produced (In sachets of 1kg)**	**Sales gross revenue (GHC)**	**Stocks in Store (kg)**
Kokonte	1125	2666.50	2,640.0
Gari	330	612.50	260.00
Agbelima	-	-	-
Starch	100	60.0	350
HQCF	-	-	-

Table 4.3: **By-Products in the EU**

Product	Quantity Produced	Sales at present (GHC)
Parboil vessel (stainless steel, swivel type)	10	41,720.00
Total (Advance Project)		41,720.00

Services to clients

The services provided at the Pilot Scale Processing Unit were roasting of groundnut and soybean and drying of Hausa Koko (Table 4.4).

Table 4.4: **Services to clients**

Type of service	Number of times	Total gross amount (GHc)
Roasting of Groundnut	5	150.00
Roasting of Soybean	2	115.00
Drying of Hausa Koko	1	35.00
	TOTAL	**300.00**

Analytical services

One hundred and eighty two (182) samples were analyzed within the period. Analyses are presented on Table 4.5.

Table 4.5: **Analytical services to clients**

No.	Types of Analysis	No. of samples	No. products
1	Water activity	23	Fresh yam, pie
2	Physical quality	13	Rice, maize
3	Pasting characteristics	30	Cowpea flour, yam bean starch
4	Milling & sieving	1	Rice
5	Texture	7	Yam cookies
6	Colordetermination	23	Rice flour, pie
7	Particle size	7	Cowpea flour
8	Rice dehulling	8	Paddy rice
9	Swelling power	12	Bambara flour
10	Solubility	9	Flour samples
11	Paste clarity	1	Yam bean starch
12	Water binding capacity	30	Yam bean starch
13	Water absorption	8	Flour samples
14	Water retention	1	Mushroom flour
15	Browning index	3	Mushroom flour
16	Water sorption isotherm	3	Cowpea flour
17	Oil absorption	3	Cowpea, pigeon pea
	Total	182	

Services by Engineering Unit

- The Engineering Unit constructed and installed burglar proof system at the cashier's office.
- Conducted repair and maintenance of two extractor fans at the Food Chemistry Division.
- Conducted repair and Maintenance of two autoclaves at the Food Microbiology Division and construction of two autoclave stands for the autoclaves.
- Changed the lighting system and installation of additional ceiling fans for the
- Constructed exhibition stands for the Commercial and Information Division.
- Conducted servicing and maintenance of the two FRI generators.
- Conducted checks and maintenance of the lighting system in the following areas; Processing Hall (FPED), Administration Division, Accounts Division.
- Six proforma invoices had been prepared for clients through the CID and the unit is awaiting responds from the clients.

5.0 FOOD CHEMISTRY DIVISION

Introduction

The major function of the Food Chemistry Division is to give support to the commercialization activities of the Institute by offering analytical services to Industry, local and International students, as well as training for students. In addition, the Division conducts applied research relating to chemical contaminants (Toxicology and heavy metals) in foods and feeds as well as food flavour (aroma) analyses. The Division also offers consultancy services and advice to clients. The Division comprises two Units namely the Food Toxicology Unit and the Industrial Services Unit.

Staff Strength and Movements

The Division currently has 14 members of staff consisting of:

- Principal Research Scientist
- Research Scientists
- Principal Technologist
- Senior Technologists
- Technologist
- Senior Technical Officers
- Technical Officers

The following staff movements occurred during the period:

a. Ms. Emefa Gblende continued her B-Tech in Laboratory Technology course at the Accra Polytechnic.
b. Mr. Charles Diako commenced his studies in the USA towards the award of a Doctorate degree.

Analytical Services

During the year, the Division offered analytical services to several companies, establishments and individuals. A total of 549 samples were received by the Industrial Services Unit for analysis. This number represents a 1.1% increase over the 543 samples received in 2011.

The samples analysed included Semolina, gari, sunflower oil, sesame seeds, dried pineapple, Bisap juice, Royal pure honey, salted Tilapia, fresh milk, Cocoa husk, Nsure evaporated milk, vegetable oil, Neat fresh palm fruit extract, noodles, fish, wheat flour, pumpkin seeds, spices, iodated salt, Trio stout extra beer, cocoa liquor, alcohol, soy bean meal, wheat grain, Storm ginger drink, rice, kenkey, dried mango, powdered chilli pepper, Melon seeds, dried banana, brown gold, corn soya blend, pepper sauce, dried pepper, Noni juice, fish meal, yam, yoghurt, sweet potato, maize and maize products, groundnut, Samartex thaumatin , cocoa powder, fruit juices, poultry feed, among others.

The clients included Intertek Ghana Ltd., Ghana Standards Authority, Agricare Ltd., Neat Foods Company Ltd., Healthylife Beverages Ltd., Karim Industry and Trading Ltd.,

CSIR-Animal Research Institute, Fruito Foods Processing Ltd., G.C. Resources Ltd., Maviga Ghana Ltd., AFTER Project, El-Rennaissance Ltd., Olam Ghana Ltd., Provest Exports Ghana Ltd., Voltic Ghana Ltd., Maridav Ghana Ltd., Ghana China Foods Co. Ltd., Feedtime Ventures, Lugay Ltd., Equator Foods Ghana Ltd., Falaboo's Ventures, Hords Ltd., Olam Ghana Ltd., Homefoods Processing and Cannery Ltd., Promasidor Ghana Ltd., Rosepark Foods and Beverages Ltd., Icecool Purified Water Ltd., Medsys Ltd., Deysark Enterprise, Plot Enterprise Ghana Ltd., Atona Foods Company, Kosher Feedmills Ltd., Vision 2000 Farms Company Ltd., The Potters Touch Ventures, Hela & Hela Ghana Ltd., Flour Mills of Ghana Ltd., Allied Cocoa Products Ltd., among others.
Analysis of the 549 samples generated a gross income of sixty seven thousand, nine hundred and ninety two Ghana Cedis (GHC67,992) as against a gross income of fifty thousand, five hundred and forty twoGhana cedis eighty pesewas(GH¢50,542.80) for 2011. This represents an increase of 34.5% over the 2011 gross income.
During the year, the Toxicology Unit received a total of 233 samples for aflatoxin analysis as against 262 samples for the year 2011. This represents a decrease of 12.4% over the previous year.

The samples consisted of peanut and peanut products, maize and maize products, rice, natural cocoa liquor, raw cocoa beans and cake, Nestle cerelac cereals, Burger peanut snack, rice, poultry feed,cocoa liquor, Tom brown, wheat flour, Hausa koko, gari, fresh and processed fish, cashew nut,khebab powder, spices, spaghetti, among others.
The clients included: Intertek Ghana Ltd., Burger Food Industries, Ghana Standards Authority, CommoditiesProcessing Ltd., Agricare Ltd., Ghana China Foods, Kesstevebel Ventures, Joan Korf Trading Enterprise, Elsykess Company Ltd., Vida Mix Foods, University of Ghana, Premium Foods Ltd., Mrs Aska Polytrade Ltd., Hords Ltd., Accra Polytechnic, Plot Enterprise Ghana Ltd., Movenpick Ambassador Hotel, Greater Poultry Farmers Association, C&S Foods Ghana Ltd.,Odonso Best, Raanan Fish Feed, Yrdent Agro Processing Ventures, Foodtech Ltd., among others.
Total charges for the 233 samples amounted to thirty thousand, six hundred and forty-nine Ghana Cedis (GH¢30,649) as against thirty-five thousand, six hundred and sixty-six Ghana Cedis (GH¢35,666). This figure represents a decrease of 16.4% over the 2011 gross income.

The gross total for the two Units of the Chemistry Division was therefore ninety eight thousand, six hundred and forty one Ghana cedis (GH¢98,641). This amount represents an increase of GH¢12,432.2 (14.4%) over the gross income for 2011 (Table 1).

Table 5.1: **Summary of gross income generated in 2012 by Chemistry Division**

Quarter	Industrial Services Unit		Toxicology Unit	
	No of Samples analysed	Gross Income GH¢	No of Samples analysed	Gross Income
1st	142	17,119	68	10,335
2nd	232	29,361	105	12,647
3rd	77	10,852	41	5,525
4th	98	10,660	19	2,142
TOTAL	**549**	**67,992**	**233**	**30,649**

Accreditation of Chemistry Laboratories

Internal Audits
In compliance with the Accreditation Quality Manual, two internal audits were conducted during the year. These were held in February and September 2012.

External Audit(Reassessment Audit)
A reassessment audit was conducted by SANAS from 17th – 19th July 2012 for the purpose of renewing the accreditation for the chemistry scope. The existing scope was expanded to include testing for aflatoxins in peanut and peanut product as well as maize and maize products. The audit was very successful.

Proficiency Tests
According to the CSIR-Food Research Institute Quality Manual, the analytical methods in use have to be subjected to proficiency testing once every year. The Division placed the orders for the test materials. The Toxicology Laboratory conducted the test and obtained acceptable z-scores for the parameters tested. The Industrial Services Unit however, received the test sample very late when time had elapsed for the submission of results. Reference materials ordered were used for internal quality control procedures.

Training

Staff of the Division were involved in the Internship Programme for 3rd Year students from the Food Science and Technology Department of KNUST from 18th January to 23rd February 2012. Staff of the Division trained the students on Chemical analysis of foods and demonstrated the use of specific analytical equipment in the Laboratories.

6.0 FOOD MICROBIOLOGY DIVISION

Introduction

The Food Microbiology Division (FMD) has the main task of undertaking research and development activities in food safety and quality assurance for the food industries in Ghana. The Division is made up of two Units, namely the Industrial Services Unit (ISU) and the Mushroom Unit (MU).

The Industrial Services Unit of FMD carries out services for clients through analyses of samples submitted to the laboratory or sampled directly by staff. The ISU also advises clients and inspects food production premises of clients who include exporters of food products. The analyses carried out are thirteen accredited methods by South African National Accreditation System (SANAS). The unit is also involved in training entrepreneurs and students from tertiary institutions such as Polytechnics and Universities. Staffs are engaged in research activities including molecular biology/biotechnology activities, with production of technical reports and refereed scientific publications.

The Mushroom Unit carries out research activities in indigenous and exotic edible and medicinal mushrooms. It disseminates results to stakeholders through training programmes, technical reports and scientific papers. The MU maintains a National Mycelium Bank which contains samples of mushrooms researched into. The Unit is also engaged in production and sale of mushroom spawns and compost bags to local farmers and researchers in some countries in sub-Saharan Africa like Cote d'Ivoire, Benin and Togo.

Major Activities and Outputs

Activities and Output of Industrial Services Unit (ISU)
The main activities carried out are the following:

- Technical and analytical services to clients for income generation.
- Quality control of analytical methods under the ISO 17025 accreditation.
- Visit to laboratories of food industries to advise on quality control procedures
- Advice to clients.
- Training of students from tertiary institutions in Ghana.
- Research activities

Students from tertiary Institutions were trained in laboratory procedures and quality management. Third year students of the Department of Food Science, KNUST undertook an internship programme within the year.

The ISU engaged in routine technical and analytical services carried out for clients who submit samples to the laboratory through the CID. A total of 2,038 samples were analyzed

for clients in 2012 as against 1,728 samples in 2011 (Fig. 6.1). This was an improvement of 17.94 % over samples analyzed in 2011.

The most important clients that patronized our services most and brought in much revenue during 2012 were Cadbury Ghana Ltd., Newrest First Catering, Promasidor Ghana Ltd., Pioneer Food Cannery, Aquafresh Ltd. and Niche Cocoa Industry Ltd. Other notable clients of the ISU were Airways Catering Ltd., Burger Food Industries, Cocoa Processing Co. Ltd., Euro Food Gh. Ltd., West Africa Mills Ltd., Ghana Inspection Ltd. and Olam Ghana Ltd.

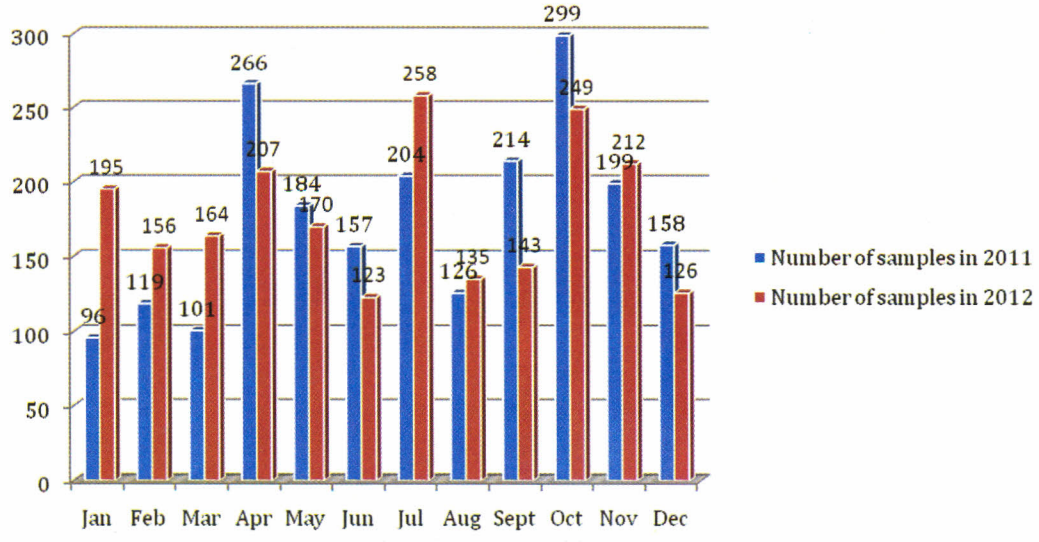


Fig 6.1 **Number of samples analyzed for clients in 2011 and 2012**

Revenue obtained from analytical services carried out by ISU for clients in 2011 was GHS 258,753.80 as compared to GHS239,381.18 in 2012 (Fig. 6.2). The 2012 figure was a reduction of 7.49% over 2011 revenue due to suspension of the ISU in carrying out further analyses to address non-conformances of the external audit by the South African National Accreditation System. As such accredited work was suspended and only samples not for accredited work analyzed.

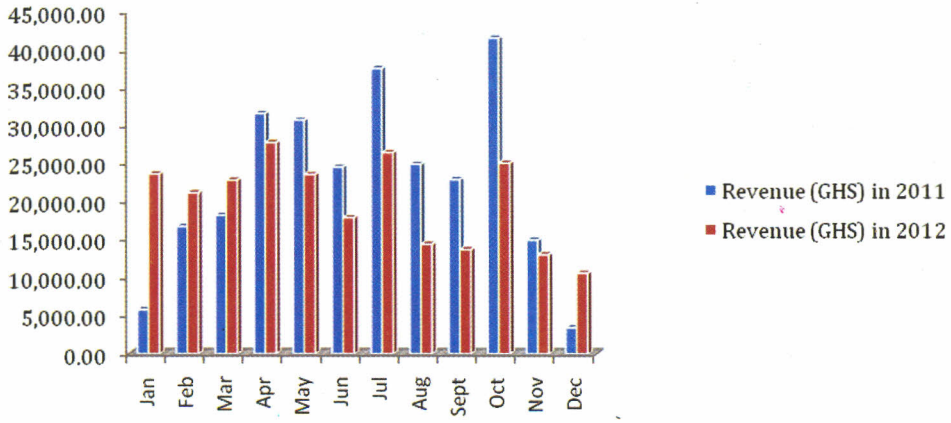


Fig. 6.2 **Revenue for analysis of samples for 2011 and 2012**

Laboratory Quality Management System: ISO 17025 Accreditation

The quality of analytical services carried out for clients was assured by maintenance of the ISO 17025 for which the Food Microbiology Division has accreditation for 11 analytical methods namely:

- Enumeration of Yeasts and Moulds. ISO 7954, 1987 (E).
- Enumeration of presumptive Escherichia coli. ISO 7251, 2005.
- Detection of Salmonella. NMKL No.71, 1999, 5th Ed.
- Coliform bacteria detection in foods. NMKL No.44, 2004 6th Ed.
- Determination of Bacillus cereus in foods. NMKL No.67, 2003.
- Determination of aerobic microorganisms. NMKL No.86, 1999.
- Detection of thermo-tolerant coliform bacteria in foods after pre-incubation
- Enterococcus determination in foods. NMKL No. 68, 2004 4th Ed.
- Aerobic microorganisms and presumptive Enterobacteriaceae enumeration on surfaces and utensils No. 5 2001 5th Ed.
- Microbiological examination of fully preserved canned foods aerobic and anaerobic. NMKL No. 59 2004 5th Ed.
- Enumeration of coagulase positive Staphylococcus aureus in foods. NMKL No. 66. 2003

Two internal audits of the quality system were carried out during the year 2012. Two Management Review Meetings were also held during the year. Staff of the Division who carried out analytical services participated in the Proficiency Testing Scheme organized by Bio Services Ltd. U.K. and performed satisfactorily.

Re-assessment of Quality System

South African National Accreditation System (SANAS) assessment was held on the 17th and 18th July 2012. Preparations for the assessment (the Accreditation Body of the laboratory's quality system) were carried out for an on-site reassessment of the quality system and

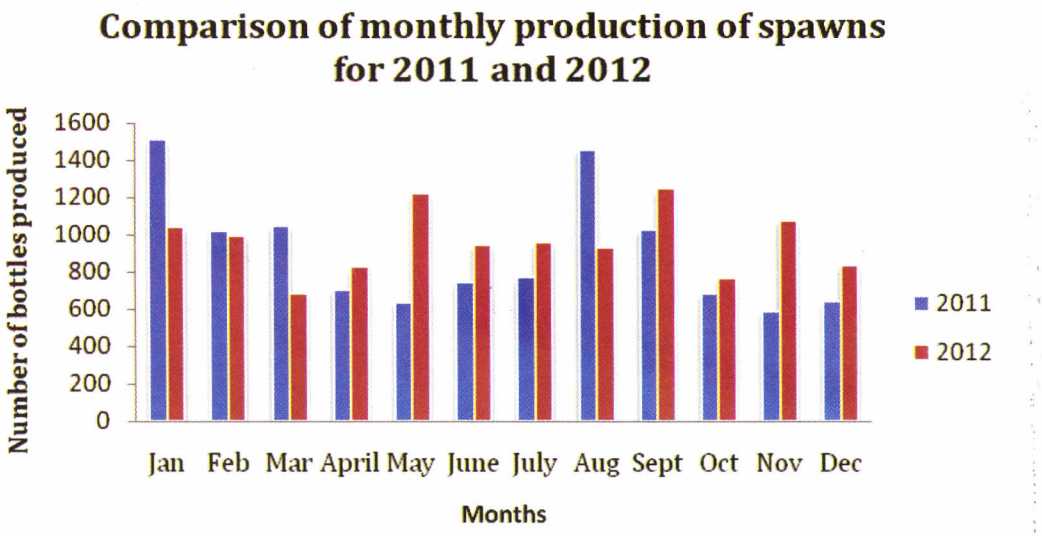
renewal of our certification. All major non-conformances identified during internal audits of 2011 were therefore addressed; and internal and external proficiency tests were carried out in preparation of the assessment. Validation of all methods using the different matrices was addressed. Corrective and preventive actions were also taken for compliance of the quality system. Reproducibility and repeatability data were also generated. The ISU suspended all other activities to concentrate on work related to re-submission of documentation for the external assessment.

Activities and Output of Mushroom Unit (MU) of the Food Microbiology Division

The main activities carried out in the Mushroom Unit were commercial production and sale of mushroom spawns, compost bags and occasionally some fresh mushrooms to clients. Research activities in indigenous and exotic edible and medicinal mushrooms were also carried out. On-going collaborative research works in the Unit include:

- Marker Assisted breeding of mushrooms for high-yield, sub-yield components and high antioxidant activities. This work is in collaboration with the Department of Botany and funded by the University of Ghana Research fund.
- Adding Value to Cassava Waste Products for Mushroom Production is funded by GRATITUDE Project

Comparative number of bottled spawns and compost bags produced and sold monthly in 2011 and 2012 to mushroom growers are as shown in Figs 6.1 and 6.2, respectively. In 2012, there was increase of 6% in spawn production (Fig. 6.3) and 334% increase in bag production (Fig. 6.4), as compared to 2011.



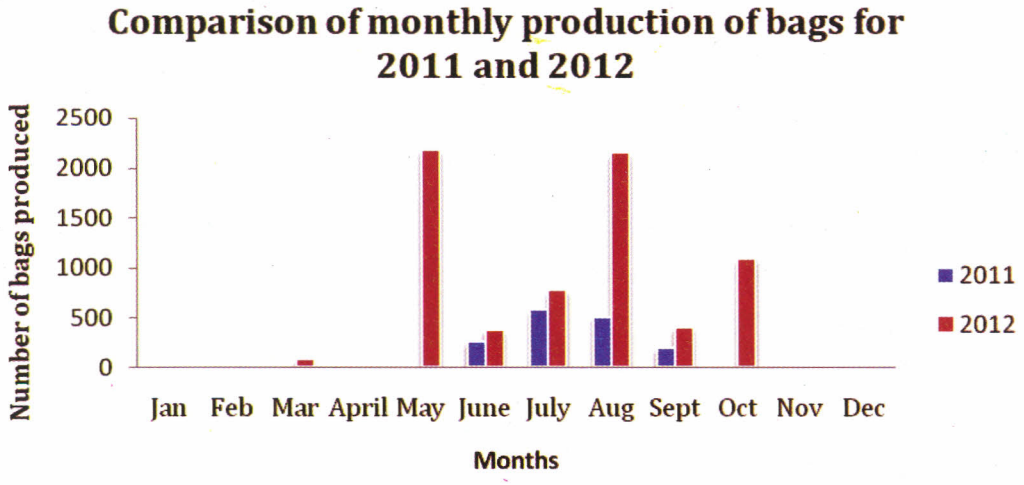


Fig.6.4 **Comparison of monthly production of bags in 2011 and 2012**

Other activities in the Mushroom Unit include research work, training and extension services to clients. These are:

- Receipt of twelve (12) new strains (7 strains of Pleurotus ostreatus and 5 strains of Lentinula edodes) from Plant Research International, Wageningen, Netherlands under the GRATITUDE project. These strains will be tested for optimum growth, yield and nutritional properties; and selected for multiplication to mushroom farmers.
- Revival of cultures in the National Mycelium Bank.
- Research work by students on attachment from tertiary institutions engaged in completing or continuing work. These are the following:

- Quaicoe, E.H. 2012. Optimum nutrient and environmental growth conditions of the medicinal mushroom Lentinula edodes. MPhil thesis. University of Ghana, Legon.
- Korley, K.J.N. (2011-2013). Utilization of radiations to sterilize compost bags and preserve mushrooms (Pleurotus ostreatus) cultivated on sawdust. Graduate School of Nuclear and Allied Sciences (SNAS). On-going PhD studies.
- Wiafe-Kwagyan, M. (2012-2015). Varietal characterization of two rice species on the biological efficiency and nutrient content of two strains of oyster mushrooms. University of Ghana, Legon. On-going PhD research funded by AfricaRice project.
- Owusu, J. and Gyamphi, R. 2012. Determination of biological efficiency of two Pleurotus species on two different wood species Triplochiton scleroxylon and Antiaris toxicharia. BSc project work conducted on industrial attachment of students to the Unit.
  University College of Education, Mampong Campus.

- Staff also participated in AWARD's Regional Mentoring Meeting for 2010 niza-tion of the AWARD Role modeling Event on 21st June 2012 in order to inspire 110 JHS and SHS female students of the Faith Baptist Church Complex of Schools in Madina Zongo Junction to undertake science and agricultural related careers.

Extension and training services are:

- Mushroom training course for four participants who attended the first training course for the year. They comprise of 1 participant from Benin, and three from Ghana. The course was run from 12th-16th March, 2012. Eight participants attended the second training course for the year. This included snail cultivation from 9th-13th July, 2012. Twenty-five women in Koribondo Bo District in Sierra Leone were trained from 24th-31st August under the IITA/USAID Project UPo CA1-Unleasing the power of cassava project for value addition and commercial-ization of cassava in Sierra Leone.
- A GTV recording was carried out on 23rd March, 2012 with Mrs Mimi Dadson and her production crew for the Nature exchange programme
- Feasibility study in Koribondo, Bo District Sierra Leone From 23th To 26th April 2012.
- Nineteen (19) Third Year Students of the Department of Food Science and Tech-nology from KNUST visited both the ISU and MU Units on 9th and 10th Febru-ary, 2012 as part of their internship programme
- Students from Faith Baptist Church Complex of Schools visited the Unit on 21st June as part of the AWARD Role Modelling Event.

Staff training in the Division:

- Ms Deborah Narh completed her MSc programme in Food Biotechnology at the University of Wageningen in the Netherlands
- Mr Godson Agbeley completed the Junior Supervisory Management Course at the Institute of Technical Supervisor at Weija.
- Mrs. Bernice Karlton-Senaya (Research Scientist) is continuing her PhD studies at the North Carolina Agricultural and Technical University, USA.
- Mrs. Amy Atter (Research Scientist) completed her Masters degree in at KNUST
- Mr. Theophilus Annan (Technologist) completed his Masters degree at Universi-ty of Ghana, Legon.

- Mrs. Nina Ackah is continuing her Masters degree at the University of Wageningin

Research projects carried out in the Division include the following:

1. Micronutrient enrichment of meals fed to pupils using highly nutritious and low-cost underutilized fish under the school feeding programme in Ghana.

2. Development of high yielding strains of Pleurotus species through hybridization
3. Growth and yield performance of exotic species and strains of Pleurotus cultivated under Ghanaian conditions part 2- P9(RL), P8(Rh), PPO, POT, EM-1
4. Utilization of dried pineapple rind Ananas comosus var. md2 in the cultivation of the oyster mushroom –Pleurotus ostreatus (Jacq.ex.fr) kummer.
5. Studies on the optimum nutrient and environmental growth conditions on the medicinal mushroom (Lentinula edodes)
6. Growth and yield performance of different exotic strains of eight Pleurotus species cultivated on Triplochiton scleroxylon in Ghana.
7. An in vitro evaluation of Pleurotus ostreatus EM-1-modified maize (Zea mays) cob as a non-conventional energy source for livestock in Ghana.
8. Growth and yield of three Pleurotus species on rice straw
9. The Efficacy of Sorghum and Millet Grains in Spawn Production and Carpophore Formation of Pleurotus ostreatus (Jacq. Ex. Fr) Kummer
10. Influence of rice husk on biological efficiency and nutrient content of Pleurotus ostreatus (Jacq. ex. Fr.) Kummer.
11. Edible and medicinal mushrooms as functional foods in Ghana
12. Phenology of mycoflora and some physical and organic composition of agricultural waste used in the cultivation of the mushroom Volvariella volvacea.
13. Biodiversity, Ecology and Uses of larger fungi (Macromycetes, Basidiomycota, Fungi) in West Africa.
14. Cultivation of the oyster mushroom (Pleurotus ostreatus) on cellulosic residues from rice straw.

7.0 FOOD NUTRITION AND SOCIO-ECONOMICS DIVISION

Introduction

The Food Nutrition and Socio-Economics Division (FNSD) has two units, Nutrition and Socio-Economics Units. The core mandate of FNSD is to conduct nutrition and food utilization studies and socio-economic research. The FNSD also plays supportive role in almost all the development oriented projects in the Food Research Institute. This report covers key activities conducted solely in the division and summaries of collaborative roles under various projects. Key activities carried out during the period under review are (i) Community nutrition outreach and training in Micronutrient fortification programs sponsored by WFP, (ii) Nutritional Impact Assessment in the three Northern Regions of Ghana, (iii) Moringa leaf supplementation trial, (iv) Collaborative Projects, (v)Training of Students on Product Development and Sensory Evaluation and (vi)Commercialization activities.

Collaborative project activities include the following:

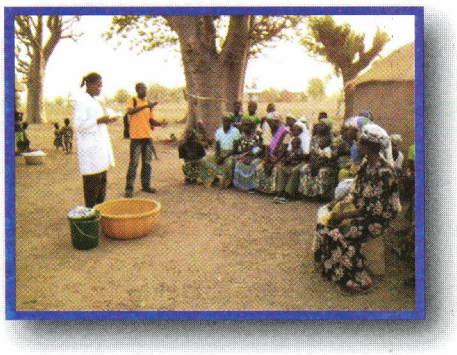
- Socio-economics studies and support for training in improved rice parboiling technology under Rice Sector Support Project (RSSP)
- Policy Task Force activities under AfricaRice Project
- Value-Chain activities under Gratitude
- Baseline surveys under West African Agricultural Productivity Programme (WAAPP1)

Key Activities

Projects

Community nutrition outreach and training on Micro-Nutrient fortifications program sponsored by WFP

Training on micro-nutrient fortification for rural women in poor communities is part of the scale–up of the community-based milling and fortification project in Northern Ghana. The project implemented by the World Food Programme aimed at reducing malnutrition in Northern Ghana. Training was organized for twenty- seven (27) women based groups in ten districts of the three northern regions of Ghana. The CSIR- Food Research Institute was

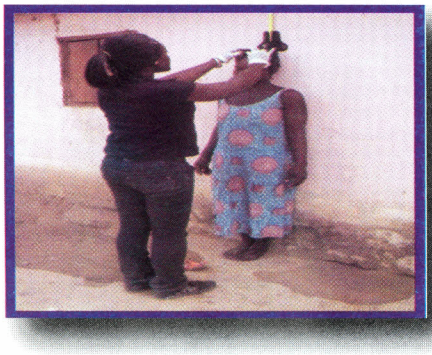


contracted by WFP as part of this project to transfer the technology of flour fortification with micronutrient premix.A participatory approach was adopted to help the beneficiaries understand and appreciate the intervention to tackle malnutrition in the communities. This was done in collaboration with the Engineering Unit of the Food Processing Division. A total of about 1,211 women were trained. Detailed report is available.

WFP's Nutritional Impact Assessment in selected communities in Northern Ghana

FRI-FNSD was contracted by WFP to conduct nutritional impact assessment of its community outreach and training on micro-nutrient fortification pilot projects. These projects aimed at improving the nutritional status of women and children by promoting flour fortification and consumption of iodized salt. The pilot projects also provided an alternate source of income for the women groups through milling, fortification and re-bagging and sale of iodized salt as a business. The pilot projects had the overarching goal of fighting against micronutrient deficiency while increasing income of women groups in their respective communities.

Nutritional anthropometry was used to assess the nutritional status of different age groups in the household. Indicators used are weight–for–length for ages < 24months and weight–for-age and weight-for-height for ages >24 months. **For Iron Status**, hemoglobin concentration was determined for mothers and their children using URIT-12 Hemoglobin Meter. Mothers between the ages of 15-49 years who have been recruited for the study were assessed **for visible goitre.** Samples of salt from each household were tested **for iodine** using iodine spot test kit obtained from the Nutrition department of the Ghana Health Service.



A child being tested for haemoglobin status and a mother's height being taken with a microtiose

Results from this study shows that in general child anthropometry in Upper East region and the usage of iodated salt in Northern and Upper West regions showed significant impact among all the indicator variables observed. The prevalence of stunting had improved in all the three northern regions. Stunting is a reflection of chronic malnutrition as a result of failure to receive adequate nutrition over a long period. Child nutritional status (underweight, stunting and wasting) had significantly reduced in Upper East Region as compared with the other regions. The Northern and Upper East Regions also recorded significant increases in maternal anaemia. In all the three Northern regions, there was no significant change observed in maternal nutritional status based on BMI classifications. The report recommends continuous education on nutrition in handout and manuals, proper infant feeding practices and good hygiene practices to be put in place to help mothers get properly informed about nutrition and health for the entire family. Detailed Report is available.

Moringa leaf supplementation trial in children and Micronutrient Enrichment of Meals fed to pupils using highly Nutritious and low-cost underutilized Fish under the School Feeding Programme in Ghana.

Collaborative Project activities

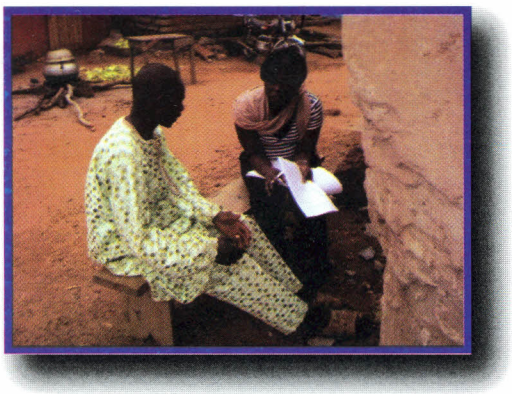
West African Agricultural Productivity Programme (WAAPP1)

Some members of the division were involved in the implementation of the Alternative Baking Flour Project, which is a World Bank-sponsored project under the West African Agricultural Productivity Programme (WAAPP). This project promotes the production and utilization of alternative flours by processors, bakers and school matrons in the Central, Western and Greater Accra Regions of Ghana. A baseline survey was conducted for the selected bakers prior to training to assess their socio-economic and production characteristics, technology awareness and adoption as well as the general institutional environment. Baseline indicators for tracking outcomes were established. These include the quantity of alternative flours used in bakeries; number of new alternative-flour-based products produced; proportion of flour cost; the total cost of production; and net benefit from production. Under a set of assumptions and various scenarios, substitution of wheat flour with high quality cassava flour (HQCF) has been shown to be profitable. Detailed Report is available. Staff of the division was specifically involved in the following:

- Baseline surveys conducted for Processors
- Training of Processors in the production of HQCF and Sweet Potato Flour
- Finalization of baseline report for adopting bakers and matrons
- Driving uptake of flour technologies through technical backstopping and monitoring

Gratitude Project

Staff of the Socio-economics Unit of the division were involved in Value Chain Analysis and levels/causes of post-harvest losses for cassava and yam in Ghana as well as Market study on the range of potential cassava and yam waste product solutions in Ghana. These activities involved field data collection, desk top reviews, key informants interviews and mapping exercise on commodity value-chains. Detail reports are available. See some pictures of interactions with some value chain actors below:



CIDA-funded AfricaRice Project

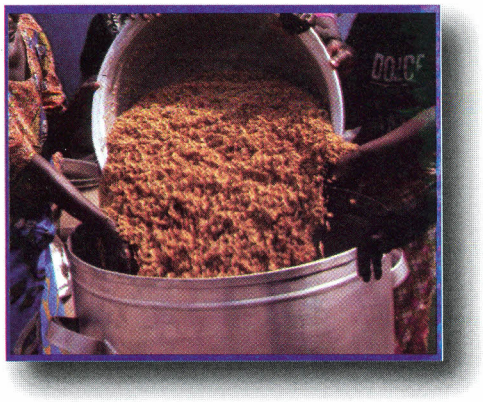
Members of staff of the Nutrition Unit were involved in the Sensory Evaluation and Consumer Acceptability Tests on New Rice-based products. This was done with an MPhil Student of the Department of Nutrition and Food Science of the University of Ghana. Local rice varieties were used for noodle production to help diversify the use of local rice and enhance its marketability. Members of staff of the socio-economics unit were also involved in training of other stakeholders in AfricaRice's hub concept as well as hub planning and harmonization meetings.

Consultancy on Yam Products Development

Staff of the Nutrition unit were also involved in the development of two yam products under a Japanese Consultancy. Developed and tested yam crisp and soyabean-fortified yam flour that could be used as breakfast meal, weaner and for making mpotonpoton. This will be fully covered under Food Engineering and Processing Division (FPED).

Rice Sector Support Project (RSSP)

Staff from the division assisted with training of rice value chain actors in selected rice production and marketing communities in Northern Region of Ghana. This activity was led by a research scientist from the FEPD. A total of 78 farmers and 98 processors were trained in Ghalahi, Taha, Nyoyini, Jana and Sahakpaligu in the Northern Region. Other stakeholders and RSSP partners who participated in the training program are Grameen-Ghana, NPAS and MoFA-AEAs. Detailed training report is available.



Picture showing horizontal placement of parboiling vessel and transfer of washed paddy into parboiling vessel.

Training

Training of KNUST Students

Students were taught the key principles of product development. This involves identification of needs through situational analysis of the target groups, conceptualization, formulation of the new product and scale-up. The new product is then tested for acceptability through sensory analysis at the test kitchen level and/or large scale consumer acceptability test in the field. Sensory evaluation involves the measurement and evaluation of the sensory properties of foods and the analysis and the interpretation of the responses by the sensory professional. Sensory evaluation is used as a practical application in product development by aiding in matching, proving and grading new and existing products.

Students were also enlightened on stakeholders in the food product development industry including home economists and home scientists, chefs, food scientists, nutritionists and food process engineers. For hands-on demonstrations or experiments two products (dzowe and queens cake using cassava flour) were developed by the students under the supervision of the staff. Sensory evaluation was conducted on these products using the triangle test and consumer acceptability test.

Training of students from Cape Coast

Some students from Cape Coast University were trained in sensory evaluation of food products

Commercialization Activities

Revenue generated from commercial activities such as Catering Services;Data Entry;Sensory Evaluation and sale of products amounted to Three Thousand Eight Hundred and Eighty Ghana Cedis, Seventy pesewas (GHS 3,880.70)

8.0 PROGRAMMES AND PROJECTS

8.1 ACCREDITATION, FOOD SAFETY AND QUALITY ASSURANCE PROGRAMME

Introduction

A Quality Management System conformable ISO/IEC 17025 was established in 2007 and has been operational to date. Having been accredited by the South African National Accreditation System (SANAS) for four (4) Chemistry analyses and thirteen (11) Microbiology methods at inception, the Institute has continued to maintain the standards so as to ensure that its Chemistry and Microbiology laboratories produce technically valid analytical results that can be internationally accepted by customers.

Outcome of Surveillance visit

At its visit in July the accreditation body, South African Accreditation System (SANAS) granted continued accreditation to the entire General Chemistry scope. Dr. Margaret Owusu and Mr. Vincent Owusu Kyei-Baffour were approved as technical signatories for the General Chemistry and Toxicology scope respectively. The entire Microbiology scope was however partially suspended due to absence of records on validation and uncertainty of measurement for methods, among other non-conformances. These non-conformances were to be cleared within a given time frame for the scope to be reinstated.

Major Activities

Internal Audits

Two internal audits were conducted in the year. Chemistry, Toxicology and Microbiology; the Client Services Unit of the CID and the FRI Stores were audited in January to verify whether the operations comply with the requirements of the FRI Quality Management System and the International Standard ISO/IEC 17025 and its defined methods, procedures and instructions as stated in the documents were properly carried out. A second audit was conducted on the Microbiology laboratory in October. The two audits were conducted in January and the other in October. The audits were conducted by Dr. Charles Tortoe and Mr. Elvis Baidoo of the Processing and Engineering Division, Dr. Mary Halm, the immediate past Quality Manager, and Dr. Lawrence Abbey (Quality Manager).

January 2012 Internal Audit findings

Microbiology Laboratory

Three (3) minor non-conformances (NCs) were found in the March audit of the Microbiology laboratory.

Chemistry Laboratory
The Chemistry laboratory recorded two (2) non-conformances.

Mycotoxin Laboratory
The Mycotoxin laboratory recorded two (2) non-conformances.

Stores
One (1) non-conformance was identified at the Stores.

Commercialization and Information Division
Three (3) minor non-conformances were identified at the CID.

October 2012 Internal Audit findings

Microbiology Laboratory
All the non-conformances identified during the previous January 2012 audit were addressed. However, fourteen (14) non-conformances (NCs) were identified in the October Audit.

Management Review Meetings
Management Review Meetings were held twice in the year to ensure the continuous suitability and effectiveness of the Quality Management System and to introduce necessary changes and improvements. Two meetings were held on 17th May, 2012 and 26th November, 2012. The main matters discussed were: Status of work in the Divisions; Problems and difficulties encountered; Suggestions for improvements; Internal /External Audit findings; Corrective and preventive actions; Results of Proficiency tests and Internal quality controls; Purchasing/Procurement; Customer feedback and Complaints; Resources and Staff training and other matters. Members of the Management Review Meeting included the Director (Chairperson); Deputy Director and Heads of Microbiology Division, Chemistry Division, Commercial and Information Division; Accounts and Stores Division, Administration Division and the Quality Manager as Member/Secretary.

Participation in proficiency tests/inter laboratory comparisons

Proficiency Tests
By the Quality Manual, the methods in use have to be subjected to proficiency testing at least once every two years. No proficiency tests were held in 2012.

Notification of surveillance
The Quality Manager received a notification of surveillance assessment from SANAS on the 11th of June, 2012. This assessment was scheduled for 17th to 19th July, 2012. The scope for the proposed audit was to cover the management system and technical activities

including vertical assessments, witnessing of laboratory activities, quality documents compliance and the implementation thereof against the requirement of our Quality Manual, ISO/IEC 17025:2005 and additional SANAS requirements.

8.2 PROJECTS AND PROGRAMMES

A. GAINS FROM LOSSES OF ROOT AND TUBER CROPS (GRATTITUDE)

Start date: January, 2012 **Estimated duration:** 2 years, 8 months
Sponsors: European Union **Budget:** € 350,850.00

Location: Greater Accra, Brong Ahafo and Volta Regions and possibly Northern and Ashanti Regions

Principal Investigator: Dr. Nanam Dziedzoave

Participating Scientists: Dr. Charles Tortoe, Mrs. Wilhemina Quaye, Mr. Gregory Komlaga, Mr. Eric Owusu Sarpong

Collaborating Institutions: Caltech Ventures, St. Baasa Ltd, Social Development and Improvement Agency (SODIA)

Objectives: To improve the postharvest management of cassava and yams leading to reduced physical losses, reduced economic losses through value-added processing and valorization of waste products.

Methodology: Laboratory Research, Field trials, Industrial trials
Activities/Progress made since previous report:

1. Cassava/ Yam Value Chain Analysis has been completed.
2. Market Study on the range of potential Cassava (and Yam) waste product solutions in Ghana has also been completed.
3. Work on market study is almost complete and draft report written.
4. Work on cassava and yam value chains is about 80% complete.
5. Key yam varieties and level of losses have been identified.
6. Assessment of on-farm yam storage structure is completed.
7. Development of High Quality Yam Flour (HQYF) is in progress.
8. Development methods for growing mushrooms from the waste of cassava\yam peels is in progress
9. Communication channels have been developed to disseminate information to stakeholders.
10. Project publicity has been prearranged based on bi-weekly press releases and briefs.
11. A website has been constructed and relevant information has been uploaded.

12. A brochure/handout/ newsletter have been designed to document information on the technologies.
13. GRATITUDE Newsletter has been printed for distribution.
14. Market study was carried out and is almost complete.

- Reports on Cassava Value Chain, Yam Value Chain and Market Study for the range of potential Cassava and Yam waste product solutions in Ghana were completed and submitted for review.
- Additional information was collected on the market study for the range of potential Cassava and Yam waste product solutions.

15. Postharvest characteristics of eighteen farmers key yam varieties were documented during the period.
16. An improved yam storage barn was constructed at Primukyeae. Using an RCBD techniques of 3 replicates (20 tubers each) of five farmers' key yam varieties (pona, lariboko, dente, muchumodo, serwah) were stored for dormancy studies for a period of 90 days.
17. Development of High Quality Yam Flour (HQYF).
18. A survey was conducted in 14 suburbs of Accra to assess consumers' preference for yam varieties.
19. Development of methods for growing mushrooms from the waste of cassava\yam peels.

A baseline assessment on processing systems of project partners as Caltech Venture Limited, St. Baasa Ghana Limited and Social Development and Improvement Agency (SODIA) was submitted to partners. Other processors assessed included Casacossa and household processors.

20. Five major communication channels were selected to ensure that all targeted groups or stakeholders have an equal share of the information on the project.
21. An initial press release dubbed "Post-harvest losses in roots and tuber production to be reversed" was publicized on June 22nd 2012 by Ghana News Agency GNA). (As an on-going activity, information is sent on monthly basis to Ghana News Agency (GNA) where both print and electronic media source for information to be distributed to their media houses for national publication.
22. Website has been fully constructed and having specialized interaction.

B. IMPROVING LIVELIHOOD OF SMALL HOLDER CASSAVA FARMERS THROUGH BETTER ACCESS TO GROWTH MARKETS (CASSAVAGMARKETS)

Start date: 1st June 2012 **Estimated Duration:** 4 years, 6 months
Sponsors: European Commission (EC) **Budget:** EC= £287,883.00; FRI= £31,987.00
Total= £319,870.00

Location: Greater Accra, Volta and Brong-Ahafo Regions

Principal Investigator: Dr. Nanam Tay Dziedzoave

Participating Scientists: Marian Tandoh-Wordey, Elvis Baidoo, Paa Toah Akonor, Cletus Gyato

Collaborating Institutions: Natural Resources Institute, UK, University of Agriculture Abeokuta, Nigeria, University of Malawi, Tuber Crops Research Institute, India, Tanzanian Food & Nutrition (TFNC), Africa Innovations Institute (AfII), Uganda
Objective(s): To provide knowledge and technologies to allow the development of value chains linking small-holder farmers to growth markets for HQCF in the context of climate change & variability.

Methodology: Transfer of composite flour baking technology through training workshops with the use of posters, brochures; Bank facility facilitation and search for new markets.

Activities/Progress made since previous report:

1. Existing different bin and flash dryers have been technically assessed and reported.
2. A review of previous experiences and work done on cassava cyanogens and interventions carried out on internationally acceptable safe limits has been done.
3. Reviewed previous experiences in the development of new products from HQCF
4. Processing and quality parameters/standards have also been reviewed and included in the report.
5. Options of available value chain development using CAVA value chains as basis have been identified.
6. Communications channels have been identified to enable dissemination of project information to stakeholders easier.
7. Project publicity channels have been pre-arranged for initial press releases and briefs.
8. Project specialized website development is under construction

C. IMPROVING FOOD SECURITY BY REDUCING POST HARVEST LOSSES IN THE FISHERIES SECTOR (SECUREFISH)

Start date: 1st January, 2012 **Estimated duration:**3 years
Sponsors: European Commission **Budget:** € 227,800.00

Location: CSIR-FRI

Principal Investigator: Dr. Lawrence Abbey

Participating Scientists: Dr. Wisdom Amoa-Amua

Collaborating Institutions: University of Surrey

Objective(s): To enhance food security by addressing post harvest losses comprehensively in the fisheries sector in selected low and medium–income countries.

Methodology: Training of fishermen/women, processors and consumers;
Use of flyers and posters

Activities/Progress made since previous report:
Trials on the single screw extruder (workpackage 2)

- Extrusion runs were performed on the single screw extruder (Fabricated at Food Research instituted) equipped with screws designed to impart high shear.
- A circular die with a 5-mm diameter annular exit was used. Barrel screw speed were held constant across all extrusions.
- Rice flour with moisture content of 30% was used and the feed rate and temperature set points were optimized for each combination of rice flour and salt.

D. RICE SECTOR SUPPORT PROJECT (RSSP)

Start date: August, 2011 **Estimated duration:** 2 years

Sponsors: Agence Francaise de Developpment (AFD), MoFA/DCS

Budget: € 120,000.00

Location: Northern, Upper East, Upper West and Volta Regions

Principal Investigator: Joseph Gayin

Participating Scientists: Wilhemina Quaye, Elvis Baidoo, Charles Diako, George Anyebuno, Ali Sampare

Collaborating Institutions: SARI, CRI, MoFA, GRATIS, GRIB, GRAMEEN, CRAN

Objective(s): To strengthen stakeholders of the rice value chain.

Methodology: Materials used include parboilers and rice. Methods used are survey, demonstrations and training sessions.

Activities/Progress made since previous report:

1. Writing of report on training conducted in the Upper West Region
2. Submission of returns with appropriate documentations attached and request for funds transfer
3. Mid-term evaluation by external consultants and review of mid-term evaluation Report
4. Preparation for fieldwork (Training of rice farmers, processors and millers in Northern, Upper East and Volta Regions) in the next quarter in progress.
5. Training of rice value chain actors (A total of 78 rice farmers and 98 processors) was conducted in selected rice production and marketing communities in Northern Region of Ghana in November and December 2012.

E. Impact assessment study of a Community-based milling and fortification study in Northern Ghana.

Start date: January, 2012 **Completion Date:** 28th June, 2012

Sponsors: UN-World Food Programme (WFP)

Actual Cost/Expenditure: $ 17,255.23

Location: Northern Ghana

Principal Investigator: Mrs. Ruth Adisetu Pobee

Participating Scientists: Dr. Wisdom Plahar, Mrs. Wilhemina Quaye, Ms. Hannah Oduro, Mr. Eric Sarpong Owusu

Collaborating Institutions: World Food Programme

Major Findings:

1. In general, child anthropometry in Upper East Region and the usage of iodated salt in Northern and Upper West Regions showed some significant impact with all indicator variables used.
2. The prevalence of stunting had improved in all 3 regions. There was a significant decrease in the prevalence of underweight from 18.4% to 12.9% in Upper East Region, from 28.4% to 19.3% in Upper West and a decrease from -1.86% to – 1.69% in Northern Region.
3. The usage of iodated salt had increased but there was no significant impact observed at baseline and end line.
4. For maternal aneamia, there had been significant increases however, there was no significant positive impact observed for the prevalence of aneamia among children in all three regions.

5. Apart from iron rich foods, maternal knowledge on micronutrient and nutrition was very poor.

Reasons for termination: End of project

Expected beneficiaries/Potential impact: Reduction in Iron deficiency aneamia and Iodine deficiency disorders in women of child-bearing age and children (6-59months)by 5%.

Publications from project: Impact assessment of WFP community-based milling and fortification in Northern Ghana. (Consultancy Report)

F. Cassava Adding Value for Africa (C: AVA) Project-FRI

Start date: June, 2008 **Estimated duration:** 5 years

Sponsors: Bill and Melinda Gates Foundation

Budget: USD 119.527.10

Location: Accra, Volta Region and Brong Ahafo Region

Principal Investigator: Mr. Gregory Komlaga

Participating Scientists: Dr. Charles Tortoe, Dr. Kwame Vowotor, Mrs. Charlotte Oduro-Yeboah, Mr. Elvis Baidoo, Mrs. Mary Amengor, Mr. B.A Mensah, Mrs. B. Kalton-Senaye, Mr. Cletus Gyato

Participating Technologist: Mr. Peter Delabor, Mrs. Iris Tamakloe

Collaborating Institutions: NGOs, University of Greenwich- UK, CSIR-Crop Research Institute, Ministry of Food and Agriculture

Objective(s): To significantly boost the income of small-scale farmers by linking them to new markets

Methodology: Trainings and demonstrations

Activities/Progress made since previous report:

1. Monitory visits to end users (bakers and matrons in SHS) in Greater Accra and Brong Ahafo Region.
2. Training of end users in the Volta region.

3. There was the training ofsix (6) kitchen staff of Ghana Prisons Service and HQCF twenty four (24) commercial bakers on composite bread baking and pastry making with and wheat flour in Ho.
4. Monitoring visits were made to end users of HQCF in the Greater Accra, Volta and BrongAhafo regions.
5. Monitoring visits were made to end users of HQCF in the Greater Accra, Volta and Brong Ahafo regions of Ghana.
6. Monitoring and evaluation visits were made to end users of High Quality Cassava Flour (HQCF) in the Greater Accra, Volta and Brong Ahafo regions of Ghana.

G. USAID/CORAF (WECARD) SONGHAI Project- Improving Post-Harvest Quality and Packaging of Rice, Sorghum/Millet and Cassava Products to Enhance Marketability in West Africa

Start date: August 2009 **Estimated duration:** 2 and half years

Sponsors: USAID West Africa Regional Programme

Budget: US$ 748,000.00

Locations:
- Rice: Senegal, Mali, Liberia, Ghana and Nigeria
- Sorghum/Millet: Senegal, Mali, Niger, Burkina Faso and Nigeria
- Cassava: Ghana, Nigeria, Benin and Togo

Principal Investigator: Dr. Kwame Akorli Vowotor

Participating Scientists: Mr. Gregory Komlaga, Mr. Joseph Gayin, Ms. Wilhemina Quaye

Collaborating Institutions: CSIR-Food Research Institute, Ghana; Institut National de Recherches Agricoles, Poto Novo,Benin;Institut de Technologie Alimentaire (ITA), Avenue des Zarmakoyes, B.P. 10110 Niamey, Niger.

Objective (s): To promote improved rice, sorghum/ millet and cassava processing technologies to ensure food security, enhanced marketability and increased farmers and processers' incomes.

Methodology:
- Capacity building;
- Facilitation of access to improved technologies;

- Improving the quality and packaging of processed products/marketing;
- Extension/network/multi-partnership.

Activities/Progress made since previous report:

1. Two baseline studies have been organized for rice and cassava;
2. Project actors and partners have been made aware of the objectives and results of the project in the target countries;
3. Training manuals have been developed, validated, published and distributed;
4. A network of experts/trainers have been implemented;
5. Project beneficiaries have been trained to adopt the technology options;
6. The producers and processors were supported to purchase equipment.
7. Monitoring and Evaluation activities were carried out

Major Findings:

(a) Cassava Processing

A number of interventions are required for the production of good quality gari and High Quality Cassava Flour (HQCF).

These include among others:

1. The type of cassava variety used for gari and HQCF processing
2. The use of stainless steel knives for processing
3. Use of potable water
4. Cleaning of grater before grating
5. Duration of fermentation of dough in gari processing
6. Type of gari roasting equipment (should be preferably stainless steel)
7. Sifting and grading of gari after roasting
8. Duration of pressing out liquid for HQCF Processing
9. Duration of drying for HQCF Processing
10. Sifting quality of mesh in order to achieve the required HQCF particle size
11. Storage of gari and HQCF (the products must be packed in air tight package and stored in a well-ventilated area)

(B) Rice Processing

A number of interventions are required for the production of good quality rice.

These include among others:

1. Type of paddy rice used
2. Type of rice parboiling equipment used
3. Temperature of water during parboiling
4. Drying temperature of parboiled rice
5. Cleanliness of drying patio

Reasons for termination:
The Project reached its two-year completion point (January 2009 to December 2011)

Expected Beneficiaries/Potential Impact:

(i) Gari Processors
(ii) High Quality Cassava Flour (HQCF)Processors
(iii) NGOs
(iv) Rice Processors

Publications from project:

(i) Cassava Processing Manual
(ii) High Quality Cassava Processing (HQCF) Manual
(iii) Rice Parboiling Manual
(iv) Constraints and Opportunities for Improving Cassava Processing Technologies in Ghana, Togo, Benin And Nigeria (A paper presented at the West African Agricultural Productivity Project (WAAPP) Workshop from 12th to 16th September 2011.
(iv) Benefit Cost Ratios of Cassava Processing Technologies in Selected Countries in West Africa (A Paper under preparation)

H. Cassava: Adding Value for Africa (C:AVA) Project

Summary: The project aims to significantly boost the incomes of small-scale African farmers by linking them to new markets. This goal is expected to be achieved through the use of innovative interventions to capacitate farmers, village processing units and market intermediaries to competitively deliver high quality cassava-based products to a well sensitized market. From the initial stages of the contract, the project was targeted to end in March 2011; however, it has been given a two (2) year low cost extension, thus it is estimated to end in the year 2013. The new directive still focuses on improving cassava value chains but is narrowed down to processing, market development and credit management excluding production activities. This reduces stakeholders from ten (10) to eight (8) with the exclusion of Ministry of Food and Agriculture (MoFA) Brong Ahafo and Volta Regions.

Estimated duration: 2 years

Sponsors: Bill and Melinda Gates Foundation **Budget:** USD 504,967.00

Location: Greater Accra, Brong Ahafo and Volta Regions

Principal Investigator: Dr. Nanam Tay Dziedzoave

Participating scientists: Mr. Victor Antwi

Participating Technologist(s): Mrs. Beullah Sallah

Collaborating Institutions:

- Associates for Sustainable Rural Development (Ho)
- Progressive Youth in Community Development (Hohoe)
- Christ Apostolic Agency for Rural Development (Atebubu)
- Social Development and Improvement Agency (Bechem)
- Association of Africa women in Development (Sunyani)
- Forestry Research Institute of Ghana- FORIG- (Kumasi)

Background information and justification: Through an initiative led by the University of Greenwich's Natural Resources Institute, UK, in close partnership with the Food Research Institute, Ghana, the Bill and Melinda Gates Foundation is funding a 3 year project on cassava-" Cassava: Adding Value for Africa"- in Ghana. Four other African countries-Nigeria, Uganda, Tanzania and Malawi-are also beneficiaries of this initiative. This project was set up to develop the cassava value chain and to maximize achievements in the cassava sub-sector.

Objective(s): The project aims to significantly boost the incomes of small-scale African farmers by linking them to new markets.

Expected beneficiaries: Cassava farmers, processors and end users

Expected outcome: C: AVA-Ghana will develop value chains for High Quality Cassava Flour (HQCF) in Ghana, to improve the livelihoods and incomes of at least 20,000 small-holder households as direct beneficiaries including women and disadvantaged groups, it will promote the use of High Quality Cassava Flour (HQCF) as a versatile raw material for which diverse markets have been identified in pilot studies.

The project will focus on three potent intervention points;

- Ensuring a consistent supply of raw materials;
- Developing viable intermediaries acting as secondary processors or bulking agents in value chains and
- Driving market demand and building market share (in, for example, bakery industry, and components of traditional foods or plywood / paperboard applications).

Farmers and farmer/ processors will be supported in production and primary processing activities through partnership with NGOs, identifiable service providers or other extension services. Business development and other specialists will support intermediaries to meet the requirements of end users. End users will be supported technically in adopting HQCF.

Activities/Progress made since previous report: 396 community members of project targeted community based processing groups produced and sold processed traditional cassava products.

1. 237 processors sold processed cassava to bin dryer operators in Ghana.
2. 995 farmers sold fresh roots for HQCF production by Bin Dryer operators.
3. 5,137 farmers sold fresh cassava roots for production of local products.
4. Employment generated for 1619 paid employees at processing sites; and 6,245 paid workers on farms.
5. 1,382 tons of HQCF produced sold into viable markets.
6. Three (3) business focus group meetings were held for one hundred and thirteen (113) stakeholders in Ho and Hohoe.
7. There was a technical training for thirty (30) end users of HQCF in Ho through the collaborative effort of ASRUD and CAVA-FRI.
8. Monitory visits were made to implementation partners during the period under review.
9. One stake holders meeting was held in September 2012 at CSIR-FRI to discuss progress of work.
10. There was a technical training workshop organized in Ho by the Ghana country office in partnership with Natural Resources Institute (NRI) on quality management.
11. There was a field visit to Ghana by Dr. Hollics, NRI, UK.
    a. Monitoring visits were made to project partners in the Volta and Brong Ahafo regions during the period under review.
    b. A member of the Monitoring and Evaluation Team in UK, Fedra Vanhuyse, paid two weeks (October 8 – 20, 2012) working visit to C:AVA-Ghana country office. She was taken round project partners in the Volta and Brong Ahafo Regions for evaluation of project activities.
    c. Semi-annual report for the project (April-September, 2012) was within the period under review.

I. West African Agricultural Productivity Project (WAAPP)-Use of alternative food flours for baking-Capacity and capability building of local bakers and educational Institution in coastal communities

Summary: To aid improve export competitiveness, biodiversity, land administration and management, technology diffusion, trade facilitation and market access, the West African Agricultural Productivity Project (WAAPP) was born. The focus of this project is on making agriculture more productive and sustainable and to promote regional integration initiative in the agricultural sector. It reflects the World Bank's commitment to Africa's regional cooperation in agriculture and will be one of the Bank's key contributions to the implementation of broadly supported agricultural strategies Africa-wide. WAAPP would

significantly go a long way to raise agricultural yield which are so important in meeting the Millennium Development Goals of halving extreme poverty by 2015.

This project is about transferring flour technologies to bakers, matrons of SHSs and cassava processors in Western, Central and Greater Accra Regions so as to reduce the cost of wheat flours used in production of bread and other pastries.

Estimated duration: 1year, 6months

Sponsors: World Bank- WAAPP Budget: USD 15 million

Location: Western Region (Ahanta West), Central Region (Mfantsiman District), Greater Accra Region (Dangbe East)

Principal Investigator: Dr. Nanam Tay Dziedzoave

Participating scientists: Mr. Peter Addo, Mr. Eric Sarpong Owusu

Participating Technologists/Technicians: Mrs. Iris Tamakloe, Mrs. Constance Boateng, Mrs. Alice Padi, Ms. Paulina Addy (MoFA)

Collaborating Institutions: Ministry of Food & Agriculture (MoFA) - District offices in above Districts

Background information and justification: The demand for food in Africa outweighs the quantity of food available. This implies that, food production has failed to keep pace with population growth of many countries on the continent. Roots and tuber have a high potential of reversing this trend if improved. According to MoFA, yield per unit area of these commodities are low. Information from CSIR-Crop Research Institute shows that roots and tubers account for approximately 40% of Ghana's Annual GDP.

With support from the World Bank, ECOWAS initiated WAAPP to ensure a successful execution of its agricultural policy and to overcome agricultural challenges.
Over the years, there has been the increasing cost of production in baking. There was thus the need to formulate flours from alternative resource substitutes to reduce cost. As a result, this project aims at making a 15% savings on raw materials for the production of bread and other pastry products by substituting wheat flour with high quality cassava flour, Sweet potato, corn and cowpea flours.

Objective(s):

- To enhance the technical capacity of 60 bakers in 6 communities in Central, Western and Greater Accra Regions in the use of alternative flours in bread and selected pastry products.
- To develop the capacity of matrons in 35 SHS and 5 Teacher Training Colleges in the above mentioned regions in the use of alternative flours in students' bread.
- To develop the capacity of 15 local cassava processors to produce alternative flours for bakers

Expected beneficiary: Cassava farmers, processors and end users

Expected outcome: To reduce the cost of production of bread and other pastry products.

Activities/Progress made since previous report: Backstopping and distribution of some of Alternative flours to beneficiary bakers and Institutions

1. A total of 2,435kg of alternative flour (HQCF) have so far been supplied to the beneficiary communities and Institutions.
2. Shooting of a documentary at the request of CORAF Senegal through WAAPP-CSIR on the success stories of some of the beneficiaries who are successfully using (AF) in their operations.
3. About 10 bakers and pastry workers are successfully using (AF) in the three selected regions after they have been introduced to the four technologies.
4. Preparation towards baseline survey and subsequent training of selected processors.
5. Preparations towards training second batch of Matrons from beneficiary Educational Institutions.
6. Arrangements with respect to Technical Backstopping and monitoring of beneficiaries in all three project enclaves.
7. Finalization of draft baseline report for community bakers. And also draft reports on beneficiaries who have already received training under the project.
8. Baseline survey was successfully undertaken for all the processors within the project enclaves.
9. Selected processors from all the project enclaves were also trained in the production of HQCF and Sweet Potato flour at the CSIR-FRI CPDU at Pokuase. In all, 15 processors have been trained.
10. Draft report on the baseline survey for community bakers in the project enclaves was finalized
11. Initial backstopping and monitoring in all the three project enclaves was undertaken.

Major Findings:

1. Substitution with alternative flours (viz HQCF) presents a decent opportunity for baker and matrons to reduce cost of production and consequently save money for other productive and consumptive use.
2. For Processors production of the new flour potential represents another income source for livelihood improvement.
3. Beneficiaries are ready to use the technology once the flour is always available.
4. Substitution at source i.e. at the flour mills level is ideal as expressed by beneficiaries of the project,
5. Processors need to be assisted to produce the flour for the trained end users.
6. Depots to be created within the project enclave to ensure regular supply of the flours.

Expected beneficiaries/Potential impact:

1. Improvement in livelihood through reduced cost of inputs (flour component the major ingredient in the baking process) when the alternative flours are used in baking.
2. Reduced cost of feeding students through reduced cost of flour used in the production of bread and other flour related products for feeding students. Improved Nutrition for students as well.
3. Processors processing capacity will be increased leading to increased income. that the alternative flours will bring to them.
4. Farmers will have ready market for their produce to avoid post harvest losses and thus increase their incomes and livelihoods
5. Substitution of the alternative flours for wheat will also help government reduce the importation of wheat, and save the much needed foreign exchange.

Publications from project:

- Technical report on baseline assessment of bakery activities drafted
- Technical report on baseline assessment of matrons and processors also drafted
- Technical report on training for all the beneficiaries in the three project enclaves drafted
- A manuscript on 'Bakery Production and Technical Efficiency: Evidence from Ghana. Under preparation

J. CIDA-funded/AfricaRice Project on Rice post-harvest handling, marketing and the development of new rice-based products

Summary: The ultimate outcome of this project is to increase food security and sustainable livelihoods among rice value chain actors in Africa. To achieve this, the project will introduce improved harvest and post-harvest rice processing practices and technologies to upgrade the quality and marketability of locally produced rice in order to meet urban consumers' preferences. The project will also promote the development and adoption of new rice-based products. Moreover, to foster an enabling environment for regional rice production and trade, the project will provide technical advisory and policy guidance support to the regional economic communities in sub-Saharan Africa.
The activities of this project will be carried out in Cameroon, The Gambia, Ghana, Mali, Nigeria, Senegal, Sierra Leone and Uganda. The nature of project activities in each country will depend on the specific country needs and circumstances.

Estimated duration: 5 years

Sponsors: Canadian International Development Agency (CIDA)

Location: Afife, Atebubu, Navorongo

Principal Investigator: Dr. P-N.T. Johnson

Participating Scientists: Mr. Joseph .K. Gayin, Mrs. Wilhemina Quaye, Mr. Eric Owusu, Mr. Charles Diako, Mrs. Ruth Pobee, Ms. Hannah Oduro

Participating Technologist(s): Mr. Ali Sampare, Mr. Isaac Apollonius Nyarko, F. Mboom

Collaboration Institutions: McGill University, NARS, CSIR-SARI, CSIR-CRI, Ghana Rice Inter-professional body, Sinapy Aba (Micro-finance), Selassie Farms (Secondary Processor), TechnoServe, University of Ghana-Departments of Nutrition & Food Science and Crop Science, MoFA, MoTI- NBSSI, Single Mothers Rice Processors (Primary Processor), GRATIS Foundation (Processing equipment), Institute of Packaging Ghana, Consumer Association of Ghana

Background information and justification: In response to global food crises, CIDA has developed a Food Security strategy which focuses on Food aid and nutrition, Sustainable agricultural development and Research and development. The aim of this project is in alignment with CIDA's "Food security" priority theme for Africa and its contribution to research and development. The measures taken through research and development will give farmers in partner countries better access to the new technologies and specialized

expertise they need for their farming operations, to keep pace with the growing demand for food.

Rice has become an important staple for both rural and urban dwellers and is gradually taking over from traditional crops such as root and cereal crops. Ghana therefore spent $218 million as at 2009 for the importation of rice. Despite the efforts made in local rice production the cost of production is high and uncompetitive in the domestic market due to relatively cheaper imported rice. The high local demand for foreign rice is crowding-out local farmers and processors from their own domestic market resulting in jobs loss, poor quality livelihood and increased food insecurity among rice farmers and other value-chain actors. There is therefore the urgent need for intervention in the rice industry to ensure proper post harvest handling and marketing.

Objectives: To introduce improved harvest and post harvest rice processing practices and technologies to upgrade the quality and marketability of locally produced rice to meet Sub-Saharan African consumers' preferences.

Expected beneficiaries: Small-holder rice producers, women rice parboilers, local artisans, local rice traders, scientists and agricultural extension staff

Expected outcome:

- Increase access to improved harvest and post-harvest rice processing practices and equipment for farmers, millers, parboilers and marketers in "good-practice concen tration areas" of targeted countries.
- To increase applied knowledge of rice producers, processors and consumers in new rice-based products developed from slower-digesting varieties, broken rice fractions and rice by-products.
- Rice value-chain actors in target countries would have enhanced applied knowledge of improved harvest and post-harvest rice processing practices and the making and use of new value-added rice-based products and by-products.
- Improve evidence-based rice policy formulation and adoption by policy-makers in targeted pilot countries.
- Increase coordination and harmonization of regional rice policy in the Regional Economic Communities.
- Scientists and agricultural extension agents in selected pilot countries would have increased applied knowledge on rice harvesting, processing, marketing and policy analysis.

Activities/Progress made since previous report: Successful pretesting of questionnaire on consumer preference

1. Started characterization of local rice varieties for noodle production
2. Commenced field work on the determination of rice harvest and post harvest losses
3. Determination of harvesting and threshing losses by two BSc students of the College of Agriculture and Consumer Sciences of the University ofGhana (UG) has been completed and dissertation presented. Their work was on the "Assessment of harvest losses of rice cultivated under rain fed and irrigated conditions".
4. One MPhil student from the Department of Nutrition and Food Science of the UG working on the "Characterization of local rice varieties for noodle production" has also completed and presented her work.

5. Another MPhil student, also of the same department of UG is working on the "Assessing the qualitative and quantitative losses in the rice value chain in Ghana- A case study of Rice cultivated at Afife in the Volta Region". He has completed his data collection and about to finalize the thesis for submission in July.

6. A PhD student of the Department of Botany of UG has started his work on " Utilization of by-products of two rice varieties, Oryza sativa and Oryzaglaberrima for the production of edible mushrooms".

7. At the inception of the project, three rice growing zones (Afife, Atebubu and Navorongo) were selected.These sites originally referred to as Good Practice Concentration Areas are to be called Rice Development Hubs. Activities are yet to begin in these hubs.

8. In February, the coordinating agency, AfricaRice, Benin, decided to institute synergies in all other rice development projects (projects on agronomy, breeding, post-harvest handling and marketing being handled by the different CSIR Institutes) so as to ensure that there are no duplications and that all the research activities are carried out in tandem and along the rice value chain. They therefore requested that all the operating zones of the various projects should be put under "Rice Development Hubs". A new agreement was signed between AfricaRice and CSIR.

9. A meeting of rice stakeholders was held in Kumasi in April 2012 and three new sites (Navorongo, Kumasi and Afife)were selected.

K. African Food Tradition Revisited by Research (AFTER) Project

Summary: The African Food Tradition Revisited by Research (AFTER) Project aims to revisit traditional African products, knowledge and know-how in the light of new technologies for the benefit of consumers, producers and processors in Africa and Europe. By applying European science and technology to African traditional food products, AFTER seeks to turn research into quantifiable and innovative technologies and products that are commercially viable in both European and African markets. The 10 selected products representing 3 families of foods (fermented cereal-based, fermented salted fish and meat, & vegetable and fruit based functional foods) fit into a matrix of technologies and processes shared between Europe and Africa that will be jointly developed within the framework of AFTER.

Creating new markets and trade opportunities for improved traditional foods and novel products in Europe and Africa will increase economic returns for all stakeholders involved in the production chain, down to the community level. Due consideration will be accorded to regulatory, ethical and IPR issues while also protecting the intellectual rights of Africans.

In Ghana, the dehulled kenkey will be characterized according to existing knowledge on technologies and processes. The improved product, produced through reengineering and new processing technologies, will be tested for consumer acceptance, safety and nutritional quality. The market and entry requirements for new kenkey will be assessed. Involving EU and African companies in production trials for the improved product will translate the results into ready-to-use information for food companies.

Estimated duration: 4 years

Sponsors: European Union- Seventh Framework Theme

Location: Greater Accra, Central and Eastern Regions

Principal Investigator: Dr. Wisdom Kofi Amoa-Awua

Participating Scientists: Dr. Mary Obodai, Mrs. Charlotte Oduro-Yeboah, Mr. George Anyebuno, Mr. Charles Diako, Mr. Hayford Ofori

Participating Technologist(s): Mr. Theophilus Annan

Collaborating Institutions: Ministry of Food and Agriculture- Women in Agricultural Development, University of Ghana, Legon

Background information and justification: Kenkey's importance in modern-day life is underlined by the wide spectrum of fermented foods marketed both in developing and industrialized countries, not only for the benefit of preservation and safety, but also for their highly appreciated sensory attributes. The process of kenkey-making is lengthy and laborious; therefore it is more often purchased from a commercial kenkey producer rather than cooked at home. The producers who are mainly women with little or no formal education– carry out commercial production as a family-acquired art. In a survey conducted in Accra, Allotey (1996) found that at most production sites the amount of maize processed weekly ranged from 0.05 to 1.2 metric tons with an average of 0.3 tons of maize processed into 0.5 tons of kenkey. There are however, a few large production sites with weekly capacities of several tons (up to 5 tons) of maize. The production of kenkey is based on traditional technologies that have been handed down in generations Commercial production and street vending of kenkey is the source of livelihood for many traditional food processors and food vendors in Ghana and these activities make a sizeable contribution to the rural and urban economy in Ghana. Kenkey, as a street food is convenient, cheap, and affordable for the poor and provides informal and self-employment opportunities as well as supplementary income for households. The vending of kenkey contributes positively to the food security of all the actors in the value chain including maize farmers, input suppliers, kenkey processors and vendors. The market for kenkey was originally limited to Ghana but recently it has a niche market in the Diaspora including some West Africa countries. There is however a possibility for further extension to the international markets.

This study is part of an European Union collaborative project between CSIR-Food Research Institute, four European countries and seven African countries. It will directly contribute to improving the competitiveness of traditional products and facilitate the implementation and uptake by food companies. Beyond these direct results, the lessons learnt and the methodologies for the assessment of traditional products and processes will be shared with other countries worldwide in order to disseminate the results among the research community involved in food research in developing countries.

Objective(s):

- To reach comprehensive scientific knowledge of the existing know-how on technologies, processes and products.
- To propose improved traditional processes by reengineering of the unit operations with the aim of improving the safety and nutritional quality while keeping or improving the organoleptic characteristics of traditional products.
- To reach objective criteria of acceptability of the traditional products by the consumers and to ensure that the products can effectively access the EU markets in view of regulatory and ethical issues while protecting the intellectual rights of the people in Africa.
- To present the results into ready-to-use information for food companies including

SMEs via guidelines on quality management, food law and regulation and consumer protection and to transfer the results to the stakeholders from Africa and from the EU.

Expected beneficiaries: Consumers, producers and processors in Africa and beyond Food companies including SMEs

Materials and Methods: Survey methodology
A semi-structured questionnaire was administered to producers, sellers and consumers of kenkey. The questionnaire aimed at gathering information about the production, vending and consumption of kenkey in Ghana in order to identify the major problems and bottle-necks related to kenkey so as to investigate some of them and propose adequate solutions. The total sample size of the respondents to be interviewed for the whole geographical region was calculated using $Ni = 4X\ pi(1-pi)/d2$
Ni is the total number of respondents to be surveyed for the study (Chadare et al, 2008).
$pi = np\ /Nt$
$Pi = np/Nt$; the proportion np of the product producer, seller and consumer among the Nt randomly interviewed persons and d is the expected error margin fixed at 0.05 (Dagnelli, 1998). Based on the calculation above, the total number of consumers to be interviewed was three hundred and fifty four (354), producers was two hundred and thirty two(232) and sellers was two hundred and nine (209).

Expected outcome: To improve traditional African products in the light of combined and/or new technologies for mutual benefits for the consumers, the companies and the producers of Africa and Europe.

Activities/Progress made since previous report: Final submission of the Regulatory Report.

1. Completed sensory evaluation of Kenkey and other fermented maize products
2. Consumer testing of products is on-going
3. Mrs. Charlotte Oduro-Yeboah (PhD) and Mr. Theophilus Annan (Msc) continued their research work in their respective areas

i. Write-up on analysis of results of the sensory tests and consumer acceptance of kenkey and other fermented maize products carried out in the 1st quarter was completed.

ii. There was a trip to Anum and Bawjiase for sample collection for microbial analysis to test the safety of the products: Analysis carried out included enumeration of Coliforms, Escherichia coli, Clostridium, yeast and moulds etc.

iii. MPhil student (Mr. Theophilus Annan) continued his work in the development of starter cultures for production of dehulled kenkey: Microbial analysis –Lactic acid bacteria and yeasts identification and selection of starter cultures based on their

technolo gical properties.

iv. PhD student (Mrs. Charlotte Oduro-Yeboah) continued her work in the reengineering of dehulled kenkey:
- Physicochemical (moisture, pH, titratable acidity, particle size, pasting properties and colour) properties of laboratory and traditional white kenkey (nsiho) and its interme diates.
- Textural measurement of laboratory white kenkey and traditional white kenkey-types.
- Sampling white kenkey samples and their intermediates from Anum, South Senchi and Bawjiasie for physical and chemical analysis. (Five samples each from each location).
- Trials on yoghurt preparation using dehulled maize dough were conducted.
- Preparation of "wasawasa" (couscous) using yam with the idea of using maize dough later.

4. A PhD student (Mrs. Charlotte Oduro-Yeboah) continued her work in the reengineering of dehulled kenkey which included the following activities:
   - Physicochemical (moisture, pH, titratable acidity, particle size, pasting properties and colour) properties of laboratory and traditional white kenkey (nsiho) and its interme diates from Anum and Atimpoku
   - Textural measurement of laboratory white kenkey and traditional white kenkey types
   - Colour measurement of white kenkey samples from Anum, Atimpoku and sweet kenkey from Osino
   - Chemical composition of the white kenkey types from Atimpoku and sweet kenkey from Osino
5. MPhil student (Mr. Theophilus Annan) has completed his work and is preparing for his project defense (viva).
6. Dr Wisdom Amoa-Awua attended the EFFoST 2012 Annual Meeting from November 20-23 in Montpellier, France where he presented a poster titled 'Value-addition to Kenkey, an indigenous African fermented food, targeting the international market' .
7. MPhil student (Mr. Theophilus Annan)completed his laboratory analysis. Write-up is on-going.
8. PhD student(Mrs. Charlotte Oduro-Yeboah) continued her work in the reengineering of dehulled kenkey:
9. Physicochemical (moisture, pH, titratable acidity, particle size, pasting properties and colour) properties of laboratory and traditional white kenkey (nsiho) and its interme-di ates.
10. From October 24th - December 22nd she travelled to Montpellier where she carried out a series of experiments:

- Scanning Electron Micrograph (SEM) on maize grain samples and dehulled samples among others
- Textural measurement of laboratory white kenkey and traditional white kenkey types
- Differential Scanning Calorimetry (DSC) carried out on fermented dehulled dough (12 hours), precooked dough(aflata), white kenkey types- Anum Kenkey, Atimpoku Kenkey and sweet Kenkey), Ga and Fanti kenkey
- High Performance Liquid Chromatograpy (HPLC) determinations for sugar and organic acids

L. Micronutrient enrichment of meals fed to pupils, using highly nutritious and low-cost underutilized fish under the school feeding programme in Ghana.

Summary: Four underutilized fish species, namely woevi or 'one-man-thousand' (Sierathrissa leonensis), flying gurnard (Dactylopterus volitans), common bogue (Boops boops) and anchovies (Anchoa guineensis); as well as tuna frames were used. They were solar and mechanically dried, milled into powder and analyzed for proximate, mineral content, biochemical, microbiological, sensory and shelf life. Characterization of the fish species showed that they are of high nutritional significance in either human food supplements or formulations. They showed high protein content, good general amino profile, abundance of polyunsaturated fatty acids, and a unique source of micronutrients, particularly minerals. The high nutritional value of the products showed their potential for food supplementation in the school feeding programme, although generally these products might be regarded as fish for the poor. Overall acceptability by the school children rated all the foods on the positive side of the hedonic scale, especially banku with anchovies okro stew, rice with tuna frames stew and rice with flying gurnard stew.

Estimated duration: 1year

Sponsors: United Nations-Food and Agricultural Organization (UN-FAO)

Budget: $10,000

Location: Accra, Ghana

Principal Investigator: Dr. Margaret Ottah Atikpo

Participating Scientists: Dr. Lawrence Abbey, Mrs. Mary Amengor, Mrs. Linda Hagan

Participating Technologists/Technicians: Technologists in CSIR-FRI Microbiology lab, Chemistry lab, Test Kitchen; CSIR-WRI; ECOLAB, Legon

Collaborating Institutions: CSIR-WRI and ECOLAB, Legon

Background and Justification

Inadequate food supply in terms of meeting the energy requirements affects at least 925 million people worldwide. More than two billion people are affected by micronutrient deficiency, prevalent in poor rural and urban areas. Micronutrient deficiencies are connected to low dietary intakes of vitamin A, iron and iodine or non-availability of selenium, zinc and calcium in the diet; e.g., zinc deficiency contributes to death of 800,000 children globally per year and rickets which is caused by calcium deficiency.

Fish products are a good source of many of the micronutrients with levels of most minerals found in significant amounts in fish bones. An increased use of seafood, including bones, could contribute significantly to reducing the level of micronutrients and protein malnutrition.

Objectives: To increase the nutritional status of school children in Ghana using locally processed fish products of low cost and high nutritional value.

Expected beneficiaries: School children, adolescent girls, women of childbearing age

Activities/Progress made since previous report:

1. FAO in collaboration with Fisheries Commission, CSIR-Food Research Institute and Ghana Standards Authority organized a sensitization Workshop for stakeholders in the Fisheries sector in Ghana on the need to embrace the use of these underutilized fish species in food for the school feeding programme.

2. The project findings were presented.

3. Different Committees were put in place at the Workshop at Coconut Grove (Accra) to discuss and come out with possible TCPs to be presented to FAO for funding. (2).

4. Also another TCP earlier written to expand the project has been discussed with FAO.

Major findings: Characterization of the fish species showed that the selected fish are of high nutritional value in either human food supplements or formulations, with high protein content and optimal amino acid profile, abundance of polyunsaturated fatty acids, and high in micronutrients, particularly minerals. It showed the potential of these products for food supplementation in the school feeding programme. The sensory evaluation indicated that the school children rated all the foods fortified with the fish powders high on the positive side of the hedonic scale.

Reasons for termination: End of project period

Expected Beneficiaries/Potential Impact:
School pupils in Ghana/increase in micronutrients of foods fed to the school children using underutilized fish species.

Publications from project:

a. Ottah Atikpo, M.A., Abbey, L.D., Glover-Amengor, M., Lawer, L., Ayin, J. and Toppe J. 2011. Micronutrient enrichment of meals fed to pupils using highly nutritious and low-cost underutilized fish for the school feeding programme in Ghana. FAO Technical report.

b. Glover-Amengor, M., Ottah Atikpo, M.A., Abbey, L.D., Hagan, L., Ayin, J. and Toppe J. 2012. Proximate composition and consumer acceptability of three underutilized fish species and tuna frames. World Rural Observations 2012, 4 (2)

M. Development and optimization of choco-peanut spread and development of high quality stabilized peanut butter.

Summary: In recent years, nuts have received considerable attention as one of the foods that have beneficial effects for cardiovascular health. As a measure to curb post harvest losses of peanuts, its development into spread and butters have gained much recognition, thus, the research to improve this product development.

Estimated duration: Two (2) years

Sponsors: Global Peanut Product Processing and Marketing team (UGA-GP3MT) - University of Georgia.

Budget: USD 3,000.00

Location: CSIR-FRI

Principal Investigator: Mr. Charles Diako

Participating Scientists: Mrs. Evelyn Buckman

Participating Technologist: Mr. Emmanuel Saka

Collaborating Institutions: University of Georgia

Background information and justification
The University of Georgia UGA-GP3MT is funded by the Peanut Collaborative Research Support Program (Peanut-CRSP) of the United States Agency for International Development with the University of Georgia at Griffin being the implementing body. CSIR-FRI operates as the Managing Partner of a series of projects being implemented in Ghana under this programme. The program aims at bringing scientists and industry together for collaborative development and transfer of technology through an early engagement approach. The development and optimization of the Choco-peanut spread was implemented with an industry partner who wants to adopt the technology and commercialize the product.

Objective(s): To develop and optimize a prototype peanut-based spread with cocoa ready for industrial adoption

Expected beneficiaries: Small, medium and large scale industries; food processes.

Materials and Methods: Peanuts, sugar, stabilizer, cocoa powder, roaster, oven, refrigerator, colloid mill, blender, plaster jars, sacks and liners, gloves, hair nets and nose masks. The methods used were mixture designs and optimization methodologies.

Estimated outcome:
- To develop and optimize a prototype peanut-based spread with cocoa ready for industrial adoption.
- To develop a stabilized peanut butter for small companies.

Activities/Progress made since previous report:
1. 60 consumers of peanut spread evaluated the 9 products
2. The sensory evaluation of the prototypes was done on a 9-point hedonic scale with 1 being 'dislike extremely' and 9 being 'like extremely'. Contour plots showed the following scoring:
   - Sweetness: Consumers scored an acceptance of 7 and above for sweetness for formulations with high levels of peanuts and sugar.
   - Peanut flavor: Acceptance scoring for this attribute was high (7 and above) for
   - Chocolate flavor: More sugar and peanuts masked the bitter taste of the cocoa powder used and gave an acceptable chocolate taste which was scored natural from 6.5 and above for those formulations with high levels of sugar and peanuts.
   - Spreadability: This was affected by high levels of natural cocoa powder. Consumers therefore gave high scores (8-9) to formulations with high amounts of peanuts and sugar which made the product highly spreadable.
   - Smoothness: Product smoothness was scored from between 8 and 9 for samples with more peanuts and sugar in the formulation
   - Overall acceptability: Overall consumer acceptance was scored between 8

and 9 for formulations with high peanuts, sugar and low natural cocoa powder.

3. Different locations were used for the sensory evaluation
4. An ABSTRACT of this work has been accepted for the IFT conference coming up in Las Vegas, USA in June 2012
5. The project focused on the verification of the product developed to help in the selection of a formulation that consumers like most which will have greater chance of commercial success.
6. Four products were developed from four formulations and subjected to sensory evaluation.
7. Mr. Gregory A. Komlaga was appointed the project leader of the Peanut CRSP project to coordinate the project activities at FRI effective July 1, 2012.
8. There was a Choco Peanut Spread product Launch in collaboration with CBA Foods (industrial partner), during the Grand Sales Fair 2012 at the Accra International Trade Fair Centre. The launch was published in the Daily Graphic and Ghanaian Times newspapers.
9. The project leader was invited by the UGA-GP3MP team to Georgia, USA in September 2012 for an orientation on project activities (planning of future activities, financial/technical reporting) and participation in the Georgia Peanut Tour 2012.

Major findings:

1 CSIR-FRI in partnership with CBA foods (an industrial partner) developed and launched a non-detectable aflatoxin peanut product "Peanut Choco Spread" at Trade Fair Centre during the 2012 Grand sales trade fair. The launch was very successful and demand for the new product has since been increasing.

2. CSIR-Food Research Institute trained twenty key entrepreneurs in the groundnut processing enterprise in Ghana on how to eliminate aflatoxin during groundnut processing. This was a major innovation in the peanut processing industry. Expected Beneficiaries/Potential Impact: The project has benefited some food processors in the peanut industry especially the CBA foods in the elimination of aflatoxin in peanut products, this will go a long way to prevent its harmful effect on consumers

PUBLICATIONS FROM PROJECT:

Media Popularization:

Diako, C. CSIR develops peanut spread with no aflatoxins. The Ghanaian Times, Thursday, August 2, 2012.

N. Tackling Malnutrition in Northern Ghana-Cereal Flour Fortification

Summary: The World Food Programme (WFP) and its partner agencies have long been recognized for their ability to deliver food to deprived and resource –poor people all over

the world. Relatively little is known about the efforts it puts in place to check that the food they supply provides vitamins and minerals and not just calories. As a result of that, the technology of cereal flour fortification with micronutrient (vitamin/mineral) premix was transferred in twelve communities in the Upper East, Upper West and the Northern regions of Ghana. This was organized as part of WFP/UNICEF joint project on Tackling Malnutrition in Northern Ghana using fortification of their staple foods (cereal flour) with six vitamins and two minerals as a means of meeting their nutritional needs. A hand-operated mixer designed and fabricated at the CSIR-Food Research Institute was employed for the mixing process. The training sessions were also facilitated by the use of a poster which showed step-by-step procedures. A Group discussion approach was adopted to help participants feel a sense of ownership of the programme and to also appreciate the intervention.
Estimated duration: ~2 years
Sponsors: CIDA/WFP

Location:

- Upper-East Region (Gorogo, Zorko Goo, Tangasia, Chuchuliga Namosa)
- Northern Region (Woribogu-Kukuo, Yilonayili, Gortani, Yankazia, Nansoni)
- Upper-West Region (Lam-Uollo, Ketuo and Dahile-Kpanagaan) Principal Investigator: Mr. Joseph Gayin

Participating Scientists: Dr. P-N.T. Johnson, Ms. Hanna Oduro
Participating Technologist: Mr. Seidu Ali Sampare
Collaboration Institutions: World Food Programme (WFP)
Background information and justification: Under nourishment accounts for a third of all deaths in children under the age of five in developing countries annually (WFP, 2011). Micronutrient malnutrition also known as "hidden hunger" due to lack of intake, absorption and utilization of food accounts for 7.3% of the global burden of diseases (Fe, I, Zn, Vit. A). Malnutrition is both a cause and manifestation of poverty. Northern Ghana has the higher percentage of Ghana's poor (WFP/UNICEF report, 2009). In order to aid in poverty reduction, the concept of a deliberate addition of one or more micronutrients to particular foods (usually staples) so as to increase the intake of these micronutrient(s) was born. This was in order to correct or prevent a demonstrated deficiency and provide a health benefit.

Objectives:

- To improve the nutritional status of women and children by promoting the flour fortification with micronutrients
- To provide an alternate source of income for women groups through milling and fortification

Expected outcome: Improve the nutritional status of malnourished pro-poor farming communities in the selected communities in the northern regions.

Activities/Progress made since previous report:

- Fabrication (in progress) of 27mixers
- Preparation of Premix using whole grain maize
- Trainings have been conducted in communities
- Reports have been submitted to WFP
- Commenced the fabrication of five (5) hand mixers

APPENDIX I

Senior Members and Senior Staff List

Directorate

1.	Dr. Nanam Tay Dziedzoave	-	Prin. Res. Scientist/Director
2.	Robert. M. Yawson	-	Snr. Scientific Secretary
3.	Stephen Nketia	-	Scientific Secretary
4.	Benjamin Addi Okae	-	Scientific Secretary (M&E)
5.	Faustina Mante (Mrs.)	-	Prin. Admin Assistant
6.	Mariam Yakubu (Ms.)	-	Technologist

Administration Division

1.	Janet Aggrey -Yawson (Ms.)	-	Admin. Officer/Ag. Head. Admin.
2.	Eric K. Ofori	-	Prin. Admin. Asst.
3.	Jacob Kuwornu	-	Prin. Works Supt.
4.	Isaac Hammah	-	Prin. Works Supt
5.	Christiana Ketsie (Ms.)	-	Snr. Admin Asst.
6.	Victoria A. Asunka (Mrs.)	-	Snr. Admin. Asst.
7.	Beullah Adadevor-Sallah (Mrs.)	-	Prin. Admin. Asst.
8.	Anita Adusah	-	Snr. Admin. Asst.

Accounts Division

1.	Coffie Tutu Aikins	-	Accountant/Head. Finance
2.	John M. Nakotey	-	Chief Stores Supt.
3.	Kenneth K. Aidoo	-	Chief Accounting Asst.
4.	Judith Dogbegah (Ms.)	-	Chief Accounting Asst.
5.	Christine Amegah	-	Prin. Accounting Asst.
6.	Derrick V. A. Sallah	-	Prin. Accounting Asst.
7.	Joseph K. Larbi	-	Snr. Accounting Asst..
8.	James Cromwell	-	Snr. Stores Supt.
9.	Mabel Aryee (Ms.)	-	Accounting Asst
10.	Wolase Efodzi	-	Stores Supt.

Commercialization & Information Division

1.	Kwame A. Vowotor (Dr.)	-	Snr. Res. Scientist/Ag. Head. CID
2.	Kwabena A. Bugyei	-	Scientific Info. Officer
3.	Raphael Kavi	-	Librarian
4.	Augustine Andoh	-	Chief Tech. Officer
5.	Benedict Awotwi	-	Chief Tech. Officer
6.	Philip.O. Baidoo	-	Prin. Accounting Asst.
7.	Joana B. Dzikunu (Ms.)	-	Snr. Admin. Assistant
8.	Jeremiah Lartey- Brown	-	Prin. Technical Officer

9.	Mary Assimah (Ms.)	-	Snr. Admin. Assist.
10.	Syndy M. Williams	-	Marketing Assistant
11.	Judith Larweh	-	Technical Officer
12.	Rufai Braimah	-	Technical Officer

Food Processing & Engineering Division

1.	Charles Tortoe (Dr.)	-	Snr. Res. Scientist/Head. FPED
2.	Lawrence D. Abbey (Dr.)	-	Research Scientist
3.	Cletus K. Gyato	-	Research Scientist
4.	Benjamin A. Mensah	-	Research Scientist
5.	Ebenezer C. Tettey	-	Research Scientist
6.	Joseph Gayin	-	Research Scientist
7.	Gregory A. Komlaga	-	Research Scientist
8.	C. Oduro-Yeboah (Mrs.)	-	Research Scientist
9.	Peter Adoquaye Addo	-	Research Scientist
10.	Elvis A. Baidoo	-	Research Scientist
11.	Paa Toah Akonor	-	Research Scientist
12.	Jonathan Ampah	-	Research Scientist
13.	Seidu A. Sampare	-	Chief Tech. Officer
14.	Rhodes Y. Anthonio	-	Prin. Works Supt.
15.	Robert O. Lamptey	-	Prin. Works Supt.
16.	Isaac Apollonius Nyarko	-	Senior Technologist
17.	Emmanuel A. Saka	-	Technologist
18.	Edna Mireku (Ms.)	-	Technologist
19.	Solomon Dowuona	-	Technologist
20.	Helene A. Annan (Mrs.)	-	Technologist
21.	Emmanuel Alorsey	-	Technologist
22.	Patrick Mintah	-	Prin. Tech. Officer
23.	Peter Delabor	-	Prin. Works Supt.
24.	Joseph Akoto	-	Prin. Works Supt.
25.	Desmond Mensah	-	Prin. Tech. Officer
26.	Godwin Armah	-	Snr. Tech. Officer
27.	Thomas Najah	-	Snr. Tech. Officer
28.	Samuel Asiedu	-	Snr. Tech. Officer
29.	Makafui Torgbui	-	Technical Officer
30.	Agartha Amuzu	-	Technical Officer
31.	Jemima Ofori (Ms.)	-	Technical Officer
32.	Ofori Brempong	-	Technical Officer
33.	Emmanuel Tettey Agbloe	-	Works Supt.

Food Microbiology Division

1.	Margaret Ottah Atikpo (Dr./Mrs.)	-	Snr. Res. Scientist/Head. FMD
2.	Mary Obodai (Dr./Mrs.)	-	Snr. Res. Scientist/Head M.U
3.	Bernice D. Kalton-Senaye (Mrs.)	-	Research Scientist
4.	Matilda Dzomeku (Mrs.)	-	Research Scientist
5.	Ivy Yawson (Mrs.)	-	Research Scientist
6.	Anthonia Andoh (Mrs.)	-	Research Scientist
7.	Amy Atter (Mrs.)	-	Asst. Res. Scientist
8.	Deborah L. Narh (Ms.)	-	Asst. Res. Scientist
9.	Nina Bernice Ackah (Mrs.)	-	Asst. Res. Scientist
10.	Evans Agbemefle	-	Asst. Res. Scientist
11.	David K. Asiedu	-	Prin. Technologist
12.	David K. Baisel	-	Snr. Technologist
13.	Michael Amoo-Gyasi	-	Snr. Technologist
14.	Richard Takli	-	Technologist
15.	Theophilus Annan	-	Technologist
16.	Alexander Henry K. Appiah	-	Technologist
18.	May A. Boham Dako (Ms.)	-	Technologist
19.	Angela Adams	-	Technologist

Food Chemistry Division

1.	Kafui A. Kpodo (Dr./Mrs)	-	Prin. Res. Scientist/Head. FCD
2.	George A. Anyebuno	-	Research Scientist
3.	Charles Diako	-	Research Scientist
4.	Dr. Margaret Owusu (Ms.)	-	Research Scientist
5.	Hayford Ofori	-	Research Scientist
6.	William K. Amevor	-	Prin. Technologist
7.	David N. A. Ankrah	-	Prin. Technologist
8.	Nelson Y. Amey	-	Prin. Technologist
9.	Kofi Kwegyir Essel	-	Snr. Technologist
10.	Vincent Kyei Baffour	-	Technologist
11.	Vida Awidi (Ms.)	-	Snr. Tech. Officer
12.	Belinda Quaye (Mrs)	-	Snr. Tech. Officer
13.	Derrick Ashley	-	Snr.Tech. Officer
14.	Dorothy Narh (Mrs.)	-	Snr. Tech. Officer
15.	Emefa Gblende (Ms.)	-	Technical Officer
16.	Ebenezer Tawiah	-	Technical Officer
17.	Frank Dogbey	-	Technical Officer

Food Nutrition & Socio-Economics Division

1.	Wilhemina Quaye (Dr./Mrs.)	-	Snr. Res. Scientist/ Head. FNSD
2.	Mary Glover Amengor (Mrs.)	-	Snr. Res. Scientist
3.	Lynda Hagan (Mrs.)	-	Research Scientist
4.	Eric Owusu Sarpong	-	Research Scientist
5.	Ruth Adisetu Pobee (Mrs.)	-	Research Scientist
6.	Hannah Oduro (Ms.)	-	Research Scientist
7.	Evelyn S. Buckman (Mrs.)	-	Asst. Res. Scientist
8.	Frank Peget Mboom	-	Technologist
9.	Alice Padi (Mrs.)	-	Snr. Tech. Officer
10.	Constance Boateng (Ms.)	-	Snr. Tech. Officer
11.	Mary Abena Okai	-	Snr. Tech. Officer

APPENDIX II

Table 1.1 Appointments

No.	Name	Position	Effective Date
1	Ms. Antonia Andoh	Research Scientist	17th September 2012
2	Mr. Jonathan Ampah	Research Scientist	8th October 2012
3	Mr. Benjamin Addi Okae	Research Scientist (M&E)	3rd September 2012
4	Ms. Anita Adusah	Senior Admin. Assistant	3rdSeptember 2012
5	Ms Mary Abena Okai	Senior Technical Officer	11th September 2012
6	Ms. Judith Larweh	Technical Officer	3rd September 2012

Table 1.2: Regularization of staff 2012

No.	Name of staff	Designation
1.	Ms. Hannah Oduro	Research Scientist
2.	Mr. Paa Toah Akunor	Research Scientist
3.	Ms. Mariam Nasara Yakubu	Technologist
4.	Mr. Frank Peget Mboom	Technologist
5.	Mr. Vincent Kyei Baffour	Technologist
6..	Mr. Alexander H. K. Appiah	Technologist
7.	Mr. Derrick Victor Sallah	Principal Accounting Assistant
8.	Mr. Frank P. Mboom	Principal Technical Officer
9.	Ms. Wolase Efodzi	Stores Superintendent
10.	Mr. Rufai Ahmed Braimah	Technical Officer
11.	Ms. Sindy Martha Williams	Technical Officer
12.	Mr. Ofori Bempong	Technical Officer
13.	Ms. Jemima Ofori	Technical Officer

Table 1.3: CSIR-FRI Staff Promotions

Name	Designation	Promoted To
Richard Takli	Assistant Technologist	Technologist
Joseph Akoto	Senior Works Superintendent	Principal Works Superintendent
Isaac Hammah	Senior Works Superintendent	Principal Works Superintendent
Samuel Asiedu	Technical Officer	Senior Technical Officer
Dorothy Narh	Technical Officer	Senior Technical Officer
Daniel Nuerty	Driver Gd. 2	Driver Inspector
Richard Twum- Baah	Security Assistant Gd. 1	Senior Security Assistant
Philip Agyaye	Security Assistant Gd. 1	Senior Security Assistant
Foster Bosompem	Security Assistant Gd. 2	Security Assistant Gd.I

APPENDIX III
CSIR-FRI Staff under Training

NAME	PROGRAMME OF STUDY	INSTITUTION
Mr. Robert Yawson	PhD, Science, Tech & Environ. Policy	University of Minnisota, USA
Mrs. Bernice Karlton - Senaye	PhD, Energy & Environ. Systems	North Corolina State Univ. USA
Mrs. Charlotte Oduro-Yeboah	PhD,Food Science	University of Ghana
Ms. Deborah L. Narh	MSc, Biotechnology	Wageningin University
Mrs. Nina Bernice Ackah	MSc,Food Quality Management	Wageningin University
Mrs. Evelyn Sewaah Buckman	MSc,Food Science	KNUST
Mrs. Angela Addy	BSc, Accounting	IPS
Mrs. Agartha Amuzu	BSc, Agric	University of Ghana
Ms. Constance Boateng	B.Tech, Hospitality Management	Ho Polytechnic
Ms Emefa Gblende	B-Tech, Science Laboratory	Accra Polytechnic
Mr. Joseph Gayin	PhD, Food Science	University of Guelph, Canada

Table 1.1: Retirement 2012

No.	NAME	DESIGNATION	TYPE OF RETIREMENT	YEARS OF SERVICE
1.	Dr. Paa Nii T. Johnson	Chief Research Scientist / former Ag. Director	Compulsory	31
2.	Dr. John T. Manful	Senior Research Scientist	Voluntary	
3.	Mr. David Asiedu	Principal Technologist	Compulsory	39
4.	Ms. Christiana Ketsie	Senior Administrative Asst	"	36
5.	Mr. Samuel K. Asiedu	Senior Technical Officer	"	35
6.	Mr. Jacob A. Kuwornu	Principal Works Supt.	"	32
7.	Ms. Greta Akpokli	Senior Admin. Assistant	"	31
8.	Mr. Robert O. Lamptey	Chief Works Superintendent	"	29
9.	Mr. Kenneth K. Aidoo	Chief Accounting Assistant	"	29
10.	Mr. Ransford Addo	Principal Technical Officer	Voluntary	

APPENDIX IV

Conferences, Courses, Workshops and Seminars attended by CSIR-FRI staff

Date of the Conference/Seminar	Type of Conference/Seminar	Organizers	Venue	Participants
18th – 20th Jan. 2012	Strengthening Regulatory capacity for application review, decision making and compliance on biosafety issues	African Biosafety Network of Experts (ABNE), Kumasi		Dr. (Mrs.) Margaret Ottah Atikpo
13-15 February, 2012	Local Added value creation through knowledge transfer in cocoa and chocolate processing	Gent, Belgium		Dr. Margaret Owusu
16th - 20thJuly, 2012	Gratitude Project Meeting	NRI	Chatham, UK	Dr. NanamTay Dziedzoave
6th- 8th February, 2012	stakeholders meeting of the Nigerian Academy of Science	Nigerian Academy of Science	Nigeria	Dr. (Mrs) Margaret Ottah Atikpo
6th - 10th February, 2012	workshop on Improving Food Security By Reducing Post Harvest Losses	University of Surrey	UK	Dr. Lawrence Abbey
18th – 20th Jan. 2012	44th Session of the Codex Committee on Contaminants in Food (CCCF)	Maastricht, Netherlands	Netherlands	Dr. (Mrs) Kafui Kpodo
13-15 February, 2012	Africa Codex Experts Meeting on Codex committee on contaminants in food	AU-IBAR and CCAFRICA		Dr. (Mrs) Kafui Kpodo
27-29th February, 2012	Monitoring evaluation and impact assessment of food and nutrition security	Waginengin	Netherlands	Mrs. Ruth Pobee
6th to 8th February, 2012	Monitoring, Evaluation Impact Assessment of Food and nutrition Security	Netherland,	Netherlands	Ms. Hannah Oduro

27-29th February, 2012	Annual review and planning workshop of USAID funded competitive projects	Lome, Togo	Togo	Dr. Vowotor
1 – 15 March, 2012	Upgrading of food testing skills of food processing professional	New Delhi, India	India	Gregory Komlaga
29th March, - 2nd April, 2012	Project implementation and the launching of the project Yam Improvement for Income and Food Security in West Africa (YIIFSWA	Herbert Albrecht Conference Center, IITA, Ibadan, Nigeria	Ibadan, Nigeria	Dr. Charles Tortoe
12th – 16th March, 2012	Kick-off meeting of the Gratitude Project	NRI, University of Greenwich	United Kingdom	Dr. Nanam Dziedzoave
19th – 23rd March, 2012	Annual Review Meeting of the Gratitude Project	NRI, University of Greenwich	United Kingdom	Dr. Nanam Tay Dziedzoave
26th – 30th March, 2012	44th Session of the Codex Committee on Contaminants in Food (CCCF)	Maastricht, Netherlands		Dr. (Mrs) Kafui Kpodo
29th March – 3rd April 2012.	project implementation and the launching of the project Yam Improvement for Income and Food Security in West Africa (YIIFSWA)	Herbert Albrecht Conference Center, IITA, Ibadan, Nigeria	Ibadan, Nigeria	Dr. Charles TOrtoe
1st – 15th March, 2012	Upgrading of food testing skills of food processing professional	ITEC	India	Gregory Komlaga
12th – 16th March, 2012	Post-Harvest Loss Management and Food Processing			Charles Diako
19th – 23rd March, 2012	Kick-off meeting of the Gratitide Project	NRI, University of Greenwich, UK		Dr. Nanam Dziedzoave
29th March – 3rd April 2012.	Annual Review Meeting of the Gratitude Project	NRI, University of Greenwich, UK		Dr. Nanam Tay Dziedzoave
9 – 10 May, 2012	West Africa AWARD Fellow Mentees Progress Monitoring meeting	Ibadan, Nigeria		Ms. Matilda Dzomeku

4th June 2012 to 22nd June 2012.	Monitoring, Evaluation Impact Assessment of Food and nutrition Security	AWARD	Netherlands	Ms. Hannah Oduro
4th June 2012 to 22nd June 2012.	training programme on Upgradation of Food Testing Skills of Food Processing Professional	New Delhi, India.		Mr. Gregory Komlaga
18 – 22 June, 2012	Food safety Meeting of Gratitude	Abeokuta, Nigeria		Dr. Nanam Tay Dziedzoave
4th – 22nd June, 2012	Monitoring evaluation and impact assessment of food and nutrition security	Waginengin		Ruth Pobee
24-28 June, 2012	3rd African Conference on Edible and medicinal mushrooms (ACEMM)	University of Namibia	Na,	Matilda Dzomeku
18 – 22 June, 2012	Second Scientific Conference of the Global Cassava Partnership for the 21st Century	Kampala, Uganda		Nanam
16th – 20th July,	USDA Scientist Exchange Program dialogue on post-harvest loss and food processing	USDA	Cameroon	Lynda Hagan, Mr. Charles Diako
17 – 20 July, 2012	Meeting with the international institute of fisheries economics and trade (IIFET)	Tanzania, Dares Salaam.		Dr. Atikpo
1 – 4th October, 2012	16th ISTRC Triennial Symposium	Abeokuta, Nigeria		Nanam
20th August – 4th September, 2012	Local Added value creation through knowledge transfer in cocoa and chocolate processing	Gent, Belgium		Dr. Margaret Owusu
23 – 28 September, 2012	Food safety Meeting of Gratitude	Abeokuta, Nigeria		Nanam
23rd – 27th September 2013	Gratitude Project Meeting	Natural Resources Institute	Chatham, UK	Dr. Nanam

3rd – 7th September, 2012	Regional Training course on food systems from Agronomy to Human health on Neglected and Underutilized species of plant	Cotonou, Benin		Ruth Pobee
30th Sept – 4th October, 2012	2012 African Nutrition Congress	The University of Free State	South Africa	Ruth Pobee
15 – 30 Sept. 2012	3-day Georgia Peanut Tour to provide exposure to the peanut industry	University of Georgia	Atlanta, USA	Gregory Komlaga
23rd – 27th September 2013	stakeholders meeting of the Nigerian Academy of Science	Abuja, Nigeria		Dr. Attikpo
30th Sept – 4th October, 2012	workshop on Improving Food Security By Reducing Post Harvest Losses	University of Surrey, UK		Dr. Lawrence Abbey
3rd – 7th September, 2012	2012 African Nutrition Congress	The University of Free State, Bloemfontein, South Africa		Ruth Pobee
4th – 22nd June, 2012	Regional Training course on food systems from Agronomy to Human health on Neglected and Underutilized species of plant	Cotonou, Benin		Ruth Pobee
20th August – 4th September, 2012	Annual review and planning workshop of USAID funded competitive projects	Lome, Togo		Dr. Vowotor
24th August – 2nd September, 2012	Mushroom training and production of mushrooms	IITA	Sierra Leone	Matilda Dzomeku/ Richard Takli
17 – 20 July, 2012	Strengthening Regulatory capacity for application review, decision making and compliance on bio safety issues	African Bio safety Network of Experts (ABNE), Kumasi		Dr. (Mrs) Margaret Ottah Atikpo

23 – 25 October, 2012	Meeting with the international institute of fisheries economics and trade (IIFET)	Tanzania, Dares Salaam.		Dr. Atikpo
23 – 28 September, 2012	16th ISTRC Triennial Symposium	ISTRC	Abeokuta, Nigeria	Nanam
16th – 20th July, 2012	Second Scientific Conference of the Global Cassava Partnership for the 21st Century		Kampala, Uganda	Nanam
16th – 20th July, 2012	USDA Scientist Exchange Program dialogue on post-harvest loss and food processing	USDA	Cameroon	Lynda Hagan
24-28 June, 2012	3-day Georgia Peanut Tour to provide exposure to the peanut industry	Atlanta, USA		Gregory Komlaga
1 – 4th October, 2012	Post- GA 30 Consultative Forum of National Members of the International Council for Science (ICSU) in Africa	ICSU	Pretoria, South Africa	Dr. Nanam Tay Dziedzoave
14 – 15 December, 2012	C:AVA Country Managers Meeting	Africa Innovation Instiute	Kampala, Uganda	Dr. Nanam Tay Dziezdoave

APPENDIX V
Scientific Reports and Publications

Edited Research Reports

1. Oduro, H., Sampare S.A, Pobee R.A, Nyarko A., Johnson P-N.T. and Anaman E. (2012). A report on training workshops to introduce fortification of cereal flours with micronutrients in twenty-seven communities in the three Northern Regions of Ghana. Held from 15th to 21st March, 2012.

2. Tortoe, C., and Quaye, W. (2012). Report on Joint Value Chain Workshop held on 18th-21st June 2012 at CSIR-FRI Conference Room. CSIR-FRI, Accra, Ghana. Pp. 49.

3. Tortoe, C. And Owusu, E. S. (2012). A Rapid Assessment of the Yam Value Chain in the Brong Ahafo Region of Ghana. CSIR-FRI, Accra, Ghana. Pp. 29

4. Quaye, W., Tortoe, C., Sarpong-Owusu, E., Okai, M. and Dzidzoave, N. (2012). Value chain analysis and levels/causes of post-harvest losses for cassava in Ghana. CSIR-FRI, Accra, Ghana. Pp. 57.

5. Quaye, W., Tortoe, C., Sarpong-Owusu, E., Okai, M. and Dzidzoave, N. (2012). Value chain analysis and levels/causes of post-harvest losses for yam in Ghana. CSIR-FRI, Accra, Ghana. Pp. 47.

6. Quaye, W., Tortoe, C., Sarpong-Owusu, E., Okai, M., Tandoh-Wordey, M. and Dzidzoave, N. (2012). Market study for the range of potential cassava and yam waste product solutions in Ghana. CSIR-FRI, Accra, Ghana. Pp. 48.

7. Tortoe, C. and Dzidzoave, N. (2012). Baseling data of cassava and yam processing products by SMEs, large and households processors in Ghana. CSIR-FRI, Accra, Ghana. Pp 38.

8. Tortoe, C., Nyarko, A., Dowuna, S. and Ofori, J. (2012). Training Workshop of yoghurt production for an entrepreneur. 28th October-30th October, 2012. CSIR-FRI, Accra, Ghana. Pp 18.

9. Tortoe, C., Nyarko, A., Dowuna, S. and Ofori, J. (2012). Training Workshop on pineapple ginger juice and pineapple-orange jam for small scale Industries. 22nd October-25th October, 2012. CSIR-FRI, Accra, Ghana. Pp 20.

10. Tortoe, C., Nyarko, A. and Ofori, J. (2012). Training Workshop on pineapple, water melon and coconut juice for an entrepreneur. 25th -27th January, 2012. CSIR-FRI, Accra, Ghana.

11. Komlaga, G.A and Glover-Amengor, M. (2012)Annual technical report on CSIR-FRI/C:AVA Project activities for the period April 2011 through February 2012

Journal Papers

1. Glover-Amengor M., Ottah Atikpo M.A., Abbey L.D., Hagan L., Ayin J. and Toppe J. Proximate Composition and Consumer Acceptability of Three Underuti lised Fish Species and Tuna Frames. World Rural Observ 2012: 4(2)65-70] ISSN: 1944-6543 (Print): ISSN: 1944-6551 (Online). http://www.sciencepub.net/rural,

2. Komlaga G.A., Glover-Amengor M., Dziedzoave N.T., Hagan L.L. Consumer acceptability of wheat/cassava composite bread. World Rural Observ 2012:4(2):78-81]. ISSN: 1944-6543 (Print); ISSN: 1944-6551 (Online) http://www.sci encepub.net/rural

3. Glover-Amengor M and Mensah F. (2012). Nutritional evaluation of Moringa oleifera leaves using three drying methods. Journal of Research in Biology 2012 2(3): 001-006

4. Glover-Amengor M., Diako C. and Kyei-BAffour V. (2012). Investigation of appropriate packaging material and shelf-life stability of Moringa oleifera leaf powder. Journal of Research in Biology 2012

5. Hayford O., Diako C. and Amoa-Awua W.K.(2012). Bioccumulation of Heavey Metals in Africa Red Snapper (Lutjanus Agennes) and Cassava Fish (Pseudotol Research. Vol.2 (10), 2012.17-22.

6. Akonor, P.T., Tortoe, C. and Oduro-Yeboah, C. (2012). Physicochemical characteristics of non-alcoholic beverage produced from malted roasted variet ies of maize (Zea mays). International Journal of Food Science and Technology. (In press).

7. Tortoe, C.,Johnson, P-N.T., Slaghek, T., Mathilda, M. and Timmermans, T. (2012). Physiochemical, proximate and sensory properties of pineapple (Anan- as sp.) syrup developed from its organic side-stream. Food and Nutrition Science. 2013 (4) 163-168. Doi 10.4236/fns. 2013.42023.

Conference Posters

1. Tortoe, C.,Johnson, P-N.T., Slaghek, T., Mathilda, M. and Timmermans, T. (2012). Physiochemical, proximate and sensory properties of pineapple (Anan as sp.) syrup developed from its organic side-stream. Poster presented at the X International symposium on Vaccinium and other superfruits, 17th-21st June, 2012, Maastricht, The Netherlands.

2. Amoa-Awua, W.K., Oduro-Yeboah, C., Mestres, C., Tomlins, K., Bennett, B., Obodai, M., Annan, T., Owusu, M., Ofori, H., Anyebuno, G., Diako, C., Tortoe, C. andPallet, D. (2012). Value-addition to kenkey, an indigenous African fermented food targeting the international market. Poster presentation at EFFoST, 20th-23rd November, 2012, Montipelli, France.

Consultancy Reports

1. Pobee, R.A., Quaye, W., Oduro, H., Owusu, E.S. and Plahar, W.A. (2012). Impact assessment of the UN-WFP's community-based milling and fortification in northern Ghana.

2. Pobee RA,Syeda A, Dimitri K, Oluniyi O, Spek N.V.D. (2012). Tackling Malnutrition in Northern Ghana. A Monitoring and Evaluation System for community-based micronutrient fortification of cereal flours and household salt iodisation.

3. Tortoe, C., Nketia, S., Owusu, M., Akonor, Glover-Amengor,M., T.P., Hagan, L., Dowuona, S. and Padi, A. (2012). Consumer Evaluation Training Workshop for Enumerators and Sensory Evaluation on Diversified Yam Recipes held on 14th December, 2012. CSIR-FRI, Accra, Ghana. pp.35.

4. Tortoe, C., Nketia, S., Owusu, M., Akonor, T.P., Glover-Amengor,M., Hagan, L., Dowuona, S. and Padi, A. (2012). Report on a Consultative Meeting with Partners, Interface and Wrap-up Meetings held on 18th September, 2012, 12th and 15th November, 2012 at CSIR-FRI Conference Room, Accra. CSIR-FRI, Accra, Ghana. pp.32.

Media Publications

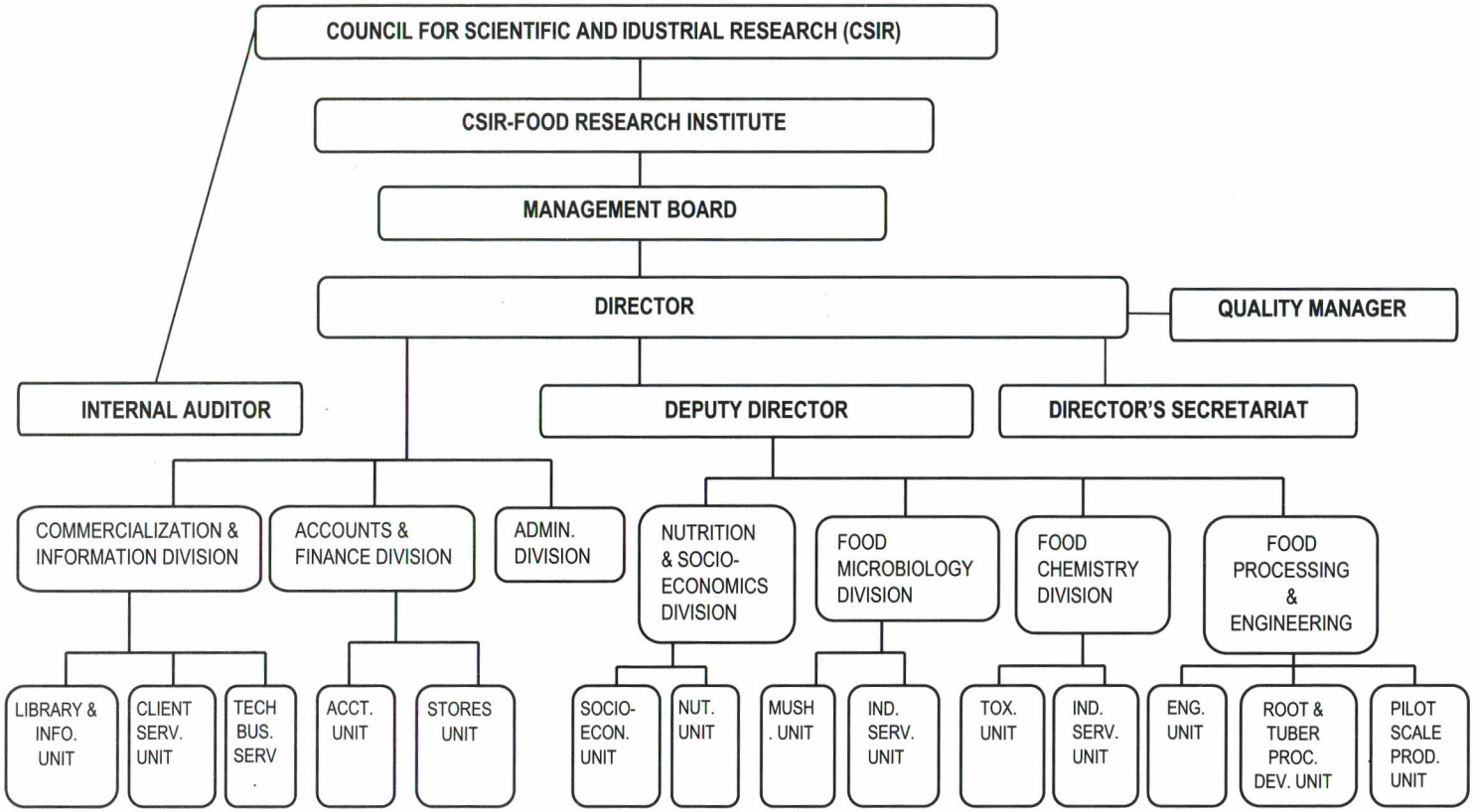
1. Andoh, A. and Ottah A.M . Modern biotechnology and biosafety in Africa. Daily Graphic, Saturday, May 5, 2012.

2. Diako, C. CSIR develops peanut spread with no aflatoxins. The Ghanaian

Times, Thursday, August 2, 2012.

Book

1. Ofosu-Appeah T., Amengor-Glover,M., Okwabia M. and Gbogbo S. et al (2009). Communication and Advocacy Strategy towards attaining universal salt iodisation in Ghana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