Research Application Summary

CSIR and collaboration with Universities in agricultural research in Ghana

Mamaa Entsua-Mensah, R.E
Council for Scientific and Industrial Research (CSIR), Ghana
Corresponding author:

Abstract

The paper provides an overview on capacities and operations of research institutes under the Council for Scientific and Industrial Research (CSIR) in Ghana. It highlights the link between the research institutes and capacity development institutions in Ghana and beyond.

Key words: Capacity development, CSIR, Ghana, University-research linkages

Résumé

L'article donne un aperçu sur les capacités et les activités des instituts de recherche dans le cadre du Conseil pour la recherche scientifique et industrielle (CSIR) au Ghana. Il met en évidence le lien existant entre les instituts de recherche et les institutions de renforcement des capacités au Ghana et au-delà.

Mots clés: Renforcement des capacités, CSIR, Ghana, liens Université-recherche

Background

The Council for Scientific and Industrial Research (CSIR) was established in 1968 by NLC Decree 293 of 1968, amended by NLCD 329 of 1969, and re-established in its present form by the CSIR Act 521 of 1996. The CSIR is the foremost national scientific and technological institution with a mandate to carry out research into science and technology issues that pertain to national development, and to promote science acculturation throughout Ghana. It has a head office, 13 institutes and sub stations along with many field stations and research plots scattered countrywide. Named according to their mandate activities, the institutes of the CSIR are:

Animal Research Institute (ARI), Building and Road Research Institute (BRRI), Crops Research Institute (CRI), Food Research Institute (FRI), Forestry Research Institute of Ghana (FORIG), Institute of Industrial Research (IIR), Institute for Scientific and Technological Information (INSTI), Oil Palm Research Institute (OPRI), Plant Genetic Resources Research Institute (PGRRI), Savannah Agricultural Research Institute

(SARI), Soil Research Institute (SRI), Science and Technology Policy Research Institute (STEPRI) and Water Research Institute (WRI).

The Council employs well-trained specialists and professionals with relevant qualifications in the various disciplines to carry out research in industry, agriculture, environment and public health for the national good.

With a mandate to organize and coordinate scientific and technological research for national development, and to expand the frontiers of scientific applications in Ghana, the CSIR is one of the largest employers of scientists and research professionals in Ghana. For its role, the Council is endowed with facilities that facilitate the conduct of scientific research for the benefit of itself, industry and the private sector.

CSIR's role in National Agriculture Research

Agriculture continues to be the largest sector of Ghana's economy, contributing in recent years (2000-2008) an average of about 39% of GDP, compared to about 26% for the industry sector and 31% for the services sector. Arable and industrial crop production has increased marginally over the last 10 years with the only exception being cocoa which increased significantly between 2000 and 2005. Cotton and coffee production declined very significantly in the last decade. Available information on the livestock sub-sector indicates that the country's meat situation is in deficit to the tune of over 95,000Mt annually. Similarly, a deficit of about 460,000 Mt is recorded for fish.

The identified basic problems of the agriculture sector include: reliance on rainfed agriculture and low level and low performing irrigated agriculture; low level of mechanization in production and processing; high post harvest losses as a result of poor post harvest management; low level and ineffective agricultural finance; poor extension services as a result of several institutional and structural inefficiencies; inadequate markets and processing facilities; low performing breeds of livestock; poor feeding of livestock; high cost of feed for poultry; poor livestock housing and husbandry management; competition from imports and poor post-production management of livestock products; over-fishing of natural water bodies; undeveloped fish value chain and inadequate skills in aquaculture (METASIP, 2011).

According to the FASDEP II document, the "vision for the food and agriculture sector is linked to the national vision in GPRS

II, NEPAD's CAADP and the MDGs. Both the GSGDA and the Comprehensive African Agricultural Development Programme (CAADP) framework have targets for agriculture sector performance that will contribute to the attainment of the broader goals. The GSGDA expects agriculture to spur industrial growth. Also, in the GSGDA the economy (non-oil) is expected to grow at 6.5% by 2010 and 8.2% by 2013. This level of growth demands higher growth performance than the average of 5.6% recorded over the 2000-2006. Agriculture growth target under CAADP is at least 6% and governments are urged to raise budgetary allocation to agriculture to at least 10%. The ECOWAS Agricultural Policy (ECOWAP) and the CAADP of NEPAD are the key efforts with the overriding goal of helping African countries increase their economic growth through agriculture-based development, which eradicates hunger, reduces poverty and food and nutrition insecurity and makes it possible to increase exports. This goal is in close harmony with GSGDA I (2010-2013) and the FASDEP II. The CSIR with its agricultural based institutes bases most of its research on solving these agricultural problems.

Collaboration with Universities

The CSIR has collaborated with the universities for many years. Scientists from the CSIR help in the supervision of B.Sc, M.Sc and MPhil project work and theses. The scientists teach part-time at the various universities. The students' use the facilities of the CSIR such as lab equipment, field instruments, farm machinery workshops and libraries. They also come on attachment to the institutes for two to eight weeks at a time. The Food, Soil and Water Research Institutes will be highlighted here with regards to their collaboration with the universities.

Food Research Institute

The CSIR-Food Research Institute (CSIR-FRI) has been using its expertise and state-of-the-art equipment and facilities in food processing and analysis to play a major role in manpower development through training programmes for students from tertiary institutions. The Institute undertakes these training programmes for students from both local and foreign institutions. The Institutions with which the FRI has been having this type of collaboration on more or less regular basis so far include:

- Nutrition and Food Science Department of the University of Ghana, Legon
- Kwame Nkrumah University of Science and Technology, Kumasi
- University of Cape Coast, Cape Coast

- University for Development Studies, Tamale
- Université D'Abomey Calavi, Representative of Benin
- Department of Dairy and Food Science, Royal Veterinary and Agriculture University, Copenhagen, Denmark
- Accra Polytechnic

Number of students involved and the areas of collaboration. For the past five (5) years, over 300 students from the local Polytechnics and the Universities, notably the University for Development Studies and the Accra Polytechnic have been trained in Food Chemistry and Analysis. In addition, graduate students from the Nutrition and Food Science Department of the University of Ghana have also received part of their training in Food Microbiology and Human Nutrition at the Institute. In 2006 alone, there were about 30 students who did undergraduate attachments with FRI from Universities in Ghana such as the Kwame Nkrumah University of Science and Technology (KNUST), University of Ghana (UG), University of Cape Coast (UCC), University for Development Studies (UDS), etc. There were two PhD students who worked in the Food Chemistry Division in Aflatoxin Analysis and Sensory Analysis from the Université D'Abomey Calavi in the Republic of Benin. There were also some foreign students who did graduate attachment in the Food Microbiology Division. The Institute's manpower development activities in collaboration with the tertiary institutions are in the following four categories:

1. Training and supervision of graduate students on their PhD and MPhil work
2. Training and supervision of undergraduate students project work
3. Short-term practical training in Food Analysis, and
4. Student attachment.

Work undertaken is mainly in the area of General Chemical Analysis of Foods, Food Microbiology, Aroma Analysis, Mycotoxicological Evaluation of Foods, Food Processing, Food Formulations and Nutritional Evaluation of Foods.

Suggestion for Formalising the Current Relationship

The relationship so far has been based only on formal requests that are in most cases not supported with adequate remuneration. Some projects such as the project on Capability Building in Traditional Fermented Food Processing (1992-2004) established networks and collaboration with institutions in the West African Region. Some students are sponsored for attachment with the

institute in Food Chemistry or Food Microbiology Divisions. Every year students from all the universities as well as polytechnics request attachment with the Institute, in partial fulfillment of their University or Polytechnic degree/diploma programmes. There is the need for a formal MOU to spell out all details concerning the specific areas of collaboration. This should take into account the following:

- Institute ability to handle a specific number of students per year
- Agreed costs of the use of facilities and materials
- Co-supervision on students' safety and conduct whilst working in the laboratories
- Joint ownership of publication and technologies developed.

Estimated Cost of Collaboration

The cost involved in the training programmes vary depending on the type of project involved, required inputs and the duration. Some sponsored PhD students are made to pay bench fees of about $2,000 (Two thousand Dollars) which does not include the cost of inputs from project funds. The cost of short-term practical training is worked out based on the areas and types of analytical training required, based on the consumables involved. Undergraduate project works are also charged based on the cost of inputs. Undergraduate students on attachment are paid GH¢20.00 a month by the Institute as transport allowance.

Institute's Core Competencies, Especially Areas of Monopoly. The institute's core competencies with regards to areas of monopoly include:

- Food chemistry and analysis: Aflatoxin analysis and Aroma analysis
- Food microbiology: Traditional fermented foods, Biogenic amine determination, antimicrobial interactions, food borne pathogens, food safety
- Food commodity processing operations
- Formulation and quality evaluation of high protein-energy foods
- Food product development and quality evaluation

Facilities within the Institute that can be used in this collaboration, include Laboratories, Human Resources, etc.

The Institute is equipped with analytical laboratories for chemistry, microbiology, biochemistry, toxicology and nutrition, housed in a spacious ultra-modern building. It also has special laboratories for fish, cassava and cereals. There are well equipped pilot plants for specific commodities, and a general one with operational wet and dry processing lines. The laboratories, which are being accredited for international recognition of some of the analytical methods, have state-of-the-art equipment for high quality results. The chemistry laboratories for example have GC and GC-MS for aroma analysis and HPLC for mycotoxin analysis. The microbiology laboratory also has high-tech equipment like Polymerase Chain Reaction (PCR) machines and Denaturing Gradient Gel Electrophoresis (DGGE). The Institute is ISO 17025 SANAS certified.

In terms of human resources, the Institute has cadre of highly qualified research scientists who are mostly PhD holders. Most of these senior members are part-time lecturers at the University of Ghana and the University of Cape Coast, with several years teaching experience at both the undergraduate and graduate levels. In addition, some are internal and external examiners for the University of Ghana and the KNUST. The areas of expertise include Engineering, Food Science and Technology, Biochemistry, Chemistry, Entomology, Food Microbiology, Economics, Nutrition, Mycotoxicology, Information and Marketing among others.

Soil Research Institute

The CSIR-Soil Research Institute (CSIR-SRI) to date could best be described as an extension of the faculties of agriculture of Ghana's universities and agricultural colleges. CSIR-SRI has been collaborating with universities and colleges (local and abroad) in human capacity development for the Ghanaian economy. The areas of collaboration could be put under the following headings:

1. Current relationship with the universities with regard to training (including the use of laboratories, supervision of thesis, practical attachments, etc.)

Training could be put in four categories:

a. Lecturing/teaching. Scientists of CSIR-SRI lecture at the faculties of agriculture, crops science departments of

i. Kwame Nkrumah University of Science and Technology (KNUST)
ii. University of Ghana, Legon
iii. University College of Education Winneba – Mampong
iv. University of Cape Coast Diploma/Certificate programme at Kwadaso Agricultural College
v. University of College of Education Winneba – Kumasi

Scientists teach undergraduate (levels 100, 300 and 400) and graduate students (taught courses for masters and doctorate). The courses taught are: soil science (introduction), soil fertility, soil chemistry and mineralogy, soil microbiology and soil pedology. Scientists who do lecturing spend 6 to 9 hours per week averagely though some do more hours up to 15 hours per week (especially when combining undergraduate and graduate courses). Scientists also teach soil science in the certificate and diploma courses of the agricultural colleges.

b. Supervision of Theses. CSIR-SRI Scientists supervise project works of the students they teach leading to the writing of theses. All categories of students are supervised (i.e. diploma, BSc, MSc, PhD students). In 2006 SRI Scientists supervised 5 PhDs (3 for faculty of agriculture and 2 for Renewable Natural Resources), 3 MScs (1 for faculty of agriculture, 1 for Renewable Natural Resources, and 1 for Material Science Engineering) and 1 BSc student. These students carry out all their field, green house and laboratory works at SRI.

Students from Japan and Nigeria come annually to be trained on the Sawah technology in rice cultivation. They are trained to do field work (levelling, water management, fertilization, and weeds and pest control) related to rice cultivation. They also collect soil, water and plant samples from the fields from analysis in the laboratories and the data generated are used to write their theses which they defend in universities in Japan, Nigeria (IITA) and Ghana. Two students from the University of Bonn working on the Glowa project also used SRI laboratories for the PhD project work in 2006.

c. Practical attachments. Annually students from KNUST, UCC, Kwadaso Agricultural College, Ejura Agricultural College and from Damongo College come on attachment training in laboratory analysis, field experimentation, data collection and analysis.

ii. Number of students involved and the areas of collaboration

The areas of collaboration are lecturing, use of laboratory facilities, supervision of theses and practical attachment.

Accra	No. of students Involved
Lecturing	400
Use of laboratory facilities	100
Supervision of theses	30
Practical attachment	50

iii. Suggestions for formalizing the current relationship

There is the need to create the awareness of the level of use of CSIR-SRI facilities and human resources by other sister institutions and the need to formalize their use.

Memoranda of understanding should be signed with the various collaborators to formalize the current relationship.

iv. Estimated cost of collaboration
Cost of collaboration could be estimated to be 15 to 20% of academic user fee per student paid to the universities.

v. Institute's core competencies, especially areas of monopoly

Human resource. CSIR-SRI can boast of a strong team of experts in all fields of soil science (pedology, soil fertility, chemistry, microbiology, mineralogy, soil water management, etc.). CSIR-SRI is the only institution with the highest number of soil scientists.

CSIR-SRI has about 39 experienced field and laboratory soil technicians who carry out field and laboratory activities for the various projects. Large projects requiring much expertise in soil science and environment could be effectively executed by SRI.

Laboratory faculties. CSIR-SRI has good laboratory facilities for soil fertility and chemistry, soil physics and soil microbiology. Good facilities for digitized soil mapping, soil suitability maps for all agricultural crops, for mechanized agriculture, soil susceptibility to erosion, etc. There is no other institution in

Ghana that carries out this kind of work. It has the best soil microbiology laboratory facilities in Ghana.

Soil information library. CSIR-SRI has indigenous soil resource information library where information on any soil in Ghana could be obtained. Survey reports on soils of all the major large scale agricultural ventures in Ghana, regional soil survey reports and special project reports could be obtained in CSIR-SRI library. CSIR-SRI has a good data base for agro-climatology of Ghana.

Research stations. CSIR-Sri has field experimental stations in all the agro ecological zones of Ghana. These research stations are used for carrying out research and with demonstration plots among farming communities purposely for agro-technology transfer.

vi. Facilities within the CSIR-SRI that can be used in these collaborations

Facilities which have been at the disposal of CSIR-SRI's collaborators are:

- Good laboratory facilities – Soil fertility and chemistry laboratories (with equipment in good working conditions – AAS, spectrophotometers, flame photometers, gas chromatographys (for pesticide residue analysis), pH meters, conductivity meters, hot plates, ovens, kjeldahl plants, X-ray defractometer, etc.

- Excellent soil microbiology laboratory – The only laboratory where carbon sequestration analysis is done in Ghana. It has all the equipment for all soil microbiology studies e.g. autoclaves, refrigerated centrifuge, microflow, incubators, carbon sequestration equipment, hot air sterilizers, etc.

- Excellent cartographic laboratory where soil information gathered during the fields surveys are put into maps. Digitized maps are also produced using GIS facilities in SRI.

- Excellent soil museum where monoliths of about 360 soil series found in Ghana could be seen. This especially good for studies by students, lectures, scientists and all involved in agriculture and environment.

- Excellent field demonstration plots for sawah rice technology demonstration. Students from Japan, Nigeria (IITA) and Ghana use their fields for their training and collection of data for their thesis.

- CSIR-SRI has ten research stations in the various ecologies of Ghana.

- CSIR-SRI has thirty scientific research scientists with 9 PhD holders, (4 more pursuing PhD studies in various universities) and 17 MSc holders

- CSIR-SRI has thirty-nine experienced field and laboratory technicians.

Water Research Institute

The Institute has a good relationship with the Universities and Polytechnics in training of students at the levels of HND, Bachelor, Masters and PhD.

Collaborating Universities: Faculties and Departments

Kwame Nkrumah University of Science and Technology (KNUST): Faculty of Renewable Natural Resources, Department of Agricultural Engineering, Department of Theoretical and Applied Biology, Physics Department and Materials Engineering Department.

University of Ghana, Legon
Department of Oceanography and Fisheries, Department of Environmental Sciences, Geology Department, Department of Geography, Zoology and Botany Departments.

University of Cape Coast, Cape Coast
Department of Agricultural Engineering, School of Biological Sciences and Department of Physics.

University for Development Studies, Tamale
Faculty of Applied Sciences, Department of Applied Biology and Environmental Science.

University of Mines and Technology, Tarkwa
Department of Geological Engineering and Materials Engineering Department.

Accra Polytechnic, Accra
Department of Laboratory Technology.

The areas of training are the use of laboratory equipments, laboratory analyses, supervision of students' project work and thesis as well as Proposal Writing.

The use of the Institute's resources is normally requested by the various departments of the universities and Polytechnics. Request is granted depending on availability of the resource of any time or period.

Supervision of student thesis is done privately by the research scientists. In some few cases, however, some projects have components for training of students and formally arranged with the Universities.

ii. Number of students involved and the areas of collaboration

The number of students involved per year in the collaboration is distributed as follows:

Environmental Chemistry	30
Microbiology	65
Surface Water	5
Groundwater	14
Fisheries	20
Total	134

iii. Suggestions for formalizing the current relationship

It is suggested that CSIR enters into a formal agreement with the universities/ polytechnics in areas where specialized and practical training is required and competence exists at the institutes. For example, in laboratory training and analysis for water and fishery resource management and development CSIR-WRI has competence and monopoly.

At the moment, the institutions pay little amounts which very often they fail to pay. A formal agreement will make us partners in the training instead of being seen as "Service Providers". This will make CSIR visible and also be able to have justification for accessing GETFUND.

Supervision of thesis by Research Scientists is informal and this needs to be formalized as part of the laboratory training and analysis proposed.

iv. Estimated cost of collaboration

The estimated cost of collaboration in terms of quantifying the time given by the research scientists in supervision, the use of laboratory equipment and chemicals will be about GHC1,000,000,000.00.

v. Institutes' core competencies, especially areas of monopoly

Institute's core competencies over the following areas:

a. Water quality management
b. Environmental quality analysis
c. Environmental impact assessments
d. Environmental baseline studies
e. Wastewater effluents studies
f. Genetic breeding of fish
g. Fish feed formulation
h. Taxonomy (using electrophoresis to determine genetic make up of fish)
i. Fishery science and fishery management
j. Bacteriological studies
k. Algological studies
l. Invertebrate fauna
m. Surface water resources assessment
n. Sediment studies
o. Groundwater assessment, training of technicians for drilling boreholes and pumping test
p. Use of GIS for production of various hydro geological and single parameter colour maps
q. Agricultural water management

vi. Facilities within the Institute

The following facilities are available:

- Well equipped microbiological laboratory
- Well equipped microbiological laboratory
- Partial equipped weeds laboratory
- Partial equipped invertebrate laboratory
- Well equipped laboratory for physico-chemical analysis of water and environmental samples
- Sediment laboratory
- Hydro-meteorological station
- Groundwater exploration equipment

- Borehole logging equipments
- Facilities for fish breeding
- Laboratory for fishery science
- Dormitory and Conference Room for training fish farmers
- Research Library and Documentation.

CARGS- Competitive Agricultural Research Grants Scheme. Low agricultural productivity is one of the major constraints of Ghana's economic, social and natural resource development. Sustainable national development requires accelerated growth in agricultural productivity. The inadequate diffusion and limited impact of developed improved agricultural technologies are of great concern to the Government of Ghana and other stakeholders.

Dependable access to operational funding is a perennial problem facing national agricultural research scientists. In very few instances where funding is available, it is mostly untimely. In agricultural research and extension, a short delay in funding often pushes planned activities from one season or year to another, thereby greatly reducing the productivity of the human and capital assets involved. A funding shortfall could jeopardize the completion of an experiment that had been put in place at great expense.

To address these constraints, the Council for Scientific and Industrial Research (CSIR) and the Ministry of Food and Agriculture (MoFA) in collaboration with the universities, with donors and other stakeholders has established the Competitive Agricultural Research Grant Scheme (CARGS).

The CARGS has many advantages. These include increased research effectiveness by directing resources on merit; increased efficiency by eliminating duplication of efforts; increased accountability of research resources provided; ensuring closer alignment of agricultural research and development with national research priorities and promoting demand-driven national agricultural research agenda. There is a hypothesis that CARGS can spur a virtuous circle of very relevant, demand-driven and cost effective agricultural research and development which in turn lead to sustainability of funding. If national governments, donors and private sector are convinced that their priorities are being served through CARGS then they will increase support to the fund.

The CARGS Board is be a 7-member committee responsible for the management of the CARGS in the selection of concept notes and full proposals for funding and the monitoring of the implementation of research projects. The CARGS Board meets twice a year, or in exceptional cases, as needed.
The CARGS Board is composed of the following:

- The Deputy Director-General, CSIR (Chair)
- One University representative from a University Agriculture Faculty
- One Representative from Agric-based NGO
- One Representative from a CSIR Agric-based Institute
- One representative from MoFA-Directorate of Extension Services
- One representative from a Framer based Organization
- One Technical Specialist from CSIR (Member/Secretary)

The CARGS Board members are selected as representatives of various stakeholders who have the capability of selecting proposals with best prospects for contributing to agricultural development objectives.

The CARGS supports three types of research and development activities.

First, it provides funding for ***strategic research*** that is targeted at solving problems of national importance and has clearly identified users:

Second, the scheme provides funding for ***applied and adaptive research*** that is exceptionally innovative, responds to new pressing needs or opportunities, brings together new partners, or cuts across several disciplines and commodities in such a way that it has not been catered for by the existing priority research programmes despite its merits.

Third, the Scheme considers funding for ***Commissioned (Non-competitive or Contract) Research*** on a problem/issue of national importance that falls within the perview/mandate of an Organization/Institution that possesses sole capacity and expertise to deal with the problem/issue

Commissioned research shall be awarded to grantees on the basis of the following:

a) A problem of national importance identified by the RELCs but for which no proposals were received after calls had been made
b) A problem of national importance as determined by the M & E Technical Team in consultation with the CARGS Board. Solutions to such problems must respond to some components of Ghana's development agenda
c) Where a useful innovation/technology that has the potential for increased production and value addition has been developed but has not been fully disseminated and/or adopted by end users.
d) An outbreak of any disease or pest problem that has devastating impact on agricultural productivity

Eligibility. Commissioned projects shall be awarded to grantees/institutions/organizations on the basis of proven technical competence and capability. The problem/issue must fall within the perview/mandate of that organization/institution.

Review and Approval. The CARGS Board shall review all such proposals prior to award of contract and release of funds.