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Annual Report

CSIR - INSTI

INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION

CSIR-INSTI

INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION

2021
ANNUAL REPORT

2021 ANNUAL REPORT

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LIST OF ACRONYMS & ABBREVIATIONS

AGDP	-	Agricultural Gross Domestic Product
AGORA	-	Access to Global Online Research in Agriculture
AJOL	-	African Journals Online
AMA	-	Accra Metropolitan Assembly
ARI	-	Animal Research Institute
AWS	-	Amazon Web Service
BRRI	-	Building and Road Research Institute
CC	-	Creative Commons
CCST	-	CSIR College of Science and Technology
CLIMACCESS	-	Climate Accessibility
CSIR	-	Council for Scientific and Industrial Research
CRI	-	Crops Research institute
DAIH	-	Digital Agriculture Innovation Hub
DD-G	-	Deputy Director-General
D-G	-	Director-General
DOAJ	-	Directory of Open Access Journals
DT	-	Digital Twins
FAO	-	Food and Agriculture Organisation
FORIG	-	Forestry Research Institute of Ghana
FRI	-	Food Research Institute
FPGA	-	Field Programmable Gate Array
GAEC	-	Ghana Atomic Energy Commission
GDP	-	Gross Domestic Product
GIS	-	Geographic Information System

GISD	-	Geospatial and Information Science Division
GISS	-	Geographic and Information Systems Section
GJAS	-	Ghana Journal of Agricultural Science
GJS	-	Ghana Journal of Science
GNMC	-	Ghana Nursing and Midwifery Council
GoG	-	Government of Ghana
GOPDC	-	Ghana Oil Palm Development Company
HINARI	-	Health Inter Network Access to Research Initiative
ICT	-	Information and Communication Technology
IEEE	-	Institute of Electrical and Electronic Engineers
IIR	-	Institute of Industrial Research
INSTI	-	Institute for Scientific and Technological Information
IoT	-	Internet of Things
ITS	-	Intelligent Transport Systems
ITU	-	International Telecommunications Union
KNUST	-	Kwame Nkrumah University of Science and Technology
LiDAR	-	Light Detection and Ranging
LoRA	-	Long Range Radio
MAG	-	Modernizing Agriculture in Ghana
MIT	-	Massachusetts Institute of Technology
MNO	-	Mobile Network Operator
MNS	-	Mobile Network Subscriber
MQTT	-	Message Queuing Telemetry Transport
NADMO	-	National Disaster Management Organisation
OARE	-	Online Access to Research in the Environment
OpEx	-	Opportunity and Exposure
PCB	-	Printed Circuit Boards
PGRRI	-	Plant Genetic Resources Research Institute

PNAS	-	Proceedings of the National Academy of Sciences
QR	-	Quick Response
RSA	-	Research Staff Association
S&T	-	Science and Technology
SARI	-	Savannah Agricultural Research Institute
SDI	-	Selective Dissemination of Information
SIMS	-	Scientific Information Management Section
SMART	-	Specific Measurable Attainable Reliable and Time-bound
SNAS	-	School of Nuclear and Allied Sciences
SPSS	-	Statistical Package for the Social Sciences
SSEs	-	Small Scale Enterprises
STEPRI	-	Science and Technology Policy Research Institute
STI	-	Science, Technology and Innovation
TDTC	-	Technology Development and Transfer Centre
TEEAL	-	The Essential Electronic Agricultural Library
UAV	-	Unmanned Aerial Vehicle
UV	-	Ultraviolet
WRI	-	Water Research Institute

MEMBERSHIP OF THE INTERNAL MANAGEMENT COMMITTEE

(As at 31st December 2021)

Dr. Seth Awuku Manteaw	-	Director/Chairman
Dr. Albert N.M. Allotey	-	Head, Geospatial & Information Science Division
Mrs. Janet Otoo-Abedi	-	Ag. Head, Accounts Division
Dr. Agnes Decardi-Nelson	-	Head, Printing & Publishing Science Division/ Representative, Research Staff Association
Dr. Paul A. Danquah	-	Head, Communications Division
Ing. Michael Wilson	-	Head, Electronics Division
Mr. Mohammed Nafiu Zainudeen	-	Ag. Head, Fluid Science Division
Mrs. Sarah G. Sarpong	-	Representative, Senior Staff Association
Ms. Yvonne Dzifa Azuma	-	Representative, Trade Union Congress
Mrs. Akua Boateng Agyenim	-	Chief Marketing Assistant
Ms. Esther Opoku	-	Secretary

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FOREWORD

Dr. Seth Awuku Manteaw

Director, CSIR-INSTI

The year 2021 offered the unique opportunity for the Institute to leverage its achievements in the digital space with the aim of contributing towards the modernisation of agriculture in Ghana. The year was therefore devoted to sustained communication, education and public awareness creation on the four digital solutions developed from the Institute's flagship project, the Digital Agriculture Innovation Hub (DAIH). Heads of Regional, Metropolitan, Municipal and District Departments of Agriculture in ten regions of Ghana as well as stakeholders in the agricultural commodity value chains were taken through the workings of the key outputs of the DAIH, namely, the CSIR Kuafo Market Place, CSIR Agritech Advisor and the CSIR Technologies Portal, three applications designed to improve agricultural extension and advisory services in Ghana. This was followed by the training of selected Agricultural Extension Agents and leaders of Farmer-based organisations in two regions of Ghana.

Besides, a documentary on the DAIH was produced and aired on the national television station, *Ghana Television.* The Institute plans to organise more of such trainings in the coming year as part of the sensitisation drive to contribute towards enhancing ownership of the

apps among farmers and other stakeholders. This would ultimately deepen the integration of digital technologies in agricultural extension and advisory services in Ghana.

As part of efforts at unearthing young Ghanaian tech entrepreneurial skills with potential business models which can be up scaled, the CSIR-INSTI entered into partnership with a private sector actor, Dalex Financial Services, to implement a youth challenge programme dubbed the Opportunity and Exposure (OpEx) prize competition. A team from the Electronics Division worked with the OpEx prize to select ten teams who eventually became finalists of the challenge after 20 shortlisted applicants had pitched to a panel of judges. The OpEx prize competition seeks to host these ten selected finalists for six months during which they would nurture their business models and pilot them for future up scaling.

The Institute continued to build capacity of CSIR institutes in the implementation of three software systems, namely the CSIR Online Grants Management Software, Profiles Management System and the Promotions Management System developed by the CSIR-INSTI. The Institute is leading efforts to leverage digital technologies in the administrative and research procedures of the CSIR for enhanced efficiency.

The technical divisions of the Institute continued with their research and development activities, the outputs of which found expression in research publications, development of products and offer of services to clients. Management and staff are profoundly grateful to the Government of Ghana, development partners and friends of the Institute for the support in implementing the Institute's mandate during the year.

It is the pleasure and honour of the Institute to present its Annual Report for 2021.

Thank you.

EXECUTIVE SUMMARY

2021 was a fertile year for the Institute with several novel projects and activities being commenced. A synopsis of activities for the year is captured below.

Climate Change Resilience in Urban Mobility

The project aims at identifying research-based strategies for increasing climate change resilience within urban mobility, accessibility and transport in Accra, Ghana. It is to establish a comprehensive understanding of the factors that determine resilience to climate change impact on mobility and accessibility in the Accra Metropolitan Assembly (AMA). This would be accomplished by enhancing research capacity in the field, introducing new methods for mobility analysis, new methods for predicting urban floods, and by devising policy and planning measures to advance the sustainable urban development agenda. During the year, a second Technical Report was written and some field assistants for socio-economic survey and field data collection on emergency responses were trained. A socio-economic survey using a questionnaire in all the study communities was completed.

A Geo-spatial Perspective of Floods, Transport Networks and Emergency Responders/Services in Accra

This study intends to rely/draw on existing datasets gathered within the CLIMACCESS project, such as flood-prone locations and city-wide transport network. Data would be collected on the location of emergency services such as Hospitals/Polyclinics, Police Stations and Posts, Fire Service, National Disaster Management Organisation (NADMO) and Ambulance Services. Further, data would be compiled on the population to determine access to these service centres in the delineated localities/ catchment areas. So far, activities carried out include a reconnaissance survey with the various agencies, taking of coordinates for areas identified as flood spots and those identified as safe havens or shelters. Locational coordinates using GPS has been established and a spatial database for the locations, including flood spots has been developed and draft maps produced.

UV-C Pathogen (Virus) Disinfectant

The ultimate idea of the study is to lead to the design and construction of a UV-C Pathogen Disinfectant Robot. Parameter values obtained, may help with the analyses and the design modalities of the Robot. The approach evolves to the automation of disinfection processes using robots. Such Robots could be an important tool for healthcare Centres to kill and disinfect pathogens (viral) infected rooms and spaces.

A Review of Edge Computing Variants for Data Processing in IoT

The methodology used in this research would review current edge computing paradigms adapted as solutions to the unsustainable bandwidth requirement and unacceptable latency with current use of cloud computing for data processing in IoT implementations. The main contribution of this survey work is to detail current status, challenges and unaddressed issues in the use of edge computing paradigms for data processing in IoT. Another contribution of this work is to identify key data processing methodologies for IoT data processing and to discuss the challenges, opportunities and open questions among the reviewed variants of data processing at the edge for IoT. The research work is being extended by proposing a Mesh-IoT Network that consists of Radio or wireless nodes with embedded multifaceted wireless and/or wired network interface module interconnected by a hybrid mesh network architecture having three data processing tiers as a way to reduce IoT applications dependency on the cloud while improving response time.

CSIR Online Reporting Management Software

The Online Reporting Management Platform aims at digitally monitoring Research and Development as well as Activities within the Institute. Future plans include expanding its operations to allow digital monitoring of same within the Council from Head Office.

Opex Prize – Makerspace

CSIR-INSTI entered into a partnership with the OpEx (Opportunity and Exposure) Prize to host ten (10) selected Techpreneur teams for a period of six months. The OpEx Prize seeks to unearth and sponsor young Ghanaian Tech entrepreneurs/ Techpreneurs who have a business model which can be ‘scaled’.

CSIR Space/DSpace

The DSpace is a digital service/repository that collects, preserves, and distributes digital material. It contains research articles published by CSIR Research Scientists, these articles are searchable all over the world.

Dams and Reservoirs

Preparation of discrete regional maps depicting features of dams and reservoirs within the country as captured from the Landsat satellite images were worked on.

Printing Services

Call cards, Letterheads, Files, Books and Manuals are some of the items printed out by the Institute for various Institutes of the CSIR, the Head Office and other external organisations.

Ghana Journal of Science & Ghana Journal of Agricultural Science

GJS and GJAS, the two leading science journals in the Country are published by the Institute. During the year, *Ghana Journal of Agricultural Science Vol. 56(1) and (2) (2021)* were published, seven (7) articles were featured in each issue. *Ghana Journal of Science Vol. 62(1) (2021)* was published with eight (8) articles.

Staff Strength

The staff strength of CSIR-INSTI stood at 77 as at 31st December 2021, comprising twenty-seven (27) senior members, thirty-five (35) senior staff and fifteen (15) junior staff. Mr. Benjamin Yao Folitse was appointed as the Acting Deputy Director of the Institute. Two (2) staff members retired during the year.

Income Generated

Total receipts for the year under review amounted GH¢5,743,900.52 and payments totalled GH¢5,684,058.97 with a surplus net receipt of GH¢9,841.55. The receipts are made up of salaries paid by GoG from the Consolidated fund amounting to GH¢5,166,164.39. Internal Generated Fund (IGF) amounted to GH¢ 522,376.88 and Donor Funds of Gh¢55,359.25. The IGF activities included Printing, Hiring of facilities, and Consultancy.

1.0 INTRODUCTION

The Institute for Scientific and Technological Information (CSIR-INSTI) has the mandate to develop a national capacity and capability for the efficient and effective provision of scientific and technological information on demand for the benefit of research scientists, policy decision-makers, industrialists, etc. in an appropriately packaged form for national development.

The Institute's operative objectives were to:

- carry out research into the Electronics/Communication and uptake of research findings to end-users.
- utilise and develop ICT tools and communication devices for socio-economic development
- provide sustainable training programmes in the fields of ICT and consultancy services using appropriate technologies and expertise
- adopt, adapt and master known and existing technologies
- conduct research into the following areas:
    - Intelligent Transport Systems (ITS)
    - SMART agriculture for sustainable green cities
    - High-performance data networks and Cybersecurity
    - Computer-aided designs and Robotics
    - Predictive analytics and algorithm development
- undertake science publishing services and ultimately become a leader in the speciality in Ghana.
- collect and analyse data for the design and construction of thematic maps using digital technologies to depict Ghana's resources and development potential to aid planning, policy decision making, research and general education

- collect, process, store and repackage for dissemination science and technology information embodying the results of indigenous science and technology research activities as well as those generated elsewhere for the benefit of planners in government, production and manufacturing concerns
- support the promotion of efficient research and development activities in the country through the provision of science and technology information services using appropriate information processing and communication technologies
- strengthen national science and technology information and infrastructure through effective networking and collaborative activities

In fulfilment of its mandate, CSIR-INSTI continued to collect, organise, coordinate, manage and repackage for dissemination, STI resources on a national scale to facilitate technology transfer between the developers or producers of technologies to enhance and accelerate the adaptation and diffusion of these technologies.

The divisions at the Institute under which activities were undertaken were:

- Communications Division
- Electronics Division
- Fluid Science Division
- Geospatial and Information Science Division
    - Geographic and Information Systems Section
    - Scientific Information Management Section
- Printing and Publishing Division
    - Science Publishing Section
    - Printing Section

The supporting divisions were:

- Accounts
- Administration

2.0 RESEARCH & DEVELOPMENT PROJECTS

2.1 Food Security and Poverty Reduction

2.1.1 The Use of Mobile Telephony in Poverty Reduction Among Oil Palm Processors in Ghana: The Case of Small scale Oil Palm Processors in the Kwaebibirem District, Eastern Region, Ghana

Research Team: Folitse B.Y., Manteaw S.A., Ampofo-Addo A.S., Swanzy F.K., Sackey T.A. & Folitse P.

Start Date: January 2020

Duration: 1.5 years

Sponsors: GoG

Collaborating Institution: Nil

Location: CSIR-INSTI

Introduction

The use of mobile phones has introduced significant changes in most sectors of the economy, especially in the informal sector where many Small Scale Enterprises (SSEs) are changing their ways and means of transacting business, and this has impacted greatly on the telecom industry and has made it the fastest-growing sector in the country (Overa, 2006). Mobile phones provide technological services that bring about efficiency in the cost build-up resulting in an increase in incomes and also suppliers' ability to reach out to the people involved (Aker and Mbiti, 2010). They promote social and business networks, and they replace journeys, brokers, traders and other business intermediaries (Donner, 2005, Hughes and Lonie, 2007). Oil palm processors in their routine business engage with numerous service (network) operators to make good use of their mobile phones. Mobile phones have been spreading fast among actors along the value chain and they are exchanging their marketing and business information among themselves. Processors directly contact

market brokers and near cities to sell their products. Similarly, farmers focus, search for useful and up-to-date market information from social and business networks (Ilahiane, 2007). Many studies show that access to communication technologies has an impact on the economy, poverty reduction as well as agricultural development. The use of mobile phones could increase the efficiency of processors by affordable access to business information thereby increasing production in rural areas of developing countries. A study conducted in Bangladesh specified that the use of mobile phones increased access to information among men and women and improved their living standards (Abraham, 2006; Aker, 2008; Galperin and Mariscal, 2007; Jensen, 2007, Bhavnani et al. 2008). Equally, Folitse et al. (2019) concluded that there was a high penetration rate of mobile phones among small-scale poultry farmers and underlined the importance of the mobile phone as a driver of business operations.

Therefore, it can be said that mobile phone technologies have provided a good platform for processors to share their knowledge and information among themselves on issues such as market rates and input cost in developing countries (Munyua, 2007, Lehr, 2007).

Objectives

- To find out the socio-demographic backgrounds of oil palm processors in the area of study.
- Ascertain the Importance of Mobile Phone Use to oil palm processors.
- Determine the motivation for oil palm processors use of mobile phones in the study area.
- Find out the constraints in the use of mobile phones by oil palm processors.
- Establish the relationship between oil palm processors' demographic characteristics and their mobile phone usage.

Materials and Methods

Study Area

This study would be carried out in the Kwaebibirem District in the Eastern region of Ghana. The Kwaebibirem District is located between latitude 6°22'N-latitude 5°75'S

and longitude 1°0'W– longitude 0°35'E° (KDAP, 2006). It is bordered by Birim North District to the North-West, Atiwa District to the North-East, on the South-East by Denkyembour District, and on the South-West by Akyemansa District. Kwaebibirem District has a land area of 1230 km2 with Kade as its capital. The district has a tropical climate characterized by two distinct conditions of wet and dry seasons. The wet seasons range from April to July and from September to November with total annual rainfall of about 1500 m. While the dry season ranges from December to March. Minimum and maximum temperature ranges between 25°C – 30°C respectively (GSS 2010). The main economic activity carried out in the district is agriculture; that is, crop and livestock production. The following crops are produced: cocoa, citrus, plantain, banana, and cassava, oil palm, rubber, rice, leafy and fruit vegetables, maize, among others. However, oil palm cocoa, rubber and citrus are the main cash crops produced in the district. It is estimated that about 13,095 households are engaged in the cultivation of oil palm (Ofosu-Budu and Sarpong 2013). About 50% of oil palm farmers produce palm fruits on contractual agreement with Ghana Oil Palm Development Company (GOPDC), the largest palm oil production company in Ghana (Adjei-Nsiah, Sakyi-Dawson and Kuyper 2012). GOPDC also produces about 30% of oil palm whilst 70% production of oil palm is carried out by smallholder farmers. Hence, a total area of 50,700 ha of oil palm are under cultivation in the district (Adjei-Nsiah, Zu and Nimoh 2912).

Research Design

This survey research would investigate how small-scale oil palm processors in selected rural communities in the Kwaebibirem District, Eastern Region, Ghana use mobile phones in poverty alleviation. The interview schedules would elicit responses pertaining to small scale oil palm processors' demographic characteristics, ascertain the Importance of Mobile Phone use to oil palm processors, determine the motivation for oil palm processors use of mobile phones in the study area, find out the constraints in the use of mobile phones by oil palm processors and establish the relationship between oil palm processors demographic characteristics and their mobile phone usage.

Sampling Method

The population for this study would be oil palm processors in Asuom, Otumi, Subi, Kade,

Kusi, Takorase, Wenchi, Abaam and Abodom, all in the Kwaebibirem District, Eastern Region and numbering about 380. A sample size of 120 oil palm processors from the population would be considered for this study. A random sampling technique will be used to select the 120 oil palm processors for the study from a finite population of registered oil palm processors of the Kwaebibirem Oil Palm Processers Association. All the 120 cases will be analysed, representing 100% of the total sample. The focus of the field survey would be on small-scale Oil Palm Processers. The distribution and location of Oil Palm Processers is shown in Table 1.

Table 1: Number of Oil Palm Processors Surveyed in Each of the Towns in Kwaebibirem District

Town	Oil-Palm processors	Percentage
Asuom	7	5.8
Abodom	8	6.7
Takrowase	9	7.5
Abaam	10	8.3
Wenchi	10	8.3
Kade	14	11.7
Subi	19	15.8
Kusi	20	16.7
Otumi	23	19.2
Total	**120**	**100**

Method of data collection

Interviews were conducted using structured questionnaires administered to Oil Palm Processers randomly selected from a database of Oil Palm Processers obtained from the Kwaebibirem Oil Palm Processers Association, Eastern Region, Ghana.

Results Achieved so Far

The Technical Report is being edited.

Way Forward

The manuscript being prepared for publication will be completed as soon as editing of the Technical Report is completed.

2.1.2 The Role of Middlemen in Plantain Marketing Channels in Ghana: The Case of Agbogbloshie Market, Accra

Research Team: Manteaw S.A., Folitse B.Y., Mingle N.A., Sackey T.A. Folitse P. & Koranteng I.M.

Start Date: February 2020

Duration: 1.5 years

Sponsors: GoG

Collaborating Institution: Nil

Location: CSIR-INSTI

Introduction

According to Latham (2001), plantain *(Musa paradisiaca)* is one of the most important staple food crops for millions of people both in developed and developing countries, a fact reflected in the gross value of its production. It reaches its greatest importance in parts of East Africa, where annual consumption is over 200 kg per capita and in West and Central African where more than 10 million tonnes are produced annually and are traded locally (Lescot and Jacky, 2010). Figures obtained from the FAO (2010) indicate that Ghana is the largest producer of plantain in West Africa and the second in Africa after Uganda and Rwanda.

Plantain belongs to the non-traditional sector of the rural economy, where it is used mainly to shade crops in cocoa farming in Ghana. Plantain is an essential component of the diet of many Ghanaians. More than 90% of the cultivated area in Ghana belongs to small scale farmers (Dzomeku, Dankyi and Darkey, 2011). In the Ghanaian agricultural sector, plantain is ranked third after yam and cassava (FAO, 2010) and contributes about 13.1% to the Agricultural Gross Domestic Product (AGDP). Plantain is grown across all the humid agro-ecological zones and forms an integral component in most of the complex farming systems (Swennen and Vuylsteke, 1991).

Since the last decade, plantain yields in West Africa have experienced slight increases with the largest production of 3.7million metric tonnes in Ghana contributing about 13.1% of the agricultural GDP (Olumba and Onuuka, 2020)

Plantain is a seasonal crop with relatively short shelf life hence, it is available for a limited period and post-harvest losses are very high. These situations necessitate a scientific survey of its marketing system to promote speedy sales and reduce losses of both quality and quantity. According to Adetunji, and Adesiyan (2008), relative attention given to plantain is focused on its production technology, while little is done on its marketing. It is however understandable that increased production without a consistent increase in marketing may amount to wastage of resources. Also, Njoku and Nweke (1996) later agreed that the marketing condition changed, because the sector was ignored. According to Adetunj and Adesiyan (2008); plantain market is a perfect competitive market and the business is easy to start with moderate initial capital. They further note the profitable nature of the business with high gross margin and marketable margin which are subject to increase as marketers source produce from remote communities.

Akalumbe (1994) had earlier observed the marketing and post-harvest handling systems of plantain in Southern Nigeria and agreed with Njoku and Nweke (1995) that good infrastructure and facilities for storage as well as processing coupled with means of transport are important for an improvement in the plantain marketing system.

Marketing of plantain is very difficult in Ghana because of the diaspora nature of the production areas, absence or poor conditions of roads, poor lines of communication with urban consumption centres and the irregular supplying in the market by wholesalers and middlemen who set the prices. In addition, perishable produce like plantain suffers from continuous deterioration resulting from poor post-harvest management. This aggravates loss of quality and quantity and thus affects the final price. Plantain marketing involves the role of middlemen in passing plantain from the farms to the markets. Therefore, the roles of markets cannot be ruled out because production centres are fragmented and mostly on a small scale. It is faced by a lot of marketing problems and these problems determine whether production can be expanded.

Middlemen are marketing intermediaries who do not add value to the products but receive a fee for expediting the exchange. Bryceson et al. (1993) reported that the middlemen performing the role of marketing are being accused of earning higher profit in the marketing system. Middlemen have various functions in the marketing of products, produce or services. These include maintaining contact with buyers,

negotiating prices, delivery, transfer of title, providing credit or collections, servicing of products, providing inventory and storage and arranging transportation. They are also classified differently by scholars into buying brokers. (Gilbert, 1969), finds evidence of brokers in nearly all studied fish markets like in many forms across Nigeria, farmers are not allowed to sell their produce directly to consumers but must deliver the product to middlemen who are mandated to sell the produce to traders and consumers. The role of plantain marketing in developing countries changes with its economic development and as a country develops; the structure of its urban plantain marketing changes.

Plantain marketing assumes greater importance in the Ghanaian economy because the excess production must be disposed of to earn some income. The Middlemen assist the plantain farmers with inputs wherever possible and other monetary needs to run their farming business and in return sells their produce to the consumer (buyer) at an agreed price; any attempt by the outside intermediary is often met with very stiff resistance (Agbebi and Fagbote, 2012). Wholesalers have three sub-groups: The wholesaler agent, the wholesale transporter and the wholesaler retailer. Together they perform important functions such as commodity packing, financing, transportation, sorting, grading and storage; they rarely sell to consumers except where consumer are industrial users.

The retailers also have three sub-groups: They are sedentary or stall retailers, the itinerant retailer (hawker) and the farmer retailer. In this case, the income for the producer and the retailer is very low, while the middlemen have the highest income and consequently, the price of the plantain changes as it passes through these channels such that by the time it reaches the consumer, it becomes too expensive. Hence, this study necessitates how the producers and the retailers will be free and not too dependent on the middlemen.

Objectives

- Identify the socio-economic characteristics of women in plantain marketing
- Examine the roles of middlemen in the plantain industry
- Determine the profitability of plantain marketing
- Find out the constraints of middlemen in plantain marketing

Materials and Methods

Study area

The study will be conducted at Agbogbloshie market located in Ghana's capital city Accra. Agbogbloshie lies at the centre of Accra. According to opinion leaders, Agbogbloshie is the name of a river god that controls the area. The place was formerly a burial place for Ga chiefs. In the 1960s, a well-known segment of the Accra Makola market was moved to Agbogbloshie which made the place popular for the sale of fresh foodstuffs till date. Agbogbloshie is known mainly because of the market. Different foodstuffs are sent to the market from every corner of the country for sale. The market serves as the main source of livelihoods for residents of Agbogbloshie and nearby communities. The market is vibrant both at night and during the day. It is busy at night, the time that goods brought to the market are offloaded. Different commodities are traded at the market, the common ones being foodstuffs. The market is, therefore, known to have special sections for different foodstuffs; yam market, onion market, a section for plantain, corn and its by-products, tubers like cassava and cocoyam, dry and fresh fish and much more.

Sampling procedure

The population for this study will be members of the plantain sellers association in the Agbogbloshie market in Accra, Ghana. A survey design will be adapted for the study. A random sampling technique will be used to select 50 plantain sellers in the Agbobloshie market for the study out of the 134 plantain sellers.

Data collection

The source of data for this study will be the primary data from plantain sellers who are involved in Plantain Marketing in the Agbobloshie market. In Ghana, plantain is the fourth most important starchy staple after grains, cassava, and yam (Cropley and Morriss, 1993). On a food-value basis, it is the second most expensive starchy staple in urban markets after yam, reflecting a strong consumer preference and an excess demand for the crop (Cropley and Morriss, 1993). Data collection will be through the use of a structured questionnaire administered through face-to-face interviews. Data

to be collected will included in the socio-economic characteristics of plantain sellers, the roles of middlemen in the plantain industry, the profitability of plantain marketing and the constraints of middlemen in plantain marketing.

Data analysis

The data collected were analysed using IBM SPSS Statistics for Windows, Version 24 (IBM Corp., Armonk, NY, USA). Data analysis was univariate, using descriptive statistics of frequencies and percentages.

Results Achieved so Far

The Technical Report is being edited.

Way Forward

The manuscript being prepared for publication will be completed as soon as editing of the Technical report is completed.

2.2 Climate Change, Environmental Conservation and Green Technology

2.2.1 Climate Change Resilience in Urban Mobility

Research Team: Kofie R.Y. & Allotey A.N.M.

Start Date: June 2018

Duration: 5 years

Sponsors: Ministry of Foreign Affairs of Denmark

Collaborating Institutions: University of Ghana (Department of Geography & Resource Development) and University of Copenhagen (Department of Geoscience), Denmark.

Location: Accra, Ghana

Introduction

The project aims at identifying research-based strategies for increasing climate change resilience within urban mobility, accessibility and transport in Accra, Ghana. It is to establish a comprehensive understanding of the physical and factors that determine resilience to climate change impact on mobility and accessibility in the Accra Metropolitan Assembly (AMA). This would be accomplished by enhancing research capacity in the field, introducing new methods for mobility analysis, new methods for predicting urban floods, and by devising policy and planning measures to advance the sustainable urban development agenda. The research and capacity building are expected to lead to a reduction in inequality in access to mobility and, thereby, the reduced vulnerability of local communities challenged by unsustainable spatial development practices and increased frequency of extreme weather events.

Objectives

- Identify strategies for increasing climate change resilience within urban mobility, accessibility and transport in Accra, and
- Investigate how these strategies may be integrated into the urban planning and decision-making process.

The project aims to:

- Enhance research capacity in the field, introduce new methods for mobility analysis, new methods for predicting urban floods, and
- Devise policy and planning measures to advance the sustainable urban development agenda.

Materials and Methods

This interdisciplinary research effort will draw upon the combined competences of the involved North and South partner teams within climate change scenarios, flood modeling, urban planning, socio-economic analysis, and GIS-based spatial analysis. The project will apply a combination of quantitative and qualitative methods to address the objectives of the different work packages. The quantitative methods include questionnaire surveys, computerized analysis of local and city-wide elevation models, satellite images as well as GIS-based analysis of the urban transport networks in terms of risk of flooding, connectivity and level of redundancy. A small UAV "drone" will be applied to collect local elevation data for evaluation purposes. A city-wide elevation model based on satellite images will be obtained for the project. The qualitative methods include focus groups, key informant interviews, field observations, in-depth qualitative interviews and participatory community workshops.

Results Achieved So Far

1. Inception workshop successfully organised on 27th June 2018 at Alisa Swiss Hotel, North Ridge, Accra
2. A reconnaissance survey was undertaken with all collaborating researchers.
3. Team members travelled to Copenhagen, Denmark for a project meeting (18th – 27th August 2018)
4. Enumeration Areas of Greater Accra Region for 2000 and 2010 population census acquired from statistical Service, Accra. Spatial and statistical data merged
5. Updating of enumerations areas with population data of 2000 and 2010

6. Scanning newspapers reports on flooding in Accra from the past 15 to 20 years completed
7. Organised satellite images of the Greater Accra Region have been interpreted and land use/land cover map generated
8. Organised meteorological data (rainfall) from CSIR-WRI and Ghana Meteorological Agency, Accra
9. Carried out community entry exercise by visiting all the selected study sites thus, Adenta, Pokuase, Santa Maria / Auntie Aku and Gleffe/ Mpoase
10. Transcribed recorded interviews in Ghanaian languages to English.
11. Had a project meeting in Copenhagen, Denmark from 10th – 14th June 2019 with all participating scientists
12. Reconnaissance survey for the fly of the drone in selected study sites have been carried out
13. Citywide elevation model created
14. Flew Drone with LiDAR mounted, at three (3) places namely, University of Ghana, Legon, Santa Maria/ Auntie Aku – Ga Central Municipal Assembly and Adenta in the Adenta Municipal Assembly. This fieldwork was achieved in 10 days (19-30th August 2019)
15. Socio-economic field survey to complete community profiling (settlement narratives) has been accomplished
16. Published article title: Comparison of Satellite-Based Estimates of Urban Agglomeration Size for the Accra Area. ISPRS Int. J. Geo-Inf. 2020, 9, 79; doi:10.3390/ijgi9020079 www.mdpi.com/journal/ijgi https://www.mdpi.com/2220-9964/9/2/79/pdf (2020)
17. Preliminary results for LiDAR images are available. They include merged and aligned points and digital surface models.
18. Design of a questionnaire on livelihood strategies and mobility patterns has been completed.
19. A pilot testing of the designed questionnaire has been accomplished.

20. LiDAR image processing manual completed
21. Field validation of drone image for three sites
22. The Four "Settlement Profile Reports" (WP-A) have been completed and published in the IGN working papers series
23. A paper draft on the integration of citywide elevation models with local Drone-based Lidar models for detailed flood modelling with Katerina as the main author is getting ready for submission. Additional field work was carried out in Accra recently to provide more validation data
24. The final city-wide flood maps and other spatial data have been published on the CLIMACCESS internet map portals
25. Technical reports on a) the flood modelling methodology (WP-B) and b) GIS analysis of mobility loss due to flooded roads (WP-C) have been completed and published on the website. (check the website: ign.ku.dk/climaccess for more activities and more information)
26. Technical report (2) "Field validation of UAV-lidar point clouds data (for flood modelling) in Accra: the case of Santa Maria, University of Ghana Legon campus/Okponglo and Adenta by Kofie et al. 2021
27. Training of field assistants and carrying out socio-economic survey in the selected communities (Glefe, Pokuase, Santa Maria and Adenta)
28. Dissemination of project status and preliminary results on web site (check the website: ign.ku.dk/climaccess)
29. Training of research assistants and field data collection on emergency responses during flooding at the four study sites (Glefe, Pokuase, Santa Maria and Adenta). Socio-economic survey completed
30. Dissemination of project status and preliminary results on web site (check the website: ign.ku.dk/climaccess)

Way Forward

- Validating flood model using satellite imagery
- Creation and field validation of digital transport network model

- Initial spatial analysis and mapping of urban accessibility levels
- Work on the remaining work packages
- Various manuscripts being prepared for publication

2.2.2 A Geo-spatial Perspective of Floods, Transport Networks and Emergency Responders/Services in Accra

Research Team: Kofie R.Y., Allotey A.N.M., Annor J., Lettu C. & Davidson E.

Start Date: June 2021

Duration: 2 years

Sponsors: DANIDA/DFC/FFU

Collaborating Institutions: University of Ghana & University of Copenhagen, Denmark.

Location: Accra, Ghana

Introduction

Much research has been done on floods in urban Accra. Some of the studies have pointed to the hydrological dimensions and risk management (Asumadu-Sakordie, et al., 2015) and interrogations into the causes, effects or impacts, and the coping strategies adopted by the communities affected by the floods. They also include recommendations on the possible sustainable developmental policy options necessary to address the flood menace (Mensah & Ahadzie. 2020). What has been overlooked is the emergency interventions that are required during flood events. If they become casualties, people trapped in floods in homes or outside homes need to be evacuated to safe locations or hospitals. Several factors come into focus, and prominent among these is the interplay between floods, the transportation or road networks and access to emergency response services.

Objectives

The main aim is to assess the interventions that are required during flood events.

Objectives are;

- Identifying the various emergency services
- Map out the emergency services using GPS
- Introducing new methods for mobility analysis,
- New techniques for predicting urban floods, and
- Devising policy and planning measures to advance the sustainable urban development agenda.

Materials and Methods

This study intends to draw on existing datasets gathered within the CLIMACCESS project, such as flood-prone locations and city-wide transport network. This will be complemented by field data on the location of emergency services such as:

a. Hospitals/Polyclinics
b. Police Stations and Posts
c. Fire Service
d. National Disaster Management Organization (NADMO)
e. Ambulance Services

Further, data would be compiled on the population to determine access to these service centres in the delineated localities or catchment areas.

These populations live within the localities or communities that fall within the flood areas, access roads and distances within which emergency services could be provided. Network analysis would be the geospatial tool to be applied.

Results Achieved So Far

1. A reconnaissance survey with the various agencies has been accomplished.
2. Area identified as flood spots (Blue spots) coordinates have been taken

3. Areas identified as safe havens or shelters in each study area have been identified and coordinates taken
4. Locational coordinates using GPS has been established
5. Spatial database for the locations, including flood spots, developed and draft maps produced.

Way Forward

- Literature on road traffic count is being organised
- Preparing to undertake road traffic count in places yet to be selected.
- Detailed write-up being organised with primary objective being revised
- GIS analysis of shortest routes

2.3 Material Science and Manufacturing

2.3.1 Poultry Incubator

Research Team: Twum-Barimah Y., Wilson M. & Gordon V.

Start Date: May 2017

Duration: 4 years

Sponsors: Not yet found

Collaborating Institution: Nil

Location: CSIR-INSTI

Introduction

Research on the possibility of using direct Sun Power as the main heating element for Bird Egg incubation with Solar Panel as the main power supply. The cost of egg production is highly reduced when free direct Sun is scavenged to produce the heat needed for the hatchery. In addition, the integrated Solar Power paves way for egg hatchery production to be established even in rural areas where there is no electricity.

Objectives

To provide efficient, high hatch rate, solar-driven and affordable Incubator for Poultry Farmers leading to an increasing bird production in support of food security and sustainability.

Materials and Methods

The previous top lid method has been modified such that a close contain setting is used. Styrofoam type container is used as the container. The power interface is designed to have Solar Power as the main Power Input. To arrive at the right parameter settings for excellent hatchery, a data logger results simulation is employed. For early warning and quick response action, a channel is developed for real time communication.

Results Achieved so Far

An incubating box, together with the control electronics are assembled together. The temperature setting seems fairly good. Inadequate Humidity values were measured.

Traditional methods were used but humidity values are still not stable. An ordered humidifier Control Set is received. Experiment with this new humidity set component is yet to begin.

Currently, the setup AC power source is from the mains supply. The solar power package is being determined and purchasing order is placed to acquire it. A normal Solar Setup includes Solar Module, DC – AC Invertor, Battery storage pack and charging controllers. Appropriate components within the power pack have to be determined and configured to deliver the exact power for incubation.

Way Forward

Experiment continues with the new set of humidifiers. Necessary modification will be made to this new product to fit to our setup. Some work will also be done on the Solar power with local products should they fit our calculations. Donors search to support the project also still continues as the project suffers serious financial support. Necessary writings and documentations on the project are also worked on alongside the main development.

2.4 Biomedical and Public Health

2.4.1 UV-C Pathogen (Virus)Disinfectant

Research Team: Twum-Barimah Y., Kessey M.B. & Osei-Atweneboana M. Y.

Start Date: May 2021

Duration: 4.5 years

Sponsors: Not yet found

Collaborating Institution: CSIR-WRI

Location: CSIR-INSTI

Introduction

Human encounter with some micro-organisms like mould, fungi, bacteria, and viruses could be harmful and sometimes deadly. They could be contracted from surfaces, food products, water bodies and in the atmosphere. Fatal ones could cause death within a short period of time. Throughout history, deadly bacteria and viruses have killed many. A small undetected outbreak could eventually lead to pandemic, killing many, leading to huge sums of money lost. These pathogens should therefore be well controlled and contained, preventing any further spread whenever it is identified.

The current Covid-19 outbreak caused many to lose their jobs, companies shut down, forced people to be quarantined in their homes, brought the transport sector (land, sea and air) to very minimal operations, halt many day to day activates and brought global operations to a halt. As at the time of writing, the Covid-19 Virus had killed millions of people around the world. Global vaccination has brought down the infection rate, yet the number of deaths keep rising. News report announced a new variant of the virus which is infectious at a much faster rate and more deadly. Researchers and Vaccine manufactures are waving the possibility of tweaking the existing vaccine to curb for the new variant.

Clearly, for total control in the containment of any deadly pathogen from further spreading, contribution from various experts with experience in control and containment of pathogens is very necessary to our survival against any deadly

pathogen. Lessons should also be learnt from current experiences in developing new methods and practices for much better approach in dealing with any future eventualities of such kind. Important tools and systems that help in dealing with such pathogens are necessary and need to be developed. In dealing with such global threats, tools and systems have to be agile, fast to deploy and cheap.

UV Light is known to impact life cycles of some mould, fungi, bacteria, and viruses.

Different types of UV lights are used for methods of sanitation, disinfection, and sterilization. Some research works have also identified the use of UV Lights in the killing of some pathogens. American Journal of Infection Control published a study of vitro experiment by HU researchers. The results showed that 99.7% of the SARS-CoV-2 viral culture were killed after a 30-second exposure to 222 nm UVC irradiation at 0.1 mW/cm2. Much more research work is needed to pin down the UV type, exact wave length, optimal time of exposure, and power of the intensity that impact the life cycle of other individual pathogens.

Actually, the main UV Light Rays covers the wavelength range from 100-400 nm on the light spectrum. This is further divided into three bands: UV-A ranging from 315-400 nm; UV-B ranging from 280-315 nm; and UV-C ranging from 100-280 nm. Works done so far report that the Far UV-C which range from 100-280 nm prove fatal to photosensitive pathogens. Perhaps, the Far-UVC technology may be one of the key tools in combatting future pandemics due to its impact on pathogens and ability to be deployed in occupied spaces. Predominantly, more research works are needed to identify the scale of UV parameters and hotspots for specific pathogens. The result could be used to build tools and equipment that are deployed during viral attack. Healthcare Centres, Aviation facilities, Hotel accommodations, industrial settings and all other entities that are critical for operations during viral attacks could quickly deploy UV-Tools in disinfecting spaces for operations to continue.

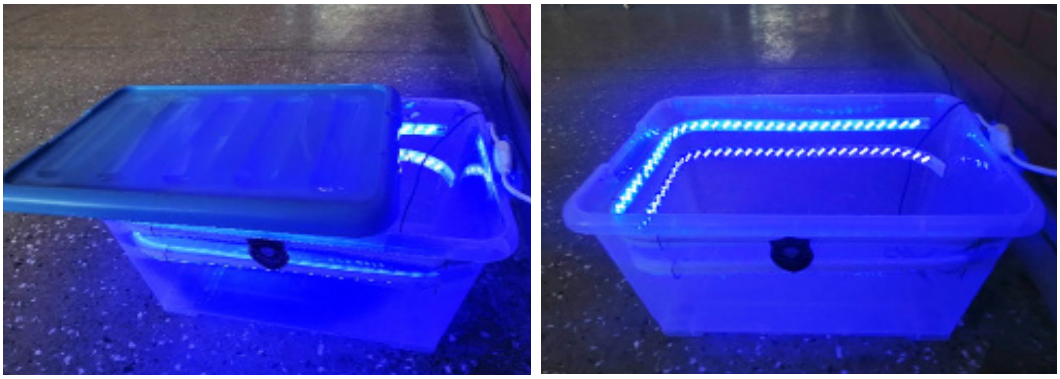
Objectives

To develop parameter set for UV Light Rays that can impact the life cycle of some individual pathogens. The pathogens include mould, fungi, bacteria, and viruses. Key parameters to derive from this study may comprise of the UV type, precise wave length, optimal time of exposure, and power or its intensity. Some other parameters could be developed during the progress of the study. It is important to identify, how

specific values of these parameters affect individual selected pathogens. It is also needful to know how specific effect and changes occur during the application of the UV Light, e.g. colour change, size shrinking, shape mutation etc. The final outcome of the experimental study is to arrive at values that kill harmful pathogens when exposed to UV Light Rays

The ultimate idea of the study is to lead to the design, construction of a UV-C Pathogen Disinfectant Robot. Parameter values obtained, may help with the analyses and the design modalities of the Robot. The approach evolves to the automation of disinfection processes using robots. Such Robots could be an important tool for healthcare Centres to kill and disinfect pathogens (viral) infected rooms and spaces.

Materials and Methods



UV-C Pathogen Disinfectant set-up

The initial experiment target remains the basic feasibility of the Project. The test is conducted for any effect of UV-Light on some selected substrates. The box shown in the above picture was constructed and used for the initial experiment. This is a transparent plastic box fitted with stripe of LED type of UV-C light. Since the LED Light failed to produce any impact on the substrate under test, UV-C light version with better power intensity is required.

Results Achieved So Far

The procedure was repeated at higher durations (2 hours, 3hours, and 4 hours) on a separate day but again there was no change in bacterial counts after each exposure.

After each exposure time period, the samples were incubated and allowed to grow. In principle, such an exposure is meant to kill the specimen preventing them from any further growth. However, there was no change in bacterial counts after each exposure and all samples used grew even after the 4 hours exposure to the UV Light rays. The conclusion is that, the wave length and intensity of the UV Light had no impact on the specimen

However, a search was conducted in the UV-C light market and a better version was found. Acquisition is made for the light to conduct the next experiment with same sample substrates.

Way Forward

Some work has to be done on the experiment setup to fit the electrical wiring and the UV-C light. New experimental box is being worked on to fit the UC-V light since this is of different shape and dimension from the previous one. The box also has to be mended to concentrate the Light intensity for greater effect in less time. Work is ongoing to achieve said results.

2.5 Electronics and ICT

2.5.1 A Review of Edge Computing Variants for Data Processing in IoT

Research Team: Wilson M., Boateng K.O & Nunoo-Mensah H.

Start Date: June 2021

Duration: 3 years

Sponsors: None

Collaborating Institution: KNUST

Location: CSIR-INSTI & KNUST

Introduction

The concept and term Internet of Things (IoT) was first proposed in 1998 during a talk show for Auto ID centre at the MIT by Kevin Ashton. The formal introduction of IoT however, was done by the International Telecommunications Union in the year 2005 through its seventh ITU Internet Report which was titled "Internet of Things" a new era of interconnectivity where today's internet of data and people give way to an Internet of Things. In its simplicity, an IoT application connects sensors and device with an "ON" and "OFF" switch to the Internet and gathers data from these sensors to intelligently control the switches of the connected devices. Cisco's April, 2011 report predicted that about 25 billion devices would be connected to the internet by the year 2015 and 50 billion in 2020. Cisco reviewed its projections to a prediction of 28 billion by the year 2022, up from 18 billion devices recorded in 2017 leading to global annual internet traffic of close to 4.8 zettabytes. Statista's publication in Jan, 2021 shows the number of internet of things (IoT) connected devices worldwide in 2018 had reached 22billion and projects the number to reach 50billion by 2030. This growth in the number of connected devices has been a major concern of many researchers across the globe and has been flagged as a major challenge.

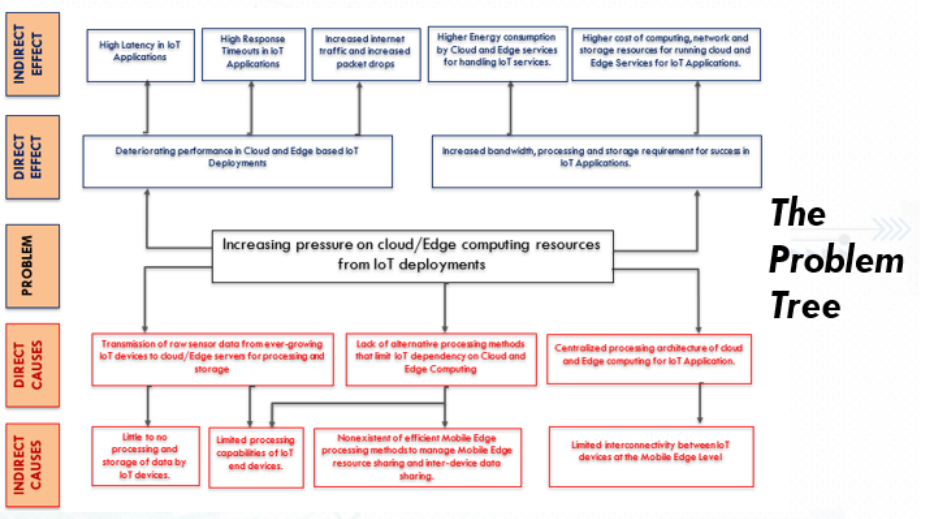
Over the past decade, cloud computing seems to have stamped its feet as the most used approach to offloading computing power in IoT applications. In a typical cloud architecture, raw data emanating from varying edge devices are transmitted through

high bandwidth data networks to remote servers for processing, storage, knowledge extraction, decision making and finally, sending of end results to same or other edge nodes for actuation. Cisco's projections however, show that with the current cloud and fog architecture, about a fifth of the global power generated will be required to transmit, process and store the huge volumes of IoT data by 2030. Furthermore, the success of many IoT applications like self-driving cars, Intelligent surveillance Systems, Digital Twins (DT), etc. impose response time constrained which are not met by even modern data networks. These solutions are currently constrained in their communication network requirements for ultra-latency with round-trip time in the order of 1ms and ultra-high reliability requirements. The above-mentioned high-end requirements are not met by the current fastest Long-Term Evolution (LTE) system which record latency values of 30-50ms round-trip time.

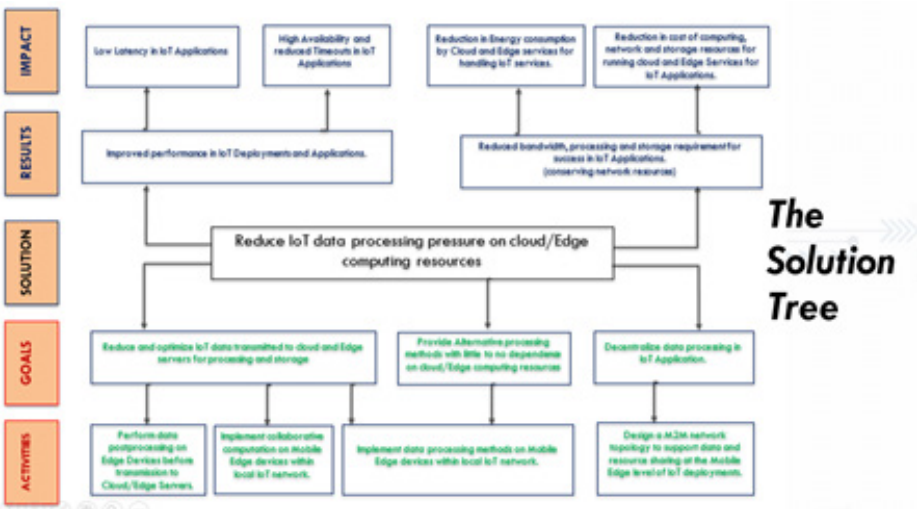
With the fast growth of the number of IoT devices it is evident that IoT data handling and processing has placed significant pressures on computing and communication facilities. This has driven many researchers to look into either improving data networks to meet the demands of IoT or to shift from cloud computing architecture into other computational methods for IoT implementations. The former approach addresses the problem of latency and response time constraints without touching on the problem of power expended in transmitting processing and storing of IoT data. In addressing these problems, works in Edge computing, Mobile Edge Computing and Edge-Cloud computing, argue that we are at a point where edge devices have adequate processing capabilities to be part of a global collaborative data processing architecture for IoT applications. Edge computing relies on servers with less power but closer to IoT devices for computational tasks. Mobile Edge computing on the other hand, depends on computing power provided by IoT devices and other mobile devices like mobile phones. Edge-Cloud computing orchestrates a hybrid of edge and cloud computing. Edge computing, however, is still in its early days and factors such as resource management, computation optimization and its implementation architecture are still open to research studies.

Objectives

The problem being addressed by this research has been developed and is captured in a problem tree as shown below:



A corresponding solution tree capturing the objective and how it will be achieved within the research scope is captured in the solution tree below:



Materials and Methods

The methodology is to review current edge computing paradigms adapted as solutions to the unsustainable bandwidth requirement and unacceptable latency with current use of cloud computing for data processing in IoT implementations. The main

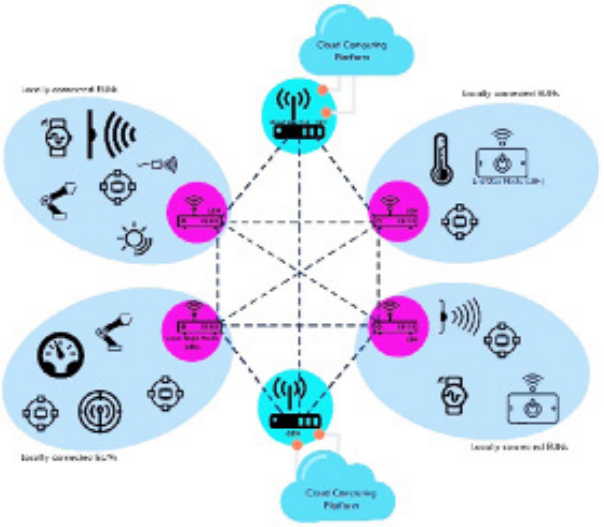
contribution of this survey work is to detail current status, challenges and unaddressed issues in the use of edge computing paradigms for data processing in IoT. Another contribution of this work is to identify key data processing methodologies for IoT data processing and to discuss the challenges, opportunities and open questions among the reviewed variants of data processing at the edge for IoT.

Results Achieved So Far

Participating Scientists have requested that we review more papers before submitting the survey paper for publication and this is being done.

A drawback identified with the solutions reviewed is that edge devices in the architectures discussed serves as the decision-making unit within the mobile edge devices independently or data sent to the edge servers by IoT nodes have no dependency linkages and are therefore pre-processed in exclusive sandboxes. For this reason, minor decisions which could have been taken by a mobile edge device will still have to happen on a cloud server if the decision depends on data from multiple nodes. Also, data pre-processing for mobile edge nodes is limited to data from sensors connected directly to the edge device. Admittedly, the reviewed works improve the traditional cloud architecture where raw data from edge nodes are pushed to the cloud, but the solutions proposed are not optimal as explained above.

The research work is being extended to address the problem by proposing a Mesh-IoT Network that consists of Radio or wireless nodes with embedded multifaceted wireless and/or wired network interface module interconnected by a hybrid mesh network architecture having three data processing tiers logically represented as below as a way to reduce IoT applications dependency on the cloud while improving response time:



Tier – 1: End User Nodes (EUN)

- Each node at this tier level is programmable to runs a self-contained reusable software piece that includes an application, defined input data sources (directly connected sensors or MQTT derived data) and data sinks where output data is pushed to or stored (on same or different node).

Tier – 2: Local Edge Nodes (LEN)

- Each Local Edge Nodes (LEN) operates similar to a tier-1 anode and plays the following extra roles:
- Data forwarding to remote nodes outsides the reach of local network coverage. The LEN is equipped with wide range communication technologies like LoRA to support its routing service provisioning.
- Running MQTT Broker software for data aggregation and distribution services within the local network
- Support and Utility Services (Eg. Data pre-processing and encryption services)

Tier – 3: Global Edge Nodes (GEN)

- Global Edge Nodes (GEN) connect to selected LEN in a mesh structure and serve as gateways for the (ME-IoT) network to the internet or remote servers.

GENs also render tier-3 data processing services as part of the ME-IoT network architecture.

- Tier-3 data processing services may include some high ended data processing services like machine learning and artificial intelligence computations.

Our proposed Meshed-Edge-IoT (ME-IoT) architecture makes it possible for edge IoT nodes to selectively subscribe to data from other nodes through a directly connected or remote MQTT broker. This allows for processing and making decisions for controlling its connected actuators based on data from multiple edge devices. Local Edge Nodes (LEN) in our ME-IoT architecture receive post-processed data from multiple End User Nodes and perform a second level of pre-processing on this data for cases where data dependencies and processing power allow for further processing and a second level of decision making. The final processing tire (GEN) performs data processing beyond the capacity of the EUNs and LEN as well as serve as a gateway for nodes within the ME-IoT to reach the cloud in situations where cloud computing resources are required. Output from any node (EUN, LEN or GEN) can be a control signal that controls a directly-connected or remote actuators. Node outputs could also be pre-processed or processed data to be stored or pushed to another node or high-end server for further processing and/or storage.

Way Forward

The research work being carried out is to setup a test-bed using Arduinos and ESP32 microcontrollers as EUNs, Raspberry Pis as LENs and FPGAs/ Raspberry Pis as GENs. An AWS is deployed for cloud computational tasks. MQTT is used as the communication protocol for inter-node communication within the ME-IoT network and to carry out Optimization experiments with the proposed architecture aiming at:

- Balancing computational tasks at the edge level of each tier to reduce data transmission to higher tier nodes and the cloud.
- Efficient task scheduling within the ME-IoT network nodes for faster response while minimizing dependence on the cloud.

2.5.2 Cell Phone Signal Booster

Research Team: Danquah P.A, Prikutse F., Gordon V., Wilson M.&Twum-Barimah Y.

Start Date: June 2020

Duration: 2 years

Sponsors: In search

Collaborating Institution: None

Location: CSIR-INSTI

Introduction

Cellular signal is broadcast from towers that are installed by the Mobile Network Operator (MNO)s. The closer you are to a tower, the stronger the cell signal is going to be. As you move further away from the tower, the signal becomes weaker, which we call attenuation, until at some point it is too weak to hold a call or transfer data. Being too far away from a cell tower is the most common reason for weak cell signals and the one you will often experience if you live or travel in very rural areas, in the basement of buildings and the corners of some rooms.

The presence of obstacles also causes poor or erratic cell signal. Obstacles such as a mountain, hill or building between the cell tower and the cellular device will result in a weak signal. One may also experience this cell signal problem if the cellular device is at the bottom of a valley or underground. The signal is not usually able to penetrate through large obstacles. The cell signal may bounce off other hills or buildings and reach the cellular device through reflection, in which case the received signal will be weaker and may fluctuate up and down, or may go off completely.

One could also experience weak or poor signals as a result of the construction materials that make up the building or vehicle in which the cellular device is. Brick, block, concrete, sheet metal and wire mesh are some of the construction materials that are known to block cell phone signals. In certain areas, the cell signal outside the building may be usable but drops significantly once the cellular device gets into the room.

- This project seeks to design and construct a cellular booster or amplifier that will enhance mobile phone signal reception in areas where the cellular signal from the MNOs is very weak. The cell phone signal booster will improve weak signals from any of the MNOs in Ghana and will be useful in rooms, basements, compounds and any other location where MNOs signals are weak.

Objectives

- To design a cell phone signal booster for Mobile Network Subscribers (MNS) in Ghana.
- To build a cell phone signal booster for subscribers of Mobile Network Subscribers (MNS) in Ghana

Materials and Methods

This project is broken down into the following: The design stage, the drawing and simulation stage, the construction stage and the testing stage.

The design stage will help in determining the values of each component to be used in the circuit. Software such as TinyCAD, OrCAD, EAGLE among others will be used in designing Printed Circuit Boards (PCB). For the purpose of this project, Dip Trace software will be used to design the PCB. It has four modules which include schematic capture, component, pattern editor, 3D modelling and PCB Layout editor. It also supports Windows, Mac, and Linux.

The cell phone signal booster circuit will be drawn using Advanced Design System (ADS) Radio Frequency (RF) software. Simulation will be done with this same software.

After obtaining desired results, the circuit will be constructed on a printed circuit board with the components that were determined during the design stage. An input antenna will be built from scratch, and used alongside an existing output antenna.

The cellular signal in decibels (dB) prior to boosting will be measured and compared to the cellular signal after boosting. This will form part of the testing stage and will be done repeatedly in order to arrive at conclusive results.

Results Achieved So Far

A Conference paper titled “An Optimal Low Noise Amplifier (LNA) design for Signal Boosting” was successfully presented and accepted for publication in conference

proceedings at the International Conference on Mechatronics, Remote Sensing, Information Systems and Industrial Information Technologies organised virtually by Institute of Electrical and Electronic Engineers (IEEE) from 20th to 22nd December 2020.

The cell phone signal booster project is still in progress. It is intended that the design of the low noise amplifier will be improved and a prototype subsequently built subject to availability of funds.

Way Forward

Further designs and simulations will be carried out with the help of Advanced Design System (ADS) and Multisim software. Beyond this phase will then be the determination of a more optimal component combination/configuration and the physical construction of the circuit (prototype) and testing.

2.5.3 Towards an Automated Moderation of Abusive Comments: The Case of Ghanaian News Sites

Research Team: Laryea B., Danquah P.A, Gordon V. & Prikutse F.

Start Date: November 2020

Duration: 24 months

Sponsors: In search

Collaborating Institution: None

Location: CSIR-INSTI

Introduction

Traditional news delivery is a one-way transmission, which is from the producer to the consumer and not vice versa. The advent internet and the birth of web 2.0 have made news delivery a two-way information transmission. The online commenting feature on news articles on websites is a must-have feature. This seeks the views of the audience on the subject matter. However, allowing user-generated content

such as comments creates uncertainty on the quality control of the content on the site as the users who are free to give their opinions on articles are not in a controlled environment with checks and balances. Online abuse and trolling are on the rise and news sites have set up techniques to control their space. In Ghana, news sites have their means of checking their audience's content; however, they find it hard to control content in local languages. The news sites only focus on content in the English language and also third party services. Whiles others provide filters for only content in the English language.

Objectives

- Automate the moderation of abusive comments on Ghanaian news sites
- To build a machine learning engine that automatically learns about abusive language on Ghanaian news sites.

Materials and Methods:

The source data will be collected from Ghanaian news websites, it is projected that a minimum 12000 and a maximum of 25000 comments will be collected. Scrapping of the data will be done using Jsoup, which is a Java library for working with real-world HTML. It provides a very convenient API for fetching URLs and extracting and manipulating data, using the best of HTML5 DOM methods and CSS selectors. A java program will be written to scrap comments from the comments links stored in the database (MySQL). The comments will then be manually annotated by two possible categories namely abusive and non-abusive in addition to cataloguing specific abusive words. The annotator will be built using Java Springboot with Thymeleaf template engine. Upon successful annotation, different classification techniques namely; naïve bayes and language model machine learning processes will be used to train and learn the abusive language for testing.

Results Achieved so Far

The project focuses on tackling abusive comments on Ghanaian websites and blogs. We sourced our training data from comments from GhanaWeb and used the language model machine learning technique to train and evaluate the result trained model. Our trained model recorded 78% accuracy with 2.498% margin of error. It also

showed a confusion matrix of 78% True Positives, 22% False Negatives, 22% False Positives and 78% True Negatives.

Way Forward

Further modelling will be done using the Naïve Bayes classification technique for testing.

2.6 Science and People

2.6.1 Colour Preferences Among Selected Adults in Ghana

Research Team: Adjah J., Bekoe S., Decardi-Nelson A., Ry-Kottoh L. & Kalognia J.

Start Date: October 2019

Duration: 18 months

Sponsors: Nil

Collaborating Institution: Nil

Location: CSIR-INSTI

Introduction

The changing world of technology has diversified the use and application of colour in printing publishing, product design, and architecture. Colour makes a significant impact on a final product as it is employed in designing, printing, and production of various artefacts. Many people express how they feel through the colours they choose as colour carries meanings that go beyond mere valuation. Globally, colour is used in all areas of endeavours, because they communicate emotions and philosophy. In Ghanaian traditional functions, for example, colours regarding the rites of passage like black and red are used for mourning. The use of colour in emblems represents the philosophies of a group or society. The Ghanaian national flag is made of two hues and one achromatic colour viz; red, yellow, green, and black – red symbolising the blood of the forefathers who fought for political freedom (Akansina, 2011); gold symbolizing the rich mineral resource (Bowell, 1992), green for her rich forests and natural wealth (Alastair et al., 2016); and black for the African race/heritage. Colours are used in all production or manufacturing processes. In advertising and marketing, consumers can develop preferred colour associations for a particular product category (Amsteus et al., 2015). The goal of this research is to explore colour preferences from a cross-section of Ghanaians by employing two theories (Ecological Valence and Hunter-Gatherer theories) as reference points. This study employs a set of variables (sex, hobbies, change of colour over time) that gives a different dimension about subjects in Ghana.

Research Questions

- Is colour just a mere expression of emotions or is it influenced by other factors?
- Is a favourite colour likely to change over time?
- What are the common colour preferences among adults in Ghana, as compared to results from other studies?

Materials and Methods

This study employed both qualitative and quantitative method of data collection. The data collection instrument designed for this study is a questionnaire adopted from Bakker et. al (2013). The questionnaire gathers demographic information and also requires participants to answer general and specific questions about their colour preferences. Data collected from the questionnaires were analysed in SPSS.

Sample size

To achieve the set objectives, the researchers purposively sampled 159 adults consisting of males and females from close sources. The researchers believed that the adult population will serve the purpose of this study. These participants were workers with different professional backgrounds eg; engineers, administrators, accountants to mention but a few. Ages were grouped into three categories namely: 25-35, 36-45, and 46-60 to represent young, middle, and old. Age restriction to 60 years was due to visual deficits in old age (Ishiharea et al. 2001).

The two tests were conducted within six months. The first test involved a presentation of printed questionnaires to participants. A total of 150 questionnaires were administered but only 50 participants answered. The test was repeated and 109 responded because it was administered via social media platforms which made it easier for them.

A simple multiple-choice and interactive procedure of selecting primary, secondary, and tertiary colours from the colour wheel, bearing in mind the properties of hue, chroma, and value as used in the Berkeley Colour Project (Schloss et al. 2010; Bakker et al. 2013; Baniani et al, 2014) was used. This procedure of simply selecting colours is common in literature because it is the first step to get information about colour preferences (Hurlbert & Ling, Annamary et. al, 2016, Bonnardel et al., 2017). The

addition of a CYMK colour palette as a reference in the questionnaire makes it more convenient for participants to answer questions as compared to CRT displays. A maximum period of two weeks was allocated to a participant to fill the forms. Other details that were captured included sex, professional background, hobbies, change of colour over time, general favourite colours, and specific colour preferences. Data collated from this assessment were first coded to numerical and ordinal values in Microsoft Excel and Stata. Subsequently, they were presented in charts and tables for further discussion.

Results Achieved so Far

This study found colour as a driving force and expression of people's emotions; whether it changes overtime or not. The results are both congruent and incongruent with previous studies that postulate colour preference as being an effective response to objects in the environment viz Ecological Valence Theory (EVT); Palmer and Schloss (2010) and Hunter-Gatherer Theory (Crozier, 2008).

Preference for hues like blue was found to be the most preferred by participants in this study. Categorically the majority of female respondents preferred blue and pink hues. The preference for blue seems to be a global phenomenon that relates to the natural environment; as such, most of the participants (both males and females) selected it.

The effect of hue, value, and chroma also influenced the preference for specific objects. Light yellow and achromatic colours (grey/black) were most preferred. Also, in the regression analysis, it was found that respondents with indoor hobbies were at a lower risk of choosing mostly bright colours. Lastly, males were found to prefer an equal blend of colours as compared to females who preferred mostly bright colours. Results of this study offers an insight for design practitioners because it gives a general idea about colour preferences among Ghanaians, and also a pedestal for future research. The focus of this paper was on adults and so it may not be a good representation for all age groups. Even though the number of specific objects mentioned are few, designers can fall on these results as a reference guide.

Way Forward

Researchers are currently reviewing the article after comments from reviewers.

2.6.2 Population Dynamics and Land Use/Land Cover Change in the Lake Bosomtwe Basin

Research Team: Annor J. & Allotey A.N.M.

Start Date: January 2020

Duration: 1.5 years

Sponsors: CSIR-INSTI

Collaborating Institutions: Environmental Protection Agency (Man and Biosphere Reserve – MAB)

Location: CSIR-INSTI, Accra

Introduction

Land use and land cover are closely related terms that are often used interchangeably (Anderson et al., 1976), but are not the same. Land cover relates to the physical nature or form of the land surface (Mather, 1985). In its broadest sense, it encompasses vegetation, water, desert, ice and other physical features of the land including those created by man (Skole et al., 1994; Rawat & Kumar, 2015). Land use, on the other hand, describes the way and the purposes for which human beings employ the land and its resources (Lambian et al., 2003).

Together, land use and land cover have important implication for the global environment. Land-use changes result in land cover changes that affect biodiversity, ecosystems, water, radiation budgets, trace gas emission and other processes that come together to affect climate and the biosphere (Townshend et al., 1993; Riebsame et al., 1994 cited in Rawat & Kumar 2015; Lambin, 2003). Ghana, like many other developing countries, has been experiencing major land cover changes.

The lake Bosomtwe which lies 33.8km (21miles) south-east of Kumasi, the capital of the Ashanti region has not been left out of this menace. This study attempted to quantify the effects of population dynamics on the observed land use and land cover changes in the Lake's basin over 35 years.

Objectives

- To identify the types of land use and land cover in the Bosomtwe basin
- To investigate the extent and trend of land use and land cover change in the basin
- To examine population trends and their association with land use and land cover changes.

Materials and Methods

The study will use multi-temporal satellite images of 1986, 2007, and 2018 from the USGS for land use/cover analysis. Census data of the same period from the Ghana Statistical Service will be used to analyse population dynamics.

The study area is contained within the Landsat path 195, row 55. The selection of the satellite images would greatly influence the quality of the image especially for those with limited or low cloud cover.

On-screen digitisation would be used to capture the boundary of the lake from the 1986 image using ArcGIS 10.5 software. The digitized boundary of the lake boundary of would then be used to create a 5km buffer zone around the lake. The 5km buffer layer would be used to subset the study area from the Landsat scenes of 1986, 2007 and 2018.

The subset images would then be classified using the supervised classification technique. Before this, a classification scheme would be developed.

Census data would be acquired from Ghana Statistical Service and analysed by observing trends over the years. A relationship would be drawn from the population data and observed changes in land use/land cover.

Results Achieved So Far

1. Satellite images downloaded, processed and analysed.
2. Change analysis within the classified images has been accomplished.
3. A brief write-up on land use and land cover changes in the study area has been done from the land use and land cover statistics that have been generated from the three classified images.

4. Population data from Statistical Service has been acquired and analysed.
5. Field validation of the classified land use and land cover images completed in December 2020
6. Satellite image of 2020 classified and land use/cover statistics generated
7. Draft technical report and manuscript completed

Way Forward

Revising manuscript for publication.

3.0 PROGRAMMES & ACTIVITIES

3.1 Communications

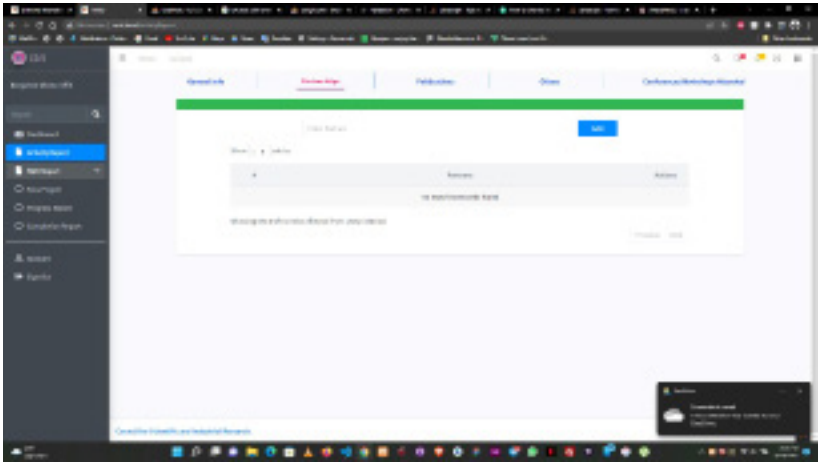
The Communications Division has the mandate to research and develop tools, equipment and communication systems aimed at solving electronics and communication problems for national development.

CSIR Online Grants Management Software, Profiles Management System and Promotions Management System Software

Management of all three (3) software developed internally by the Communications Division was carried out by same to ensure smooth usage and operation. Though trainings had been carried out previously, staff were constantly available to assist in answering questions and giving tutorials. The Profiles Management System is public and can be accessed at profiles.csirgh.com.

CSIR Online Reporting Management

The Online Reporting Management Platform aims at digitally monitoring Research and Development as well as Activities within the Institute. It is being developed in conjunction with the Electronics Division. Future plans include expanding its operations to allow digital monitoring within the Council from Head Office. As at the end of the year, the online platform was 80% complete.



Snapshot of an interface from Online Reporting Management Platform

3.2 Electronics

The mandate of the Division is to research into the development of next-generation electronics tools aimed at solving electronics and communication problems for national and social-economic development.

CSIR-INSTI Makerspace & Robotics Training Programme

Weekend Robotics Training with all COVID-19 protocol observation continued throughout the year following the easing of restrictions by government. Trainings happen at CSIR-INSTI on Saturdays from 9:00 am to 12:00 pm with an optional 2-hour slot for practice within the Makerspace facility on Wednesdays between 2:00 pm and 4:00 pm.

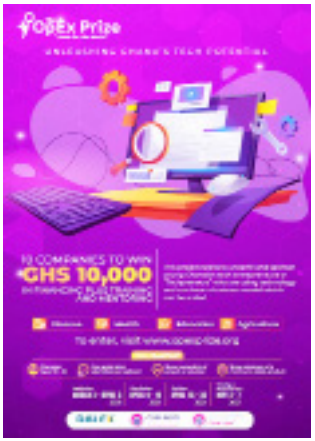
MAG DAIH Media Training

With support from MAG, CSIR organised a maiden training programme for Media on usage of the Digital Agriculture Innovation Hub (DAIH). The training programme falls under the "Knowledge Series" aimed at building a professional relationship with journalists to make them better advocates of science and research. The Head of the Electronics Division, Ing. Michael Wilson trained participants on the functionalities of the four digital solutions currently running under the DAIH.

OpEx Prize – Makerspace

CSIR-INSTI entered into a partnership with the OpEx (Opportunity and Exposure) Prize competition to host ten (10) selected techpreneur teams for a period of six months. The OpEx Prize seeks to unearth and sponsor young Ghanaian Tech entrepreneurs/ Techpreneurs who have a business model which can be 'scaled'. This is done mainly through direct and matching cash, infrastructure and knowledge support to identified companies and individuals for the testing and up-scaling of innovative products, services or solutions in the Tech domain.

The Division worked with the OpEx Prize team in selecting the top ten teams who became finalists of the challenge after twenty shortlisted applicants had pitched to a panel of judges. A one-week training programme on marketing, software engineering, etc. was also held for the winning teams.



OpEx Prize Poster

Training Session of the ten selected Techpreneurs

Pitching Session of OpEx Applicants

The following links captured media reportage on the OpEx prize competition:

- https://www.opexprize.org/
- https://www.myjoyonline.com/the-opex-prize-competition-launches-in-ghana/#:~:text=About%20The%20OpEx%20Prize,which%20could%20be%20scaled%20up.
- https://www.techgistafrica.com/entrepreneurs/the-opportunity-exposure-opex-prize-competition-launches-in-accra-for-young-ghanaian-techpreneurs/
- https://www.africa-press.net/ghana/community/the-the-opex-prize-competition-launches-in-ghana

MAG DAIH Awareness Creation amongst Agricultural Extension Officers and Farmers

The MAG Team in collaboration with the Electronics and Communications Divisions carried out a series of awareness creation among Agricultural Extension officers and Farmers in the Greater Accra, Eastern, Central, Volta, Western, Western North, Ashanti, Bono, Upper East, Upper West and Northern Regions, on the four developed MAG Deliverables. A three-paged flyer on usage of the Kuafo App was also designed and distributed during the sessions.

DAIH Awareness at Koforidua, Eastern Region

DAIH Awareness at Bolgatanga, Upper East Region.

DAIH Awareness at Sefwi Wiawso, Western North Region.

DAIH Awareness at Takoradi, Western Region.

DAIH Awareness at Cape Coast, Central Region.

DAIH Awareness at Accra, Greater Accra

DAIH Awareness at Ho, Volta Region.

Television and Radio stations also interviewed staff of the Division as content for documentaries on the MAG Deliverables.

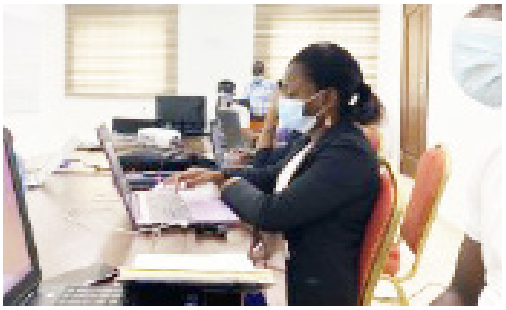
Ing. Michael Wilson explaining the Agritech App to the Media

Ing. Michael Wilson explaining DAIH to the Joy News Reporter

The Director, Dr. Seth Awuku Manteaw making an input into the MAG documentary

HACKATHON 2021

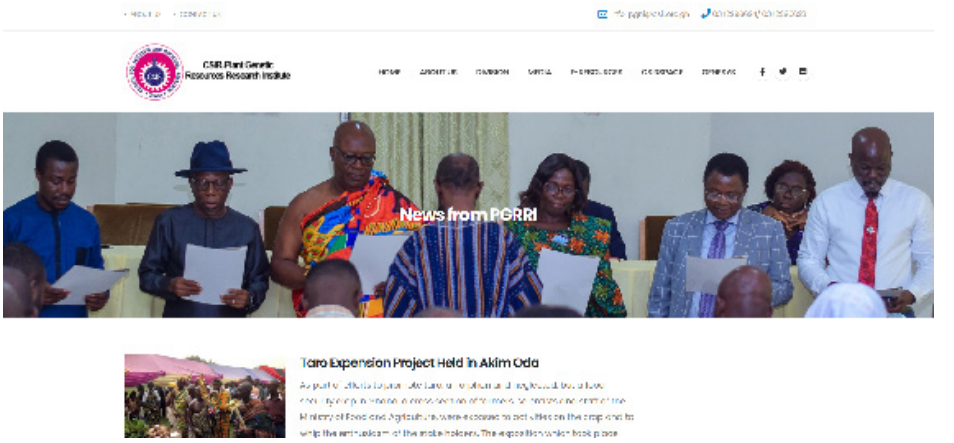
Staff of the Communications and Electronics Divisions as well as other key staff underwent a one-week training on web development and support for the applications behind the MAG Deliverables to assist in their operationalisation and maintenance. GIThub, java and HTML were some of the programming languages and technologies staff were trained on. The core team also took the opportunity to produce a Minimum Viable Product (MVP) for the E-Learning Platform and to make changes to the web version of the Agritech Advisor. The programme took place at MTN lab of the Ebenezer Secondary School, Dansoman from 6th to 14th September 2021.



HACKATHON 2021 Training Sessions

Website Development

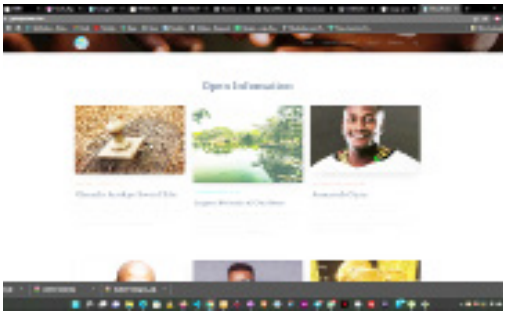
The Division was awarded the contract to design and develop a website for the Plant Genetic Resources Research Institute (CSIR-PGRRI).



Some pages from the PGRRI Website

Development of the Ghana Portal Mobile App

The Ghana Portal Mobile App aims to drive tourism in both rural and urban areas into homes where people and artifacts can be located during activities such as festivals or funerals which take place in those locations. The app which is 90% complete has features such as web-view, geofencing, maps and clusters and QR Code scan. It brings on board a location-based tourism advertising and embeds a direction and navigation map service that guides users to tourism sites. Location based tourism advertising is implemented as a notification service that alerts users anytime they drive through or get within a 50 km radius of a Ghana Portal Tagged Artifact or Tourist Site nationwide. The Ghana portal Mobile App will soon incorporate a section that allows citizens to alert and help editors authenticate and document forgotten heroes, heroines, historic artifacts and historic sites. Arrangements are being made to launch the Ghana portals QR-Cods at tourist sites.



Ghana Portal Home and Information pages

37th National Farmer's Day Celebrations

The year's 37th National Farmer's Day Celebrations held from 29th November to 3rd December 2021 at Cape Coast saw the Director, MAG Focal Person and Head of Electronics Division representing the Institute. Details of the MAG deliverables were explained to attendees. Staff were also interviewed by Mr. Anim Addo of UTV.

Head of Electronics Division, Ing. Michael Wilson interacting with some students at the 37th National Farmer's Day celebrations

3.3 Fluid Science

The Fluid Science Division has the mandate to design and produce fuel cell for the production of Brown's gas for energy generation, to introduce water in the Ghanaian fuel mix through the use of fuel cell and to design and conduct experiments on fluids, as well as to analyse and interpret data.

3.4 Geospatial and Information Science

The Scientific Information Management Section (SIMS) and the Geographic and Information Systems Section (GISS) are the two sections under the Geospatial and Information Science Division (GISD).

3.4.1 Scientific Information Management Section

This Section provides scientific and technological information services for the CSIR and analogous institutions, learned and professional associations and societies, the industrial sector, students and the general public under the collection development, cataloguing and classification and user services technical sub-sections.

3.4.1.1 Collection Development Sub-section

Responsibilities of the Collection Development sub-section include acquiring books, collecting data, print and electronic resources of science and technology information and other science materials for the library. It is also in charge of providing specific and general guidelines for the selection and acquisition of new materials through purchases, exchanges, soliciting or donations, legal deposit or through subscription and collaboration. The sub-section feeds all databases created by the Scientific Information Management Section.

3.4.1.2 Cataloguing and Classification Sub-section

All materials acquired from the Collection Development sub-section are catalogued, classified, labelled and data entered on all documents received into databases by the Cataloguing and Classification sub-section. Statistics of materials received during the year are captured in Table 3.1.

Table 3.1: Summary of statistics of materials received in 2021

Type of Material		N° of Copies Received	Percentage
Theses		72	3.39
Journals		53	2.50
Newspapers	Daily Graphic	848	39.92

	Ghanaian Times	848	39.92
	Weekly Spectator	144	6.78
	Weekly Mirror	144	6. 78
Annual Reports		15	0.71
Total		2124	100

3.4.1.3 User Services Sub-section

The user services sub-section is a public service counter where users are provided direction to library materials, expertise on multiple kinds of information from multiple sources and advice on library collections and services. The section assists clients in the identification and retrieval of information to satisfy user needs. These services are provided through both digital and manual information retrieval of books, periodicals, abstracts, theses, newspapers and reference materials for scientists, consultants and students. Manual searches are done, while search engines such as Google, Dogpile, Yahoo and Yandex are used for digital searches.

The section retrieves information for clients using foreign databases including; Access to Global Online Research in Agriculture (AGORA), Health Inter-Network Access to Research Initiative (HINARI), Online Access to Research in the Environment (OARE), Journal Storage, African Journals Online (AJOL), PubMed, Directory of Open Access Journals (DOAJ), Proceedings of the National Academy of Sciences (PNAS), Bioline International, Open Directory – Science: Agriculture: Publications: Journals. The section has also benefited from The Essential Electronic Agricultural Library (TEEAL) distributed freely by the TEEAL Project at Mann Library, Cornell University.

The User-service also offers services in Referrals, Research Advisory, Selective Dissemination of Information (SDI), Current Awareness and Question and Answer.

CSIR Space/ DSpace

The DSpace is a digital service/repository that collects, preserves, and distributes digital material. Repositories are important tools for preserving an organization's legacy; they facilitate digital preservation and scholarly communication. Currently, the Scientific Information Management Section has entered One thousand, three

hundred and eleven (1,311) research articles published by CSIR research scientists into the CSIRSpace. These articles are searchable all over the world.

3.4.2 Geographic Information System Section

The mandate of this section is to collect data for the design and construction of Thematic Maps on Ghana at the national, regional and district levels. The Section is also to answer to the need of clients for special or customised maps and to use existing capacities to train individuals and institutions on techniques of spatial data documentation using Geographic Information.

Spatial Database Development on the Resources in Ghana

Mapping Activities

Composition of Regional Maps

A CSIR Institutes and Field location map of Ghana was produces for the Deputy Director-General of the CSIR. Information on the map included the distribution and location of the thirteen (13) Institutes of the CSIR as well as their Field Stations.

District Administrative Map of Ghana Update

The two hundred and sixty administrative boundaries of district/municipal/ metropolitan assemblies, as well as their capitals have been captured and spatial database completed.

Regional land use/ cover mapping

Landsat scene, Path 195 and Row 54 covering parts of Bono, Bono East and Savannah Regions were classified.

Client Services

The following customized maps were designed and produced for WINMAT publishers

i. Ghana: Distribution of Major Resources

ii. Ghana: Naturally Resource Endowment

The maps contained information on the distribution of natural resources including;

gold oil, diamond, bauxite, manganese, clay, timber and other resources like; natural and forest reserves, sea & river ports, communication network, airports, hydro power stations among others.

Dams and Reservoirs

Preparation of discrete regional maps depicting features of dams and reservoirs within the country as captured from the Landsat satellite images are being worked on. All these regional maps have been prepared in the layout view. So far regions worked on are Ahafo, Ashanti, Northern, Upper West and Upper East.

3.5 Printing and Publishing

The Printing and Publishing Division is mandated to provide printing and reprographic services for the production of scientific, technical literature and other printing services and products to support the socio-economic development of the country. Activities of the Division include;

- Designing, receiving and generating quotations for clients.
- Printing, collating, folding/ binding and delivering jobs to clients.
- Editing, typesetting and proofreading of manuscripts submitted by researchers for publication.
- Writing reports, technical correspondence and distribution of print journals.

3.5.1 Printing Section

The section executed to perfection the following internal and external designing, editing, typesetting and printing jobs:

Table 3.2: List of main projects implemented by printing division

Nº	Client	Description of Job
1	CSIR – ARI	Call Cards (Mr. Japhet Otchere Gyamfi Geraldo)
2	CSIR – BRRI	Letterheads
		Flat Files
		Vehicle Requisition Log Book

3	CSIR – CCST	Orientation and Matriculation Programme
		Letterheads
		Flat Files
4	CSIR – DG	Call Cards
5	CSIR – FORIG	Call Cards (Prof. Daniel A. Ofori)
6	CSIR – Head Office	Call Cards (Mrs. Josephine Eyra Geraldo)
		Citation – Best Worker Award
		Book – Certificate of Proposal for Election to Fellowship Director-General
		Banner – CSIR Welcomes Korean Ambassador
		Banner – Launch of Digitized Soil Maps of Ghana Ambassador
		Flat Files
		Letterheads
7	CSIR – IIR	Call Cards (Director)
8	CSIR – INSTI	Letterheads
		Kuafo Market Place Manual
		2020 Annual Report
9	CSIR – RSA	Posters
10	CSIR – STEPRI	2020 Annual Report
11	CSIR – WRI	Call Cards (Prof. Mike Yaw Osei-Atweneboana)
12	Dr. Paul A. Danquah	Book: System Administration and Security

Samples of products from the Printing Section

3.5.2 Science Publishing Section

This Section is mandated to publish the *Ghana Journal of Agricultural Science* (GJAS) and *Ghana Journal of Science* (GJS) as well as other S&T literature emanating from the national and international scientific community. It is also mandated to conduct R&D projects aimed at aiding policy decision-makers, the scientific publishing industry, planners, researchers and the general public. GJS and GJAS are Open Access Journals, distributed under the terms of the Creative Commons (CC) License [CC BY 4.0]. Guidelines for Authors and templates for the Ghana Journal of Agricultural Science and Ghana Journal of Science can be downloaded from the CSIR-INSTI website via the respective links: http://insti.csir.org.gh/gjas.php and http://insti.csir.org.gh/gjs.php

Ghana Journal of Agricultural Science (GJAS established in 1961)

The Ghana Journal of Agricultural Science Vol. 56 (1) and (2) (2021) were published on the AJOL website. Details of published articles are given below:

Table 3.3: Articles published in Vol 56 (1) (2021) of the GJAS

N°	Title	Authors
1	Seed Management and Quality of Farmer Saved Seeds of Bambara groundnut from North Western, Northern and Eastern Uganda	M. Obura G. Oballim J. O. Ochuodho F. N.W. Maina V.E. Anjichi
2	Yield, Biochemical Properties and Cooking Quality Traits of Sweet Potatoes (Ipomoea Batatas) as Affected by Nitrogen and Potassium Fertilizer Rates	C. Darko S. Yeboah A. Amoah A. Opoku E. Baafi J. N. Berchie
3	Characterization and Land Suitability Evaluation for Cocoyam in Southern Nigeria	M.E. Nsor A.E. Akpan
4	Assessment of Perceived Effects of Climate Change on Rice Production Among Farmers in North-West Zone, Nigeria	D.H. Yakubu J.G. Akpoko M.O. Akinola Z. Abdulsalam
5	Evaluation of Poultry Manure, Cattle Dung, Water and Cattle Urine-Based Composts on Soil Chemical Properties, Growth and Yield of Amaranthus cruentus L.	F. A. Olowokere B. Akinbinu

6	Population Dynamics of Chrysichthys nigrodigitatus (Lacépède, 1803) in Ikere-Gorge, Oyo State, Nigeria	S.O. Ajagbe D.O. Odulate R.O. Ajagbe O.S. Ariwoola F.I. Abdulazeez O.O. Oyewole M.T. Ojubolamo I.O. Arabambi I.E. Odiaka B.O. Fadimu A.O. Olomola O.A. Ganiyu O.O. Oyekan
7	Efficacy of Tank Mixture Glufosinate Ammonium and Indaziflam for Weed Control in Oil Palm	F. Ekhator C.O. Okeke O.A. Ogundipe B. Ahmed C.E. Ikuenobe

Table 3.4: Articles published in Vol 56 (2) (2021) of the GJAS

N°	Title	Authors
1	Effect of Temperature and pH Variation on Anaerobic Digestion for Biogas Production	M. N. Zainudeen M. Kwarteng A. Nyamful L. Mohammed M. Mutala
2	Effects of Dried Cashew (*Anacardium occidentale* L.) Apple Meal (DCAM) on the Growth Performance and Internal Organs of Albino Rats	M. Boateng K. O. Amoah P. Y. Atuahene Y. O. Frimpong D. B. Okai G. Osei

3	Energy Consumption and Thermal Properties of Drying Banana (*musa ssp*) under Varied Relative Humidity	F. Sarpong M. T. Rashid J. Owusu-Kwarteng C. Zhou
4	Assessing Farm Records-Keeping Behavior among Small-Scale Pineapple Farmers in The Nsawam Adoagyiri Municipality, Ghana	S. A. Manteaw B. W. Akpotosu B. Y. Folitse S. Mahama
5	Incidence and Severity of Major Fungal Diseases on Tomato in Three Districts within the Forest and Forest-Savannah Agro-Ecological Zones Of Ghana	B. A. Opoku C. Kwoseh E. Gyasi E. Moses
6	Adoption of Improved White Yam (*Dioscorea rotundata*) Varieties in Ghana: The Role of Farm and Farmer Characteristics	P. P. Acheampong A. A-Appiah B. N. Frimpong J. Haleegoah E. N. Amengor B. O. Asante E. Otoo
7	Contribution of Fish Farming to the Socio-Economic Status of Fish Farmers in Oyo State, Nigeria	A. A. Ayeloja G. L. Adebisi L. A. Oyebode

Ghana Journal of Science (GJS established in 1968)

The Ghana Journal of Science published GJS Vol. 62 (1) (2021) on the AJOL website. Details of published articles are given below:

Table 3.5: Articles published in Vol 62 (1) (2021) of the GJS

N°	Title	Authors
1	A Simple Method for the Extension of Shelf Life of Cultures of Phytophthora Species Causing Black Pod Disease Of Cacao (*Theobroma cacao L.*)	I. Amoako-Attah E. Kumi-Asare Y. Bukari
2	Prevalence of Parasitic Infections on Cultured Nile Tilapia, *Oreochromis niloticus* (Linnaeus, 1758) In Bong County, Liberia	S. Addo S. Mullah P. K. Ofori-Danson S. K. K. Amponsah J. O. Nyarko
3	Influence of Salicylic Acid and Potassium Nitrate on Plant Height And Flowering Time Of Groundnut (*Arachis hypogaea* L.) under Varying Salinity and Drought-Induced Stresses	P. Nkrumah A. M. Amadu K. O. Ayeh
4	Assessment of Trace Metal Contamination by Geochemical Normalisation in Sediments of Two Lagoons: A Comparative Study of The Kpeshie and Muni Lagoons, Ghana	M. K. Dorleku C. Tay K. M. Kumi D. K. Amoah L. Yawson I. O. Hodgson
5	Perceptions of Workers on the Benefits of Institutional Source Sorting: A Case of the Council for Scientific and Industrial Research – Institute of Industrial Research (CSIR-IIR), Accra, Ghana	A. B. Yeboah J. K. Adu-Ntim J. Koranteng T. A. Tagbor A. Aniagyei C. Kwawu
6	Wildlife Species Diversity Indices and Seasonal Distribution Assessment in Road-Side Markets of South-West Nigeria	M. O. Mustafa O. A. Lawal O. O. Fafioye A. A. Aladesida F. B. Olowoyo J. Q. Nwachukwu A. N. Ejizu C. C. Nwachukwu

		C. O. Ezekwe O. O. Ovuike R. A. Ugwu
7	Knowledge and Practice of Environmental Sanitation and Personal Hygiene by Traders. A Case Study of Tamale Central Market	E. Arthur A. Z. Imoro
8	Exploring the Ethical Dilemmas of Afro-Centric Social Media Use through Agent-Based Modeling: A Review	C. H. Nwokoye I. I. Umeh I. J. Odo

3.6 Internal Seminars

Staff of various categories underwent trainings organised internally. Details are captured in Table 3.6

Table 3.6: Internal Training/Workshops 2021

N°	Date	Topic	Resource Person(s)
1	6th – 14th May 2021	HACKATHON Web & App Development	Staff of Electronics & Communications Divisions
2	11th May 2021	Wikipedia and Wikidata	Zita Ursula Zage Harriet Bayel
4	2nd – 4th June 2021	Refresher Training for Security Physical Training Techniques Introduction to Private Security Qualities of a Security Officer Security Policy in CSIR Physical Training Techniques	Mr. William K. Akpakli
3	23rd June 2021	Research Seminar	Mr. Benjamin Folitse & Dr. Paul A. Danquah

Practical and Theoretical Sessions of the Refresher Training for Security

3.7 Visibility

The year 2021 saw the Institute appearing on a number of television and radio shows sensitizing the public, especially those in the agriculture value chain on the MAG technology deliverables.

Led by the Marketing outfit, staff from all divisions were put into teams and assisted in populating the Kuafo App by visiting farmers, sellers, supermarkets in the Fruit and Vegetable food chain. Operation of the App was explained with their details taken and they being signed unto the App.

Other visibility activities included fairs and exhibitions.

A Team from the Institute being led by a farmer to vegetable farms at Haatso, Accra

Representatives of the Institute at the CSIR-FRI Food fair

4.0 ADMINISTRATION & FINANCIAL ISSUES

4.1 Administration

The Administration Division supported operation of the Institute through implementation of directives, policies, rules and regulations of the Council.

4.1.1 Management of INSTI

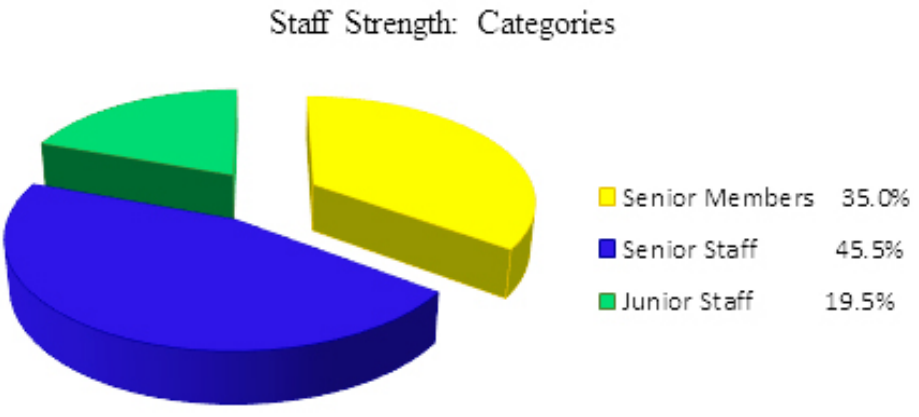
- For the period, there was no Management Board. The Institute awaited the constitution of a new Board as the previous one was dissolved due to change of Government.
- The eleven-member Internal Management Committee with Dr. Seth Awuku Manteaw as Chairman saw to internal issues of the Institute for the period. Meetings were held on 27th January 2021, 8th June 2021 and 23rd November 2021

4.1.2 Staff Strength

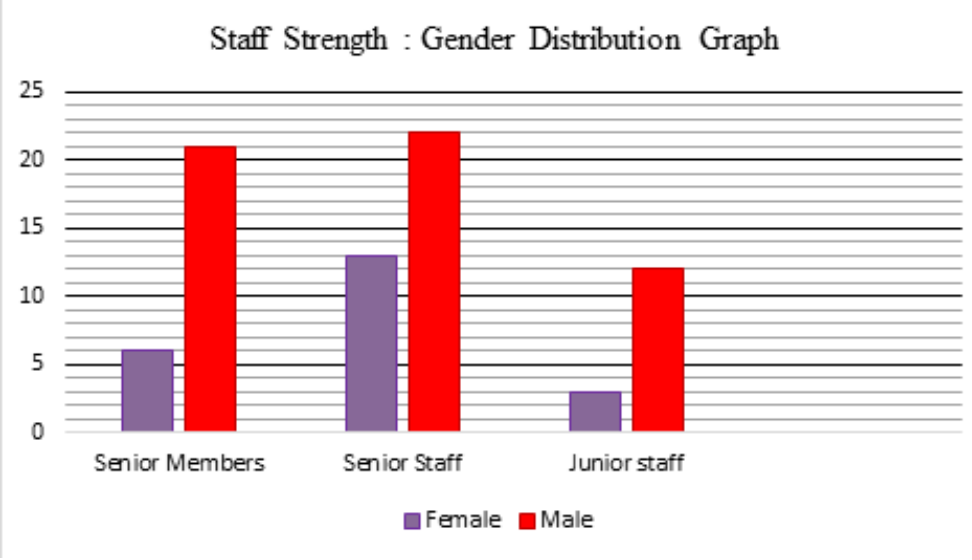
As at 31st December 2021, the staff strength of the Institute stood at seventy-seven (77), which consists of twenty-five (25) Core and two (2) Non-core Senior Members totalling twenty-seven (27), thirty-five (35) Senior Staff and fifteen (15) Junior Staff. Gender distribution is indicated in Table 4.1 with details outlined in Appendix III.

Table 4.1: Staff Strength: Gender Distribution

Gender	Senior Members	Senior Staff	Junior Staff	Total
Males	21	22	12	55
Females	6	13	3	22
Total	27	35	15	77



Staff Strength: Categories



4.1.3 Appointments

Mr. Benjamin Yao Folitse, Senior Librarian, was appointed as Acting Deputy Director of the Institute effective 1st October 2021. Before his appointment, he served as Head for the Geospatial and Information Science Division.

4.1.4 Staff Promotions

Promotion interviews were held for the following staff;

Table 4.2: List of Promoted Staff

N°	Name	Interview Date	Old Grade	New Grade
1	Mr. William Akpakli	6th September 2021	Principal Security Officer	Chief Security Officer
2	Mrs. Akua Boateng Agyenim	8th September 2021	Chief Marketing Assistant	Marketing Officer

The Marketing Officer excelled during the interview held for seven (7) candidates in CSIR and emerged as one of the top three (3). She was awarded during the Institute's annual end of year service.

Mrs. Akua Boateng Agyenim receiving her award from the

4.1.5 Newly Employed Staff

The under-listed staff were employed during the year and assigned to various Divisions of the Institute;

Table 4.3: List of Newly Employed Staff

N°	Name	Grade	Division/Section
1	Dr. Michael Dziwornu Gameli	Research Scientist	(High Performance Computing)
2	Mr. Fred Fosu Agyarko	Principal Technologist	(High Performance Computing)
3	Mr. Buertey Essegbey	Principal Technologist	Printing & Publishing
4	Mr. Moses Dusi	Library Assistant	Scientific Information Management
5	Ms. Esther Ohenewaa Nyarko	Library Assistant	Scientific Information Management
6	Ms. Anne Hawa Breh	Library Assistant	Scientific Information Management
7	Mr. Patrick Folitse	Marketing Assistant	Administration
8	Mr. Kenneth Asiamah	Principal Technologist	Communications
9	Mr. Irvyne Jojo Blisset	Technical Officer	Communications
10	Mr. Emmanuel A. Kwofie	Technical Officer	Electronics
11	Mr. Edward Aggrey-Fynn	Technical Officer	Electronics
12	Mr. Godwin Aborgeh	Technical Officer	Fluid Science
13	Ms. Victoria Yayra Azuma	Technical Officer	Geospatial & Information Science
14	Mr. Kormla David Dakey	Security Officer	Administration
15	Ms. Cynthia Osei Bonsu	Senior Technical Ass.	Administration

4.1.6 National Service Personnel

Fifteen (15) graduates were accepted to have their National Service with the Institute. They assumed duty in October 2021. Details of their enrolment are captured in Table 4.4.

Table 4.4: National Service Personnel

N°	Name	Institution	Division
1	Aryeepah Jacob Ekow Boateng	Ghana Communication Technology University	Accounts
2	Riverson Lydia Ama Amoafoah	Presbyterian University College	Accounts
3	Norfam Rauf	Accra Technical University	Accounts
4	Nuamah Victoria	University of Professional Studies, Accra	Administration
5	Mohammed Ayisha	University of Education, Winneba	Administration
6	Boateng Olivia	Ho Technical University	Administration
7	Tetteh Charles	Kwame Nkrumah University of Science & Technology	Communications
8	Charway David	Ghana Institute of Management & Public Administration	Communications
9	Owusu-Nyantakyi Boateng	Ghana Institute of Management & Public Administration	Electronics
10	Migbordzi Gameli Gameli	University of Cape Coast	Fluid Science
11	Milton Nii Addy	University of Ghana	Geospatial & Information Science
12	Arhinful Stella Bentsiafi	University of Ghana	Geospatial & Information Science
13	Offin Ameyaw Stephen	University of Ghana	Printing & Publishing
14	Komey Cedric Nii Ayitey	Kwame Nkrumah University of Science & Technology	Printing & Publishing
15	Damalie Gloria Edem	Takoradi Technical University	Printing & Publishing

4.1.7 Study Leave

As part of Council's policy on training, the following members of staff have been granted study leave to further their education at various local Institutions:

Table 4.5: Staff on full-time/ partial study leave with pay

N°	Name	Programme/Institution	Duration	Start –End Date
1	Mr. Mohammed Nafiu Zainudeen	PhD Nuclear and Environmental Protection/ University of Ghana	4 yrs partial study leave	Aug 2018-July 2022
2	Ing. Michael Wilson	PhD Computer Engineering/ Kwame Nkrumah University of Science and Technology	4 yrs partial study leave	Sep 2019-July 2023
3	Ms. Risikatu Lawal	MBA Finance/ Central University College	2 yrs partial study leave	Oct 2020-July 2022
4	Ms. Yvonne Dzifa Azuma	BCom Human Resource Management/ University of Cape Coast (Distance Education)	2 yrs partial study leave	Feb 2021-Dec 2023
5	Ms. Naa Aku Mingle	PhD Agricultural Extension/ University of Ghana	4 yrs full time study leave	Jan 2021-Dec 2026
6	Mr. Samuel Ankrah	MBA Finance/ Central University College	2 yrs partial study leave	Nov 2021-Oct 2023
7	Mr. Eric Sam	MA Theatre Arts / University of Ghana	1 yr full time study leave	Nov 2021-Nov 2022

4.1.8 Resignation

The following staff resigned from service of the Council:

- Dr. Felix Tetteh Kabutey, Scientific Information Officer and Head of Fluid Science Division with effect from 30th October 2021.

- Mr. Joshua Kalognia, a Principal Technologist of the Printing and Publishing Division with effect from 1st December 2021.

4.1.9 Retirement

Two (2) members of staff gracefully retired during the year, they are:

- Mr. Nathan K. Aborgeh, Senior Security Assistant retired from service on 11th March 2021. He joined the Institute as a Security Assistant Grade II on 27th June 2008 and rose through the ranks till retiring at his current position.
- Mr. Joseph Anyen, Senior Accountant retired from service of the Council on 20th August 2021. He was employed on 17th June 1991 as an Accountant.

4.1.10 Obituary

The Institute unfortunately lost one member of staff, Mr. Roland Allotey Pappoe on 14th July 2021 at the Pantang Hospital. Mr. Pappoe was employed as a Literate Helper on 1st August 2000 and through hard work and training rose through the ranks to the position of Technical Officer, a position he held until his death. He was buried on 11th September 2021 at Akuse, his hometown.

4.2 Accounts Division

The objectives of the Accounts Division for the year 2021 included:

- Capture financial transactions and prepare timely, accurate and transparent financial reports
- Ensure payroll duties are fulfilled
- Ensure adequate internal control procedures are put in place to safeguard the assets of the Institute
- Actively assist, support and guide management in making sound management decisions
- Take an active role in setting the annual budget, monitor the budget and do variance analysis.

4.2.1 Financial Statement for 2021

Total receipts for the year under review amounted GH¢5,743,900.52 and payments totalled GH¢5,684,058.97 with a surplus net receipt of GH¢9,841.55.

The receipts are made up of salaries paid by GoG from the Consolidated fund amounting to GH¢5,166,164.39. Internal Generated Fund (IGF) amounted to GH¢ 522,376.88 and Donor Funds of Gh¢55,359.25. The IGF activities included Printing, Hiring of facilities, and Consultancy.

The Institute projected to earn GH¢522,376.88 from IGF for 2021. There was a shortfall of GH¢81,083.99 due to shortfall in revenue from the Printing services.

The Payment of Gh¢5,684,058.97 for the period is made up of Compensation for Employees of GH¢5,181,986.90, Goods and Services of GH¢479,335.17.

There was no GOG subvention received for Goods and Services during the year 2021.

Below is summarized Statement of Receipts and Payments and the Financial Position as at December 31, 2021.

Table 4.6: INSTI Statement of Receipts and Payments for the year ended December 31, 2021

	ACTUAL 2021	ACTUAL 2020
	GH¢	GH¢
TOTAL RECEIPTS	5,743,900.52	3,994,209.79
TOTAL PAYMENTS	5,684,058.97	4,030,515.41
EXCESS/(DEFICIT)	59,841.55	-36,305.62

Table 4.7: Summary State of Affairs as at December 31, 2021

	2021	2020
CURRENT ASSETS	403,425.41	276,449.15
NON-CURRENT ASSETS	131,165.33	122,137.84
LIABILITIES	233,571.26	126,563.68
NET ASSETS/(LIABILITIES)	301,019.48	272,023.21
NET WORTH	301,019.48	272,023.21

APPENDIX I

Publications

Refereed Journal Papers

Decardi-Nelson A. & Tetteh H.A. (2021). 3D Printing Innovations: Current and the Future. *Journal of Emerging Technologies and Innovative Research*, 8(10) ISSN-2349-5162)

Amoako, J. K., Sharma, Y. K., **Danquah, P.A.** (2021). "Memorize, Reproduce and Forget" Inclination; Students' Perspectives: A Study of Selected Universities in Ghana, *Computational Methods and Data Engineering. Advances in Intelligent Systems and Computing,* 1257. Springer, Singapore. https://doi.org/10.1007/978-981-15-7907-3_41

Asani, E. O., Omotosho, A., **Danquah, P. A.,** Ayoola, J. A. & Ayegba, P. O. (2021). A Maximum Entropy Classification Scheme for Phishing Detection Using Parsimonious Features, *TELKOMNIKA Telecommunication, Computing, Electronics and Control,* 19(5), 1707-1714, ISSN: 1693-6930, DOI: 10.12928/TELKOMNIKA.v19i5.15981

Atiso K., **Folitse B. Y.**, **Manteaw, S. A.** (2021). Mobile Telephone and Agriculture Information Communication in Ghana; the Ho West District under Review, *Library Philosophy and Practice* (e-learning). 4711.

Decker, E. **Folitse, B. Y.**, **Manteaw, S. A.,** Swanzy, F., Larbi, E., Mahama, S. (2021). Occupational Hazard and Injuries among Oil Palm (Elaeis Guineensis Jacq et al). Farmers in the Kwaebibirem District in the Eastern Region of Ghana. *Ghana Journal of Science*, 62(2).

Opoku D. O., Tetteh H. T. & **Decardi-Nelson A.** (2021). The Analysis of Infographic Design Issues in the Internet Era, *Journal of Emerging Technologies and Innovative Research,* 8(7) ISSN-2349-5162

Mahama, S., **Manteaw, S. A.,** Decker, E. (2021). Gender Perceptions on the Causes of Climate Variation and its Effects on Cassava Production Among Farmers in Ghana. *Cogent Food and Agriculture* 7(1), 1911398, DOI: 10.1080/23311.932.2021.1911398

Manteaw, S. A., Folitse, B. Y., Mingle, N. A., Mahama, S. (2021). Small-Scale Urban Vegetable Farmers' Knowledge and Perceptions About Agricultural Insurance in The Greater – Accra Region, *Ghana, International Journal of Agricultural Science,* 6, 118-126.

Manteaw, S. A., Folitse, B. Y., Akporkosu, B. W., Mahama, S. (2021). Assessing Farm Records-Keeping Behaviour among Small-Scale Pineapple Farmers in the Nsawam Adoagyiri Municipality, Ghana, *Ghana Journal of Agricultural Science,* 56 (2) 2021.

Sackey, T. A., Banini, G. K., Emi-Reynolds, G., Gyasi, E. (2020). Dose Rate Assessment at a Gamma Processing Facility in Ghana. *International Journal of Applied and Physical Sciences,* 6, 9-15 doi: https://dx.doi.org/10.20469/ijaps.6.50002

Conference Paper

Antwi, B.Y., Ali, D.Y., Omar, E., Koranteng, J., **Decardi-Nelson, A.** (2021, October 20). *Recycling of Polystyrene (PS) Waste Bowls into Inherently Smooth Surfaced Plastic Plates for Application in the Souvenirs Industry.* 32nd RSA Annual General Meeting and 3rd Scientific Conference, Accra

Mingle, N.A.' Nsiah-Achampong, N.K., **Decardi-Nelson, A., Manteaw, S.A., Folitse, B.,** Ampofo, A.S., Koranteng, I.M. (2021, October 20). *Covid-19 Awareness among Primary School Children in the Greater Accra Region of Ghana: An Infographic Assessment.* 32nd RSA Annual General Meeting and 3rd Scientific Conference, Accra.

Manteaw, S. A. (2021, December 10). *Supporting Ghana's Development Through Food, Land, and Water System Transformation* [Keynote Speaker]. CGIAR, Ghana Webinar Series, Accra

Manteaw, S. A. (2021, June 22). *Development Solutions: Home Grown Innovations in Responding to Africa's Development Challenges.* Launch of the Africa Union Development Agency-New Partnership for Africa Development Centre for Excellence in Science, Technology and Innovation, South Africa

Manteaw, S. A. (2021). *Policy for Innovation and Considerations for the Africa Union Development Agency-New Partnership for Africa Development Centre for Excellence in Science, Technology and Innovation.* Science Forum South Africa 2021 on the theme:

"Igniting conversations for World Science Forum 2022, South Africa

Manteaw, S. A. (2021, December 22). *Putting Modernization in an Agricultural Modernization Agenda:* The Role of CSIR. MAG Dissemination Workshop, CSIR-STEPRI, Accra.

Prikutse, F. L., Twum-Barimah, Y., Danquah, P. (2019), Design of An Optimal Low Noise Amplifier (LNA) for Signal Boosting, International Conference on Mechatronics, Remote Sensing, Information Systems, and Industrial Information Technologies, ICMRSISIIT 2019, 9405953

Danquah, P., Kester, Q.A. (2019) *Enhanced Security Assessment Method for USSD Based Mobile Applications.* 2019 ICDSA International Conference on Computer, Data Science and Applications, ICDSA 2019, 9404234

Book

Danquah, P. A., (2021), System Administration and Security: A Vendor Neutral Perspective, CSIR-INSTI, ISBN:978-9988-3-1859-8

APPENDIX II

External Training Workshop/ Conference/ Seminar & Others

Adjah J. served as a Resource Person for the First and Second Editions of the Cosmetics and Soap Production Training Programme on 18th March and 24th June 2021 respectively, at CSIR-IIR.

participated in;

- The 32nd Research Staff Association (RSA) Scientific Annual General Meeting and 3rd Scientific Conference from 19th to 21st October 2021 at CSIR-STEPRI, Accra.
- The SciBar Camp 2021 Webinar on Interactive Science; Moving from Research to Practice on 21st September 2021.
- The 9th West African Clean Energy and Environment Trade Fair and Virtual Conference from 29th to 30th September 2021.

Allotey A.N.M. participated in a virtual Leadership Training Programme from 22nd to 26th March 2021.

Awanyo D. participated in the CSIR Administrators Conference on 15th September 2021 at CSIR-STEPRI.

Awotwi J.P. participated in;

- A Capacity Building Workshop for CSIR Communicators on 26th April 2021 at CSIR Head Office.
- The Eastern Regional RELC Activities on 2nd August 2021 at Koforidua.
- The Western North Regional RELC Activities on 30th September 2021 at Sefwi Wiawso.
- The Ashanti Regional RELC Activities on 28th October 2021 at Kumasi.
- The Volta Regional RELC Activities on 22nd December 2021 at Ho.

Danquah P.A participated in a virtual Leadership Training Programme from 15th to 19th March 2021.

Decardi-Nelson A. participated in the 32nd Research Staff Association (RSA) Scientific Annual General Meeting and 3rd Scientific Conference from 19th to 21st October 2021 at CSIR-STEPRI, Accra.

Folitse B.Y. participated in;

- The Eastern Regional RELC Activities on 2nd August 2021 at Koforidua.
- The Central Regional RELC Activities on 31st August 2021 at Cape Coast.
- The Western Regional RELC Activities on 23rd September 2021 at Takoradi.
- The Western North Regional RELC Activities on 30th September 2021 at Sefwi Wiawso.
- The Bono Regional RELC Planning Session on 5th October 2021 at Sunyani.
- The Greater Accra Regional RELC Activities on 6th October 2021 at Accra.
- The Upper East Regional RELC Activities on 18th October 2021 at Bolgatanga.
- The Upper West Regional RELC Activities on 18th October 2021 at Wa.
- The Ashanti Regional RELC Activities on 28th October 2021 at Kumasi.

Gordon V.D. participated in;

- A Ghana Institute of Engineers (GIEE) virtual workshop on New and Emerging ICT Technologies (IoT, AI, etc) for sustainable development of Ghana on 25th March 2021.
- A Ghana Science Association (GSA) virtual Scientific Manuscript Writing Workshop on 30th March 2021.
- The Operationalisation of the Ghana Innovation and Research Commercialization (GIRC) Programme on 29th April 2021

Kessey M. B. participated in a webinar on Protecting Yourself from Radiation on 24th August 2021.

Manteaw S.A. participated in;

- A CGIAR Ghana Webinar Series on Supporting Ghana's Development Agenda

Through Food Land and Water System Transformation on 10th November 2021 as the Key Speaker.

- A Panel Discussion Presentation on Policy for Innovation and Considerations for the Africa Union Development Agency-New Partnership for Africa Development, Centre of Excellence in STI at the Science Forum from 1st to 3rd December 2021 at South Africa.
- A MAG Dissemination Workshop on Putting Modernization in an Agricultural Modernization Agenda: The Role of CSIR on 21st December 2021.
- The Central Regional RELC Activities on 31st August 2021 at Cape Coast.
- The Bono Regional RELC Planning Session on 5th October 2021 at Sunyani.
- The Greater Accra Regional RELC Activities on 6th October 2021 at Accra.
- The Upper East Regional RELC Activities on 18th October 2021 at Bolgatanga.
- The Upper West Regional RELC Activities on 18th October 2021 at Wa.
- The Ashanti Regional RELC Activities on 28th October 2021 at Kumasi.

Ohene-Affih B. participated in;

- The Greater Accra Regional RELC Activities on 6th October 2021 at Accra.
- The Upper East Regional RELC Activities on 18th October 2021 at Bolgatanga.
- The Upper West Regional RELC Activities on 18th October 2021 at Wa.

Opoku E. participated in the CSIR Administrators Conference on 15th September 2021 at CSIR-STEPRI.

Prikutse F.L. participated in a European Commission virtual workshop on How to Prepare a Successful Proposal in Horizon Europe on 25th March 2021.

Sackey T.A. participated in;

- A Capacity Building Workshop for CSIR Communicators on 26th April 2021 at CSIR Head Office.
- The Maiden Nuclear Webinar on Nuclear: A Friend or Foe? on 3rd June 2021.

- The virtual celebration of Reconnaissance Day from 28th to 30th June 2021.

Sawyerr A. participated in the 32nd Research Staff Association (RSA) Scientific Annual General Meeting and 3rd Scientific Conference from 19th to 21st October 2021 at CSIR-STEPRI, Accra.

Twum-Barimah Y. participated in a webinar on NASA's Perseverance Sampling and Caching Robotic System 5th June 2021.

Wilson M. participated in;

- A webinar on NASA's Perseverance Sampling and Caching Robotic System on 5th June 2021.
- The Central Regional RELC Activities on 31st August 2021 at Cape Coast.
- The Western Regional RELC Activities on 23rd September 2021 at Takoradi.
- The Bono Regional RELC Planning Session on 5th October 2021 at Sunyani.

APPENDIX III

List of Staff as at 31st December 2021

SENIOR MEMBERS

N°	NAME	PRESENT DESIGNATION	QUALIFICATION
1	Dr. Seth Awuku Manteaw	Principal Scientific Information Officer/ Director	PhD (Agricultural Extension); MSc (Agronomy); PG Dip. (Communication Studies); MA (Communication Studies)
2	Mr. Benjamin Yao Folitse	Senior Librarian/ Ag. Deputy Director	MPhil (Agricultural Extension); M.A. (Library Studies); B.Ed. (Agric); Dip (Agric Ed.)
3	Dr. Richard Kofie*	Principal Research Scientist/ Former Deputy Director	PhD (Geography); MPhil (Geography); BA (Hons) Cert (Remote Sensing)
4	Dr. Albert N. M. Allotey	Senior Research Scientist/ Head of Geospatial & Information Science	PhD (Geography & Resource Development); MPhil (Geography & Resource Development) BA (Hons) Geography & Resource Development
5	Mrs. Dorothy Awanyo	Administrative Officer/ Head of Administration	MBA (Human Resource Mgt) BA (Public Admin.); Dip. (Librarianship)
6	Dr. Paul Asante Danquah	Senior Research Scientist/ Head of Communications	PhD (Info. Technology); MSc. (Info. Security); BSc. (Hons) Computing

7	Dr. Agnes Decardi-Nelson	Research Scientist/ Head of Printing& Publishing	PhD (African Art & Culture); BFA (Graphic Design)
8	Mr. Michael Wilson	Chief Technologist/ Head of Electronics	MPhil. (Computer Engineering); PostGrad. (Wireless & Mobile Computing); CDAC; BSc. Computer Eng.;
9	Dr. Mahamuda A. Mahamadu	Scientific Information Officer	PhD (Information & Communication Engineering) MSc. (Electrical & Electronic Engineering); PG Dip. (Management Information Systems and Management Control Systems) BSc. (Hons) Computer Science / Statistics)
10	Ms. Naa Aku Mingle	Librarian	MPhil (Information Studies) BA (Psychology & Linguistics)
11	Mr. Atta Senior Ampofo-Addo	Librarian	MSc (Management Information Systems) CIM-UK (Level 1); BA (Info. Studies & Sociology)
12	Mr. Bryan Nii Lartey Laryea	Research Scientist	MBA (Management Information Systems) BA (Information Studies & Geography)
13	Dr. Michael Dziwornu Gameli	Research Scientist	PhD (Urban Studies) MA (Geography) BA (Geography & Resource Development & Information Studies)
14	Mr. Yaw Twum-Barimah	Chief Technologist	MSc. (Telecom); BSc. Elec. &Computer Engineering

15	Mr. Victor D. Gordon	Chief Technologist	MSc. (Telecommunications & Internet Technologies) BSc. (Computer Engineering)
16	Mr. Mohammed N. Zainudeen	Chief Technologist	MSc. (Chemical Eng.); BSc. (Hons) Chemical Eng.
17	Mr. Akilakpa Sawyerr	Chief Technologist	MPhil (Radiation Protection); BSc. (Physics)
18	Mr. Christian K. Lettu	Chief Technologist	MPhil (Dev. Geography); BA (Hons) Geography & Resource Development
19	Mr. John Annor	Chief Technologist	MPhil (GIS & Remote Sensing); B.A. (Geography)
20	Mr. Frank Lemdi Prikutse	Principal Technologist	MSc. (Telecom Engineering); B.Eng. (Telecom Engineering)
21	Mr. John Adjah	Principal Technologist	MA (Communication Design); BA (Publishing Studies)
22	Ms. Maame Birago Kessey	Principal Technologist	MSc. (Information Technology); BSc. (Computer Engineering)
23	Ms. Tracy Adjeley Sackey	Principal Technologist/ Scientific Secretary	MPhil (Radiation Protection); BSc. (Physics &Computer Science)
24	Mr. Buertey Essegbey	Principal Technologist	MA (Business Administration) BSc (Management Studies)
25	Mr. Kenneth Asiamah	Principal Technologist	MSc (Information & Communication Technology) BSc (Information & Technology Management
26	Mr. Fred Fosu Agyarko	Principal Technologist	MPhil (Statistics) BSc (Actuarial Science)
27	Ms. Esther Opoku	Administrative Officer	MBA (Human Resource Mgt.) BA (Information Studies and Sociology); Diploma (Librarianship)

*__*On Contract*__

SENIOR STAFF

N°	NAME	PRESENT DESIGNATION	QUALIFICATION
1	Mr. Edwin Adotevi	Senior Technologist	BA (Comm. Studies)
2	Mrs. Janet Otoo-Abedi	Chief Accounting Assistant	Diploma (Public Finance and Accountancy)
3	Ms. Cordellia Akua Busumtwi	Chief Administrative Assistant	Cert. (Private Secretary)
4	Mrs. Faizatu Yakubu	Chief Auditing Assistant	Bachelor of Commence ICA (Gh) Part III (Commerce)
5	Mrs. Margaret Ivy Koranteng	Chief Library Assistant	Diploma (Librarianship)
6	Mrs. Akua Boateng Agyenim	Chief Marketing Assistant	MBA (Marketing) BA (Publishing Studies)
7	Mr. Emmanuel E. Davidson	Chief Technical Officer	Cert. Basic Cartography
8	Mrs. Sarah G. Sarpong	Chief Accounting Assistant	Dip. (Public Finance and Accountancy)
9	Ms. Risikatu Lawal	Principal Accounting Assistant	BSc. (Accounting); DBS (Accounting); CIPS Cert. (Purch.&Supply)
10	Mr. Alex K. I. Ocansey	Principal Assistant Printer	Cert. (ITS) Snr. Sup/ Mgt; N.V.T.I. Grade I Cert.
11	Mr. William K. Akpakli	Principal Security Officer	BA (Social Work &Psychology); SSSCE: BECE
12	Mr. Eric Sam	Principal Technical Officer	BFA (Animation) HND (Graphic Designing)

13	Mr. Samuel Ankrah	Principal Accounting Assistant	Bachelor of Commerce; HND (Accountancy); SSSCE; BECE
14	Mr. Robert Abomoi	Senior Security Officer	Security Trg. Module 3; M.S.L.C.
15	Mr. Eric K. Acquaye	Technical Officer	Advanced Certificate in Microsoft Certified Systems Eng. (GIMPA); SSSCE
16	Mr. Benjamin Ohene-Affih	Technical Officer	B.Eng. (Computer Science)
17	Mr. John Paapa Awotwi	Technical Officer	BSc. (Information Technology)
18	Ms. Samiratu A. Mamah	Technical Officer	BA (Communication Design)
19	Mr. Yaw Owusu-Ayirebi	Technical Officer	BA (Graphic Design)
20	Mr. Irvyne Jojo Blisset	Technical Officer	BSc (Information Technology)
21	Mr. Emmanuel A. Kwofie	Technical Officer	BSc (Engineering Physics)
22	Mr. Edward Aggrey-Fynn	Technical Officer	BA (Computer Science & Management)
23	Mr. Godwin Aborgeh	Technical Officer	BSc (Industrial Chemistry)
24	Ms. Victoria Yayra Azuma	Technical Officer	BA (Sociology & Geography)
25	Mr. Moses Dusi	Library Assistant	BA (Information Studies & Computer Science)
26	Ms. Esther Ohenewaa Nyarko	Library Assistant	BA (Adult Education & Information Studies) Dip (Youth Development Work)
27	Ms. Anne Hawa Breh	Library Assistant	BA (Information Studies & Sociology)

28	Mr. Patrick Folitse	Marketing Assistant	BSc (Business Administration (Marketing))
29	Ms. Doris Kumiwa	Administrative Assistant	Dip (BCom Management) DBS (Secretariaship); Nat. Banking Coll. (Cert Cashier & Frontline Exec)
30	Ms. Yvonne D. Azuma	Administrative Assistant	Dip (Public Administration) SSSCE
31	Mr. Cephas Awusie	Security Officer	Security Training Module I;G.C.E. 'O' Level
32	Mr. Abdul Rahaman Iddrisu	Security Officer	Security Training Module I; M.S.L.C.
33	Mr. Fuseini Inusah	Security Officer	SSSCE
34	Mr. Komla David Dakey	Security Officer	BA (Social Behaviour & Conflict Management) Dip (Social Work)
35	Mr. Timothy Kwamena	Assistant Transport Officer	Cert. (Trans Mgt); Intercity STC Coaches Ltd.; MSLC

JUNIOR STAFF

N°	NAME	PRESENT DESIGNATION	QUALIFICATION
1	Mrs. Salamatu Abdul Mumuni	Senior Clerk	NACVET Cert.(Stenographer)
2	Ms. Lucy Akyempon	Senior Clerk	"O" level, DBS
3	Ms. Cynthia Osei Bonsu	Senior Technical Assistant	HND (Estate Management)
4	Mr. Charles Kulley	Junior Library Assistant	SSSCE
5	Mr. Bancie Habila Hussein	Junior Library Assistant	SSSCE
6	Mr. Enos Awusie	Traffic Supervisor	Intercity STC (Def. Driving Course); MSLC
7	Mr. Joseph Lamptey	Traffic Supervisor	Intercity STC (Def. Driving Course); BECE
8	Mr. Seth Asare	Artisan	Special Junior Tech. Super. Mgt Course, ITS – Accra; MSLC
9	Mr. Mathew Narteh Amoatey	Driver Inspector	Course on Road Safety Mgt. (ATS) City & Guild (Mech. Eng. Craft Practice); BECE; Drive. Lic "C"
10	Mr. Razak Ayidana Akambase	Supervisor Grade I	B.E.C.E.
11	Mr. Kojo Asanaab	Supervisor Grade I	B.E.C.E.
12	Mr. Isaac G. Amponsah	Supervisor Grade I	NVTI GD II
13	Mr. Robert Achandi	Supervisor Grade I	M.S.L.C.
14	Mr. Francis Ayarik	Supervisor Grade I	Nil
15	Mr. Abdul Wahab Usman	Supervisor Grade II	Nil

CSIR-INSTI Office Location Map