CSIR-INSTI

INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION

2022 ANNUAL REPORT

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION

CSIR-INSTI

2022

ANNUAL REPORT

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LIST OF ACRONYMS & ABBREVIATIONS

AAG	-	American Association of Geographers
AGDP	-	Agricultural Gross Domestic Product
AGORA	-	Access to Global Online Research in Agriculture
AJOL	-	African Journals Online
AMA	-	Accra Metropolitan Assembly
AWS	-	Amazon Web Service
CLIMACCESS	-	Climate Change Resilience in Urban Mobility
CSIR	-	Council for Scientific and Industrial Research
DAIH	-	Digital Agriculture Innovation Hub
DOAJ	-	Directory of Open Access Journals
DT	-	Digital Twins
FAO	-	Food and Agriculture Organisation
FARA	-	Forum for Agricultural Research in Africa
GDIW	-	Ghana Digital Innovation Week
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
GOPDC	-	Ghana Oil Palm Development Company
GPS	-	Global Position Systems
HINARI	-	Health Inter Network Access to Research Initiative
ICT	-	Information and Communication Technology
IEEE	-	Institute of Electrical and Electronic Engineers
IoT	-	Internet of Things
LiDAR	-	Light Detection and Ranging

LoRA	-	Long Range Radio
MAG	-	Modernizing Agriculture in Ghana
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
SDI	-	Selective Dissemination of Information
SIMS	-	Scientific Information Management Section
SMART	-	Specific Measurable Attainable Reliable and Time-bound
SSEs	-	Small Scale Enterprises
STEPRI	-	Science and Technology Policy Research Institute
TEEAL	-	The Essential Electronic Agricultural Library
UESD	-	University of Environment and Sustainable Development
WRI	-	Water Research Institute

2022 Management Board Membership		
Prof. Abdulai Mohammed Sani	Chairman	Associate Professor and Consultant, African Centre for Development Informatics, Accra
Dr. Seth Awuku Manteaw	Member	Director, CSIR-INSTI
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Prof. Dr. Ezer Osei Yeboah Boateng	Member	Telecoms Engineer
Mrs. Dorothy Awanyo	Secretary	Head of Administration, CSIR-INSTI

2022 Internal Management Committee Membership		
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Mrs. Dorothy Awanyo	Member	Head of Administration Division
Dr. Paul A. Danquah	Member	Head of Communications Division
Dr. Agnes Decardi-Nelson	Member	Head of Printing & Publishing Science Division/ President of Research Staff Association (local)
Ing. Michael Wilson	Member	Head of Electronics Division
Mr. Mohammed N. Zainudeen	Member	Ag. Head of Fluid Science Division
Mr. Stephen Kwaku Asante	Member	Head of Accounts Division
Mr. William Akpakli	Member	President of Senior Staff Association (local)
Mr. Eric Acquaye	Member	President of Trade Union Congress (local)
In Attendance		
Ms. Esther Opoku	Secretary	Administrative Officer

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FOREWORD

Dr. Seth Awuku Manteaw
Director, CSIR-INSTI

The CSIR-Institute for Scientific and Technological Information (CSIR-INSTI), as part of fulfilling its mandate, has identified digital agricultural extension and advisory services as one of its niche areas of interest. This unique area of interest seeks to leverage digital technologies to promote the efficiency and effectiveness of the Institute's information dissemination mandate. Besides, the deployment of digital technologies in information dissemination will sustain CSIR-INSTI's efforts at integrating Science, Technology and Innovation (STI) in Ghana's agricultural food system to ensure the competitiveness and efficiency of value chain actors. Consequently, the focus during the year was on consolidating the gains made in the setting up of the Institute's flagship project, the Digital Agricultural Innovation Hub (DAIH) in 2020, out of which four digital solutions were developed to introduce more efficiency in the public agricultural extension and advisory services. The year saw effective outreach programmes to eight selected regions of Ghana to undertake training in the use of the Kuafo Marketplace, an e-commerce platform that seeks to address the marketing challenges of producers and processors. The training which was designed to take the form of a training-of-trainers basis, targeted farmers, agricultural extension officers, processors and key value chain actors in the regions.

In all the eight regions visited, participants were also given the skills to use the Agritech Advisor App, which seeks to bring agricultural extension closer to the doorstep of clients, as well as the CSIR-Technologies portals and CSIR Management Repository, which documents all agricultural technologies developed by the CSIR. It is Management's hope that these trainings will build the capacity of clients to use the four digital solutions effectively to boost agricultural productivity in Ghana. The CSIR-INSTI believes in the strength of partnerships, especially with private sector actors for the mutual benefit of parties. It is against this background that the Institute entered into the Grow with Google

Scholarship Programme. The programme, a Consultancy Project seeks to train the youth between the ages of 18 and 35 in Data Analytics, IT Support, Project Management and UX Design mainly via the Coursera platform over a period of three months. Similar strategic partnership with MAXLAB saw final year tertiary students being accepted into a hardware incubation programme to undergo trainings and work on institutional applied research projects. A third and equally important partnership is the one with AICCRA on the Ghana Agricultural Data Hub (AG-Data Hub), which is being developed as a secure mission-critical, reliable and multi-purpose digital data exchange backbone for information and data sharing among stakeholders and for the development of fact-based decision support systems to drive policy-making and trigger a move towards sustainable climate-smart agricultural practices.

Technical divisions of the Institute continued with their research projects, the results of which are contained in this Report.

CSIR-INSTI remains grateful to the Government of Ghana, the Governing Council of the CSIR, development partners and friends of the Institute for the support in discharging its mandate during the year.

It is the honour and pleasure to present the Annual Report of the CSIR INSTI for the year 2022.

Thank you.

EXECUTIVE SUMMARY

A number of research projects were carried out in 2022 in collaboration and in partnership with sister research institutions, private sector organisations and development partners. A summary of these projects is captured in the following sections:

Changes in Ecosystem Services in Riparian Forests Amidst Climate Change: A Case of The Densu River Basin: The project aims to assess the changes in ecosystem functions of the Densu River Catchment over a period of 30 years and to establish the underlying causes of the changes using remote sensing and a socio-economic survey.

A Geospatial Inventory System for Sustainable Mobility in Ghana: This project proposes a mapping system to detect road anomalies such as potholes for pedestrian and driver safety by building a multi-platform GIS system.

Climate Change Resilience in Urban Mobility (CLIMACCESS): The CLIMACCESS project which commenced in June 2018 aimed to 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, using an interdisciplinary research approach. The project has so far published Technical Reports and Journal Articles (3 each) on the subject.

Asutsuare Rebound: The research assessed the use of state-led developments of the Kwame Nkrumah era as the basis for individual entrepreneurship. The preliminary findings indicated that this contradiction was not evidence of failure, but of a resilient alternative to both modernist techno-utopias and neoliberal short-termism. The project showed the potential for the reuse of socialist infrastructure.

Information Security Practices: The objective of this research was to critically assess information security best practices and IT disaster recovery readiness in various sectors of Ghana. Research work has been successfully done for the Government Ministries and the Microfinance Sector, indications from the output show the need to significantly improve upon best practices in information security and disaster recovery readiness.

Grow With Google Scholarship Programme/ Consultancy Project: The Programme trained youth between 18 and 35 years in Data Analytics, IT Support, Project Management and UX Design mainly via the Coursera platform, over a period of 3 months.

MAG Platform Moderation and Outreach Programme: Kuafo Marketplace, Agritech Advisor, CSIR DSpace and CSIR Technologies, the 4 deliverables under the Modernizing Agriculture in Ghana, MAG, programme are all available online to the general public. Farmers and Agricultural Extension Officers from close-by vicinities were educated and trained on usage of the 4 deliverables, with focus on the Kuafo Marketplace. Preliminary discussions for the MAG 2023 Deliverables were held, the development of an E-learning portal was agreed upon.

Partnership with MAXLAB: A strategic partnership between the Makerspace and MAXLAB saw final year tertiary students accepted into a hardware incubation programme to undergo trainings and work on institutional applied research projects. The aim of the partnership was to transition applied research to commercialisation stage.

Partnership with AICCRA on the Ghana Agricultural Data Hub (AG-Data Hub): The Ghana Agricultural Data Hub (Ag-Data Hub) is being developed as a secure mission-critical, reliable, multi-tier and multi-purpose digital data exchange backbone for information and data sharing among stakeholders and for the development of fact-based decision support systems to drive policy-making and to trigger a move towards sustainable climate-smart agricultural practices.

Printing Services: The Institute continued to design and print various branded S&T related documents including Annual Reports, Magazines, Manuals, Calendars, Letterheads and Books for sister Institutes of the CSIR, the Head Office and other external organisations.

Information Dissemination Services: A total of two thousand, one hundred and seventy-nine (2179) materials including theses, journals, annual reports, books and newspapers were received for the library section of the Institute.

Mapping Activities: This included creation of Regional Maps, a Ghana Districts Database, Mining Districts in Ghana, District Administrative Map of Ghana, Regional Land Use and an Agricultural Statistics Database.

Ghana Journal of Science & Ghana Journal of Agricultural Science: CSIR-INSTI serves as the publishing house for GJS and GJAS, the two leading science journals in the Ghana. Ghana Journal of Agricultural Science Vol. 57(1) (2022) and Vol. 57(2) (2022)

published eight (8) articles each. Ghana Journal of Science Vol. 63(1) (2022) and Vol. 62(2) (2021) published seven (7) and nine (9) articles respectively.

Staff Strength: The staff strength of CSIR-INSTI stood at eighty-six (86) as at 31st December 2022, comprising thirty-three (33) senior members, thirty-five (35) senior staff and eighteen (18) junior staff. Three (3) staff members retired during the year.

Income Generated: Total receipts for the year under review amounted GH¢6,121,840.13 and payments totaled GH¢6,023,905.71 with a surplus net receipt of GH¢97,934.42. The receipts are made up of salaries paid by GOG from the Consolidated fund amounting to GH¢4,762,737.35. Internal Generated Fund (IGF) amounted to GH¢1,008,840.35 and Donor Funds of Gh¢350,262.43. The IGF activities included Printing, Hiring of facilities, and Consultancy.

Main Collaborating Institutions:

- Agricultural Extension Directorate, MoFA
- Google via Junior Achievers (JA) Ghana
- Forum for Agricultural Research in Africa (FARA)
- International Institute of Tropical Agriculture (IITA)
- University of Copenhagen
- University of Environment and Sustainable Development (UESD)
- University of Ghana

1.0 INTRODUCTION

The mandate of the CSIR-Institute for Scientific and Technological Information (CSIR-INSTI), is stated as; 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 include to:

- 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
- Carry out research into the Electronics/Communications 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
- 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

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, in fulfilment of its mandate.

Technical divisions of 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

Supporting divisions:

- Accounts
- Administration

2.0 RESEARCH & DEVELOPMENT PROJECTS

The mandate of the CSIR involves generating and applying innovative technologies, and efficiently and effectively exploiting Science and Technology (S&T) for socio-economic development in critical areas of agriculture, industry, environment, some aspects of public health and social sciences. Additionally, CSIR's mandate includes improving the scientific culture of civil society in Ghana; with the ultimate goal of promoting accelerated national development. The Research and Development (R & D) programmes of the CSIR are grouped under seven thematic areas, namely:

- Food Security and Poverty Reduction
- Climate Change, Environmental Management and Green Technology
- Materials Science and Manufacturing
- Energy and Petroleum
- Bio-medical and Public Health
- Electronics and ICT
- Science and People

2.1 Food Security and Poverty Reduction

2.1.1 The Use of Mobile Phones 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.

Start Date: January 2020

Duration: 3 years 2 months

Sponsors: GoG

Collaborating Institution: CSIR-Oil Palm Research Institute

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. 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. They promote social and business networks, and they replace journeys, brokers, traders and other business intermediaries. 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. 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, the study 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 costs in developing countries.

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 was 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°. 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 characterised 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. 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. About 50% of oil palm farmers produce palm fruits on contractual agreements with Ghana Oil Palm Development Company (GOPDC), the largest palm oil production company in Ghana. GOPDC also produces about 30% of oil palm whilst 70% of 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.

Research Design

A survey research investigated 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 elicited responses pertaining to small-scale oil palm processors' demographic characteristics, ascertained the Importance of Mobile Phone use to oil palm processors, determined the motivation for oil palm processors use of mobile phones in the study area, identified the constraints in the use of mobile phones by oil palm processors and established the relationship between oil palm processors demographic characteristics and their mobile phone usage.

Sampling Method

The population for this study was 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 was considered for this study. A random sampling technique was 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 Processors Association. All the 120 cases were analysed, representing 100% of the total sample. The focus of the field survey was on small-scale Oil Palm Processors. The distribution and location of Oil Palm Processors are shown in Table 2.1.

Table 2.1: 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**

Materials and Methods

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

Results Achieved

Data has been analysed, a manuscript produced and submitted to Cogent Social Sciences Journal (Taylor and Francis – UK). The paper had been accepted for publication after peer review. The publication of the paper draws the curtains on the project.

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. & Koranteng, I. M.

Start Date: February 2020

Duration: 18 months

Sponsors: GoG

Collaborating Institution: Nil

Location: CSIR-INSTI

Introduction

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 Africa where more than 10 million tonnes are produced annually and are traded locally. Figures obtained from the FAO 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. In the Ghanaian agricultural sector, plantain is ranked third after yam and cassava 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.

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

Plantain is a seasonal crop with a 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. 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 waste of resources. Marketing conditions had changed because the sector was ignored. The plantain market is a perfectly 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.

The marketing and post-harvest handling systems of plantain in Southern Nigeria indicate 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 diasporan nature of the production areas, the absence or poor conditions of roads, poor lines of communication with urban consumption centres and the irregular supply 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 the 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 with 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. The middlemen performing the role

of marketing are being accused of earning higher profits 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 as buying brokers. From 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 sell their produce to the consumer (buyer) at an agreed price; any attempt by the outside intermediary is often met with very stiff resistance. 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 consumers are industrial users.

The retailers also have three sub-groups: They are sedentary or stall retailers, itinerant retailers (hawkers) and the farmer retailers. 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 was conducted in 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 to 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 livelihood 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 in 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 were members of the plantain sellers association in the Agbogbloshie market in Accra, Ghana. A survey design was adapted for the study. A random sampling technique was 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 was 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. 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. Data collection was through the use of a structured questionnaire administered through face-to-face interviews. Data collected included 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 was 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

Data has been analysed and the technical report is at the editing stage.

Way Forward

Technical report and manuscript are being prepared.

2.2 Climate Change, Environmental Conservation and Green Technology

2.2.1 Changes in Ecosystem Services in Riparian Forests Amidst Climate Change: A Case of The Densu River Basin

Research Team:	Allotey, A. N. M., Asiamah, T. A., Limantol, A. M., & Wiafe, E. D.
Start Date:	June 2022
Duration:	6 months
Sponsors:	Self-sponsored
Collaborating Institutions:	University of Environment and Sustainable Development (UESD), Dodowa
Location:	University of Environment and Sustainable Development (UESD), Dodowa

Introduction

Riparian forested catchments consist of freshwater, vegetation and all life species that depend on the water and vegetation, including human life. These dynamic ecosystems provide a greater portion of water for domestic, agricultural, commercial, and ecological needs of the environments upstream and downstream the catchment. The hydrological and geomorphic setting can be affected by natural and anthropogenic activities interacting at multiple spatial and temporal scales to influence the composition, ecological processes, and ecosystem functions of the catchment. Consequently, the functions of forested catchments are highly susceptible to climate change and anthropogenic activities.

Each component of the catchment provides functions that sustain life in the ecosystem and also provide services for human life. The freshwater serves as a habitat for various aquatic species such as fishes, invertebrates, floating and submerged aquatic macrophytes, and other aquatic flora and fauna. The water also helps in regulating flooding and droughts in the catchment. The hydrological regime influences several physical and chemical properties of freshwater systems, such as soil and water salinity, nutrient availability, soil anaerobiosis, pH, and deposition and removal of sediments. This

makes the environment stable for the various fauna and flora species. Studies reveal that through feedback mechanisms, changes in the physical and chemical properties of freshwater systems and interactions with biotic components can influence and change the hydrological regime. The forest regulates water flows and influences the availability of water resources, and serves as a habitat for animal species found in the catchment. This has been a contributor to some processes such as carbon sequestration and storage. The forest also protects the freshwater system, serving as a water purification component and a source of bioenergy for human life and feed for animal species.

Human life is directly and indirectly dependent on forest catchments through the provision of livelihood sources. Fishing activities are carried out in the freshwater, while food is obtained from the forest through farming activities. Furthermore, water from the freshwater system serves domestic purposes, watering livestock, crop irrigation and other commercial purposes. Fuel wood is also obtained from the forest. Cultural values are also obtained from both the water bodies and forest resources. In many cases, the natural resources surrounding communities drive the livelihood activities of the communities. Communities trade around the natural resources and their value chains to the extent that the prevention of access to the resources for any reason results in economic and social implications. A study on the Densu River Basin reveals social and economic costs such as unemployment, decreasing incomes, increasing crime rates, out-migration, etc., following conservation strategies which prevented communities from using the water resources. This study differs from previous studies by employing a multi-approach to examine the changes in land use/land cover over time. Biophysical, social and anthropological approaches are employed in this study.

Objectives

To assess the changes in ecosystem functions of the Densu River Catchment over a period of 30 years and establish the underlying causes of the changes.

Materials and Methods

1. Remote sensing techniques is one of the modern tools used to monitor changes in the land use and land cover. On that basis, the research would make use of satellite imagery to analyse the land use/land cover changes over 30 years (1991, 2002, and 2021). The specific years would be selected based on availability of satellite imagery and those with less than 20% cloud cover. The satellite scenes would be acquired

in the dry season to minimize the influence of seasonal variations and for effective comparison. Besides, ancillary data consisting of existence land/use cover maps and Global Position Systems (GPS) points recorded from the field would complement the analysis. The Landsat imageries would be downloaded from the USGS website.

2. Socio-economic survey: The communities within the Densu River Basin (DRB) catchment will consitute the study population. A total of 14 communities along the DRB would be selected for the study. The DRB would be segregagted into three. The upstream towns include Mangoase, and Akwadom and their environs. The mid-stream are Nsawam and Doboro and their environs would be selected. Finally, Weija and Oblogu and their environs would be selected as downstream towns. A total of 458 respondents would be interviewed in the survey by administering a questionnaire to all the respondents.

Results Achieved So Far

- Conference presentation
- Manuscript submitted to Land Use Policy

Way Forward

Waiting for a response on the manuscript

2.2.2 A Geospatial Inventory System for Sustainable Mobility in Ghana

Research Team: Dziwornu, M. G., Kofie, R. Y., Allotey, A. N. M., Laryea, B., Agyarko, F. F., Mensah, E. A., Tsepko, E.K, & Abban, K. G

Start Date: October 2022

Duration: 10 years

Sponsors: In search

Collaborating Institutions: None

Location: CSIR-INSTI

Introduction

Sustainable transport and mobility are important ways to help achieve Sustainable Development Goals (SDG). More specifically, the Global Plan for the Decade of Action for Road Safety 2011–2020 released in 2011 included road traffic injury prevention as Target 3.6 of the Sustainable Development Goals (SDG) in 2015. Poor road network infrastructure is a growing problem around the world and in developing countries. The implications of poor road infrastructure on road traffic and pedestrian safety and economic development have been well documented. For instance, poor road surface conditions are one of the leading causes of road accidents in many parts of the world.

In many African countries, road accidents are the third major cause of fatalities after Malaria and HIV/AIDS. Statistically, it has been noted that 72 persons per 100,000 population sustained serious injuries, and about eight persons per same population died from Road Traffic Accidents (RTAs) over the past decade in Ghana. Demographically, more than 60% of road traffic fatalities were children and young persons under 35 years of age. A plethora of studies on risk factors associated with road traffic accidents in Ghana reveal most causes are driver-centric, such as over-speeding, reckless overtaking, and drunk and fatigued driving. There is, however, little work on how to leverage information and communication technology systems such as geospatial technologies for road traffic and pedestrian safety improvement.

Objectives

This project proposes a mapping system to detect road anomalies such as potholes for pedestrian and driver safety.

Materials and Methods

The first part of the methodology was divided into two phases. These are the App/Web Development Phase and the Telegram Bot Creation Phase. Below is a detailed elaboration of the various phases in the methodology.

1. App/Web Development Phase: The website's main features include a geolocation API integration with Google Maps API that allows users to easily identify the location of the pothole and store an image of the pothole. The website is designed to be user-friendly and accessible to users of all levels of technical expertise. This phase was accomplished in two respective stages.

Stage One (Ui/Ux Design): The website was designed with user experience in mind to ensure that users can easily navigate and use the platform. The website design is user-friendly and responsive on all devices, including mobile phones and tablets, making it accessible to users regardless of their device. When a user opens the website, they are presented with the homepage, which includes a call-to-action button prompting them to get started. Upon clicking the button, the user is redirected to the registration page where they can enter their name and phone number to register on the platform.

After a successful registration, the user is redirected to the data collection page where they can click the "Get Location" button to capture the GPS location of the pothole. The user can then upload pictures of the pothole and submit them to the database. The user interface was designed with simplicity and ease of use in mind to ensure that users can quickly and easily complete the data collection process. The design also incorporates visual cues and clear instructions to guide users through the process and ensure that they understand what is expected of them. Overall, the UX design of the website is intuitive and user-friendly, making it easy for users to contribute to the database and help improve road safety in Ghana.

Stage Two (Technical Details): The website was built using HTML, CSS and JavaScript. The team used Visual Studio Code as the primary Integrated Development Environment (IDE) for development. One of the major technical challenges encountered during development was making the website responsive on all devices, including mobile phones and tablets. However, the team was able to overcome this challenge by implementing a mobile-first design approach and using responsive design techniques such as media queries and flexible grid layouts. The team also utilized various libraries and frameworks to enhance the website's functionality and performance. For example, they integrated the Google Maps API to allow for geolocation data collection, and they used jQuery to simplify and streamline the JavaScript code.

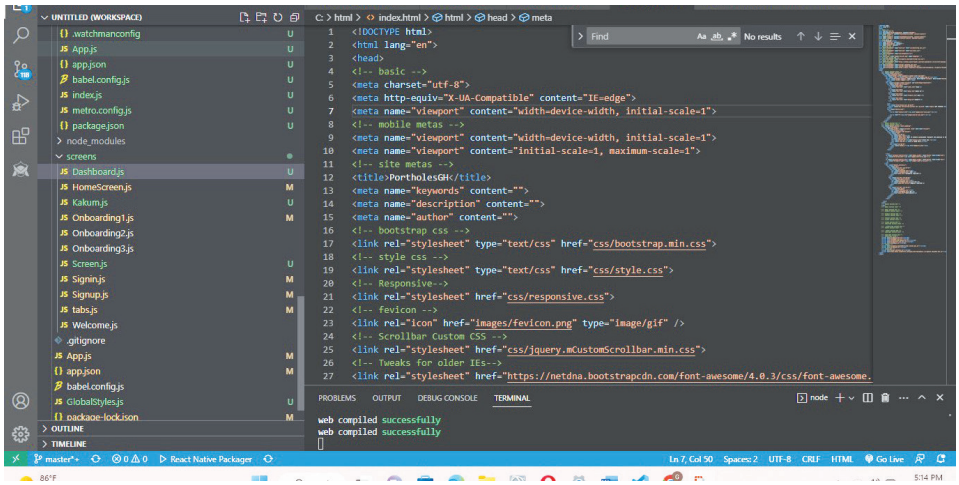


Fig 2.1 A Visual Representation Of the codes using HTML, CSS and JavaScript

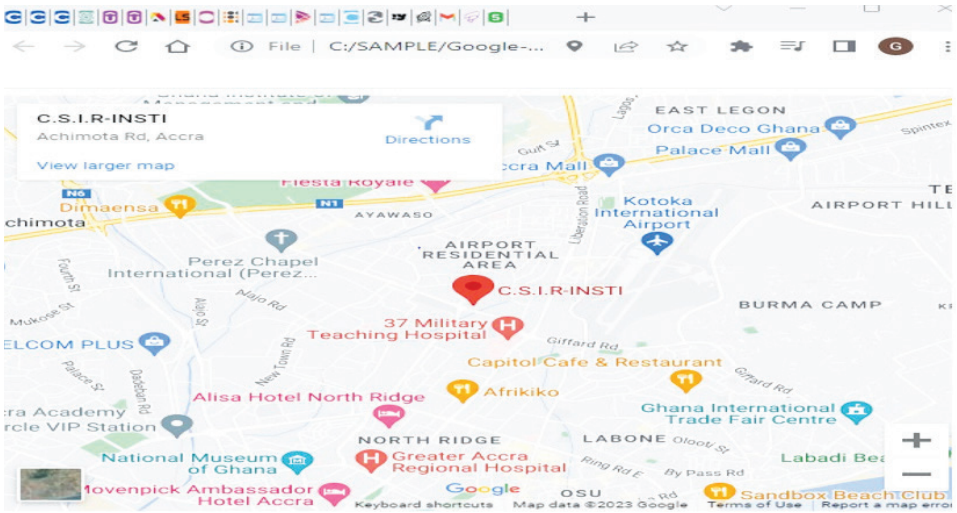


Fig 2.2 A Visual Representation of Google Map Geolocation API

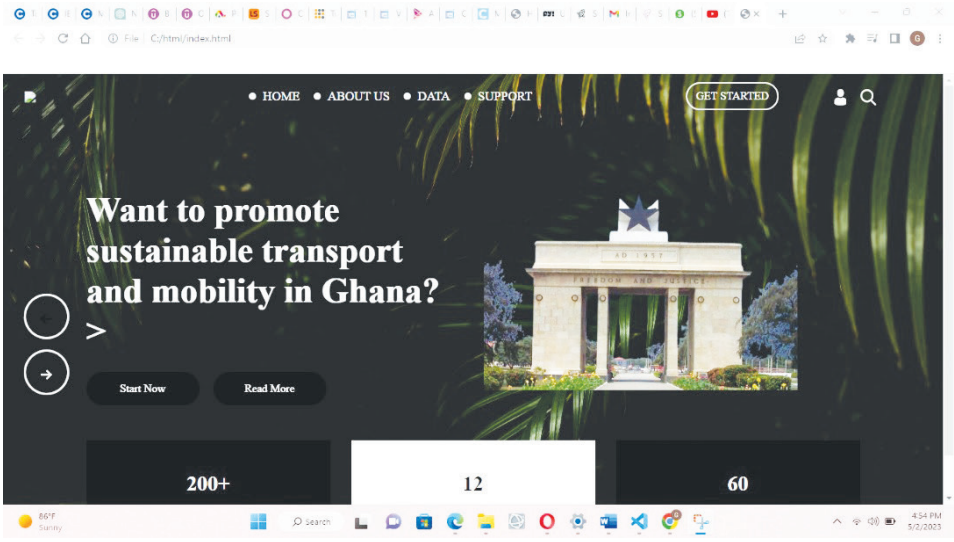


Fig 2.3 User Interface for The Website

2. Telegram Bot Development Phase: To achieve this goal, the following steps were taken as detailed below.

   Bot Registration: This began by registering our bot with the Telegram protocol and obtaining an access token. The access token allowed the bot to interact with Telegram users.

   Enabling Location Feature: Next, we enabled the "location" feature for our bot by sending the '/setprivacy' command to the Telegram protocol and setting the privacy mode to "disabled". This allows our bot to receive location updates from users.

   Extracting Pothole Location Data: When a user shares the pothole location with our bot, the bot receives a message containing the location coordinates in the format of latitude and longitude. We use the Telegram API to extract these coordinates and store them in a database.

   Establishing Database Connection: To store the location data in a database, we needed to establish a connection to the database. We used Python programming language and PyMySQL library to connect to a MySQL database.

Creating Table for Location Data: Once the connection was established, the team created a table in the database to store the pothole location data. The table had columns for the latitude, longitude, and other relevant information such as the user ID, date and time of the location update.

Inserting Pothole Data into Database: When the bot receives a new location update from a user, it inserted a new row into the table with the location coordinates and metadata. The team utilised SQL queries to insert data into the database.

Retrieving Data from Database: To retrieve location data from the database, we used SQL queries to filter the data based on various criteria such as user ID, date and time, or location proximity. The bot could then use this data to provide location-based services to users such as displaying nearby points of interest or providing directions to a specific location.

Results Achieved So Far

The team has successfully provided a platform for users in Ghana to collect and share pothole data, contributing to the development of a comprehensive database on pothole locations. The website's user-friendly design and easy-to-use features ensured that users of all levels of technical expertise could easily contribute to the database. Secondly, the team has successfully created a Telegram bot that can capture potholes using GPS location data from users and store it in a designated database. The bot can extract location data, establish a database connection, create a table for location data, insert data into the database, and retrieve data from the database.

Way Forward

- Deploy a geospatial app to crowdsource road anomaly data from the public.
- Organise stakeholder engagements on the role of GIS in road safety management in Ghana.
- Prepare project manuscripts for publication in international journals.
- Participate in international conferences.
- Prepare technical reports.
- Engage with prospective funding agencies.

2.2.3 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 for socio-economic survey using questionnaire has been completed.

28. A socio-economic survey using the questionnaire in all the study communities (Glefe, Pokuase, Santa Maria and Adenta) was completed.

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)

30. Dissemination of project status and preliminary results on web site (check the website: ign.ku.dk/climaccess).

    - Training of field assistants for socio-economic survey using questionnaire has been completed.

    - A socio-economic survey using the questionnaire in all the study communities (Glefe, Pokuase, Santa Maria and Adenta) was completed.

- 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.
- Dissemination of project status and preliminary results on web site. (Check the website: ign.ku.dk/climaccess).

Fig 2.4 Efforts to mitigate floods include continuously heightening barriers at entrance points.

Fig 2.5 Floods destroy roads and impede accessibility in a peripheral area of the Greater Accra Metropolitan Area

31. Trepekli, K., Balstrøm, T., Friborg, T., Fog, B., Allotey, A. N., Kofie, R. Y & Møller-Jensen, L. (2022). UAV-borne, LiDAR-based elevation modelling: a method for improving local-scale urban food risk assessment. Natural Hazards https://doi.org/10.1007/s11069.022.05308-9

32. Travelled to Copenhagen for 13 days for a successful project meeting with a focus on how to achieve the remaining deliverables.
33. Follow-up and mopping of field data was carried out.
34. Land use/cover for the study basin was accomplished with ground truthing. Such data was used to model the flooding situation in the study areas.

Way Forward

- Preparing a manuscript for submission on Emergency Services during flooding
- Preparing for end of project workshop in November 2023. This will be held in Accra.

2.2.4 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 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. 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;

- Identify the various emergency services
- Map out the emergency services using GPS
- Introduce new methods for mobility analysis,

- Identify new techniques for predicting urban floods, and
- Devise 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:

- Hospitals/Polyclinics
- Police Stations and Posts
- Fire Service
- National Disaster Management Organization (NADMO)
- Ambulance Services

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

Overall, we intend to carry out a study that would ascertain the location of flood 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

- A reconnaissance survey with the various agencies has been accomplished.
- Area identified as flood spots (blue spots) coordinates have been taken.
- Areas identified as safe havens or shelters in each study area have been identified and coordinates taken.
- Locational coordinates using GPS has been established.
- Spatial database for the locations, including flood spots, developed and draft maps produced.

- Adenta study area validated.
- Report being revised.
- Stakeholders workshop successfully organized.
- Workshop report produced.

Fig 2.6 Breakout Session at the Stakeholders' workshop

Fig 2.7 Participants at the Stakeholders' workshop

Fig 2.8 Typical road supposed to be the shortest route to flood prone area for emergency responders at AnteAku, near Santa Maria

Way Forward

A manuscript is being prepared for submission to a journal.

2.3 Material Science and Manufacturing

2.3.1 Asutsuare Rebound

Research Team: Dziwornu, G. M., & Stanek, L.

Start Date: July 2022

Completion Date: October 2022

Sponsors: Internationale Architectuur Biennale Rotterdam

Collaborating Institutions: University of Michigan

Location: Asutsuare, Greater Accra Region, Ghana

Introduction

After Ghana's independence in 1957, the village of Asutsuare became the focus of state-led, socialist-inspired agricultural and industrial development. A sugar plant was built, along with a housing estate and sugar cane plantation based on a new irrigation system. Twenty years after its closure in the 1980s, the plant was bought by Chinese investors. Today, it manufactures paper and plastic products, while the sugar cane plantation was repurposed for the farming of rice, bananas, and fish.

This project studies the reuse, reappropriation, and re-valorisation of modernist planning in Asutsuare. Retired employees of the sugar factory have been interviewed and younger inhabitants who explained how the material infrastructure and memories of the plant are a resource for imagining and producing a collective future. By juxtaposing their voices with photographs of the territory, this project revises concepts of long-term planning beyond Western narratives of postcolonial melancholy and post-socialist failure.

Objectives

To assess the accelerator from the past, specifically, the constant reinvention, appropriation, and contestation of long-term planning and investment of industrial heritage in Ghana.

Materials and Methods

The project draws on in-depth interviews with retired employees of the Asutsuare sugar factory and the inhabitants of town. The data was complemented by photographs, and archival materials from the Polish National Archives.

Major Findings

This research begins to reassess the ambiguous impact of long-term planning on the last sixty years of social, economic, and environmental transition in rural Ghana. While the irrigation system became a crucial resource for the development of Asutsuare, this development has been also undermined by the continuing conflicts around land taken over by the state in order to establish that very system. While the repurposed buildings are not always adequate for new programs, they have often become nodes of new activities and investments for which there was no funding available. While many inhabitants in Asutsuare appreciate the state-led development from the Kwame Nkrumah era, they appropriate it for individual entrepreneurship. We understand these ambiguities not as evidence of failure, but as an invitation to rethink the future in a way that is equally far from modernist techno-utopia as from neoliberal rejection of long-term planning.

Fig 2.9 Asutsuare Irrigation Pumps

Fig 2.10 Asutsuare Farmer House

Fig 2.11 Asutsuare Rice Nets

Fig 2.12 Asutsuare Canalisation

Expected Beneficiaries/Potential Impact

- Government of Ghana (Ministries, Departments, and Agencies)
- International development agencies
- Non-governmental organizations
- Universities and research institutions

The project assesses the use of state-led developments of the Kwame Nkrumah era as the basis for individual entrepreneurship. Based on our findings, this contradiction is not evidence of failure, but of a resilient alternative to both modernist techno-utopias and neoliberal short-termism. The project shows the potential for the reuse of socialist infrastructure.

Publications from Project

Conference Papers

1. 10th Architecture Biennale, Rotterdam, Netherlands, 22nd September 2022 – 13th November 2022.
2. 2023 American Association of Geographers (AAG) Annual Meeting, Denver, USA, 23rd – 27th March 2023.

2.3.2 Gallium, The Linchpin of The Electronic Industry: Assessment of The Economic Viability of Gallium Extraction from The Ghana's Sefwi Awaso Bauxite Mine, Awaso, Western-North Region

Research Team: Zainudeen, M. N., & Aborgeh, G.

Start Date: October 2019

Sponsors: Partial sponsorship from CSIR-INSTI

Collaborating Institutions: GAEC-SNAS & CSIR-IIR

Location: BNARI-GAEC, CSIR-INSTI

Introduction

Gallium is regarded as a linchpin of the electronic industry due to its overwhelming application in the semiconductor industry; gradually replacing silicon (Si) as the most preferred metal used for most semiconductor electronic gadgets. Ghana's bauxite ore are exported chiefly for its alumina content. Interestingly, bauxite ore contains other precious metals (often referred to as critical metals) like gallium (Ga), lithium (Li), platinum (Pt) and scandium (Sc). For decades Ghana continuous to export bauxite in the raw state with no value addition; denying the country the full economic benefits of its bauxite ore. The study therefore, assessed the economic viability of Gallium (Ga) in Bauxite Ore Deposits at Sefwi Awaso, Southwestern Ghana.

Objectives

- Geochemical and mineralogical characterization of the bauxite ore
- Estimation of the percentage recovery of gallium from various size fractions of bauxite ore after autoclave digestion and solvent extraction of gallium; with subsequent chemical characterization of gallium extract;
- Evaluation of the alumina [Al(OH)3] masking efficiency after autoclave digestion prior to solvent extraction; and characterization of masked Alumina for the presence of residual gallium; and, Comparative estimation of the economic viability of gallium in Ghana's bauxite ore

Materials and Methods

Materials: Bauxite Ore; NaOH pellets; HCl, Al(OH)3 crystals

Equipment: Top loading Status Autoclave; AAS; NAA; XRD; XRF; Water bath; Fritsch Pulverisette 2 Jaw Crusher, Aspirator (Laboport vacuum pump); Magnetic stirrer/hotplate; Multimeter; Chemical Balance and Separating funnel.

Extraction of Ga from bauxite ore was done using the Bayer process (autoclave digestion of ground homogenate of bauxite ore to obtain the pregnant liquor. By subjecting this liquor to crystallization using Al(OH)3 crystals as seed, the supernatant liquid obtained was concentrated via evaporation. The resulting aqueous solution (spent liquor) which by now was rich in gallium, underwent liquid-liquid extraction using Kelex-100 as main extractant, ethanol as modifier and kerosene as diluent. The levels of Ga and Al in the various fractions of the ore, with their respective spent liquors, were assessed using XRF spectrometry, k0-INAA and atomic absorption spectrometry (AAS). A mass balance was used to account for extraction efficiency.

Major Findings

The analysis of the ore, suggested that; hematite, Geothite, Gibbsite, Quartz, Rutile and Alabandite were the identified minerals in the Awaso bauxite ore; with Gibbsite being the dominant mineral, while the other minerals were identified in trace amounts. The overwhelming dominance of gibbsite is amply established by the huge presence of the red peaks representing it. The presence of the other minerals (quartz, rutile, goethite, hematite and alabandite) is established by the brown, pale mauve, lemon green and blue coloured peaks in the background.

The percentage (%) composition of the identified minerals is presented on a pie chart shown below.

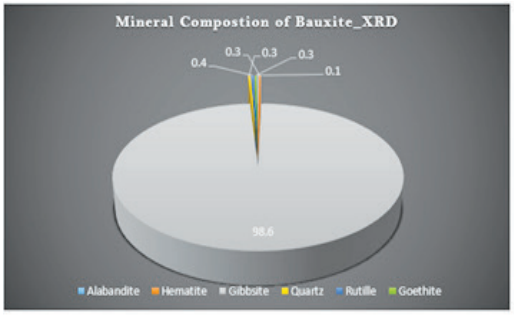


Fig 2.13 Percentage composition of identified minerals

The ore is dominantly gibbsite, Al(OH)3, with an estimated composition of 98.6%. Quartz, rutile, goethite, hematite and alabandite were present in 0.3%, 0.4%, 0.3%, 0.3% and 0.1% respectively.

Expected Beneficiaries/Potential Impact

The country at large is supposed to benefit since awareness has been created of the presence of critical mineral in the ore and possibility of its extraction.

Way Forward

- Research into the feasibility of applying the extraction technique to remove heavy metals from contaminated water in the 'galamsey' sites as a way of remediating the water bodies of harmful pollutants for the rural communities.
- Investigation and purchase of bits of the equipment to run the extraction process and alternative parts for fuel cell unit.
- Entering into agreement with the collaborating agencies at IIR and GAEC-SNAS to allow the Pilot Hydrogen production unit be brought into the FSD.

2.4 Electronics and ICT

2.4.1 Information Security Practices

Research Team:	Danquah, P. A, Asiamah, K., Prikutse, F., & Gordon, V.
Start Date:	June 2020
Duration:	36 months
Sponsors:	In search
Collaborating Institution:	None
Location:	CSIR-INSTI

Introduction

Information security is indispensable for the efficient operation of any organization in the financial sector. This study aims to evaluate the information security best practices and information technology (IT) disaster recovery preparedness of government ministries and the microfinance industry in Ghana.

This study aimed to determine if organizations adhere to information security best practices by evaluating their preparedness for Information Technology (IT) disaster recovery.

The assessment is based on the existence of documented policies, designated personnel, and internationally recognized benchmarks for information security best practices, documented IT disaster recovery plans, evidence of IT disaster recovery plan implementation, and the existence and evidence of IT disaster recovery best practices.

The research strategy was a mixed-method sequential exploratory design with an initial emphasis on qualitative data through preliminary interviews, followed by the accumulation and analysis of quantitative data. The purpose of this strategy was to use the initial findings to create a survey instrument for a larger sample. A summary analysis of the collected data indicates that the Ghanaian government ministries have generally poor information security practices and inadequate IT disaster recovery readiness. In addition, the results to date suggest that the Ghanaian microfinance industry has typically poor

information security practices. However, IT disaster recovery preparedness is relatively improved, with frequent backups being a prominent feature.

Objectives

The objective of this research is to critically assess information security best practices and IT disaster recovery readiness in various sectors of Ghana.

Materials and Methods

The research approach was a mixed-method where the data collection, data analysis, and interpretation of the evidence is purposefully done. Purposeful data integration is used to provide a broader view of the research setting, thus viewing the phenomena from different perspectives.

Results Achieved So Far

Research work has been successfully done for the Government Ministries and the Microfinance Sector, indications from the output show the need to significantly improve upon best practices in information security and disaster recovery readiness. Three journal articles have been published so far:

Danquah, P., Bekoe, S. & **Gordon, V.** (2022) An empirical assessment of information security best practices and information technology disaster recovery readiness in Ghanaian micro-finance sector, International Journal of Business Continuity and Risk Management, Vol.12 No.1, pp.42-61, DOI: 10.1504/IJBCRM.2022.121647

Danquah, P., Kani, J.A. & Bibi, D. (2022), Internet fraud: The influence of Identity Flexibility and Dissociative Anonymity, East African Journal of Information Technology, Vol. 5 No 2, pp. 39-52

Frempong, M.A. & **Danquah, P.A.** (2022), Reliability of Digital Evidence and Legal Matters: Ghana in Perspective, International Journal of Computer Applications (0975 – 8887), Volume 184, Issue No.8, pp. 9-17.

Way Forward

Working towards completion of data collection for a paper titled “Assessing Information Security Practices: A Structural Equation Modeling Approach”.

2.4.2 An Ant Colony inspired approach to Decentralized Data Processing for Load Balancing in IoT

Research Team:	Wilson, M., Boateng, K. O, & Nunoo-Mensah, H.
Start Date:	June 2021
Duration:	36 months
Sponsors:	None
Collaborating Institution:	KNUST
Location:	CSIR-INSTI

Introduction

Nature's success in optimally solving problems with high complexity, extreme diversity and dynamism have been the backbone for a class of meta heuristic optimization techniques classified to be bio-inspired. Bio inspired algorithms have been studied extensively in past decades for optimization in computing. The stochastic nature of bio inspired algorithms present an advantage over their deterministic counterpart approaches when size and complexity increases. In this field, the distributed and indirect interaction among social insects (who live in colonies) in solving complex problems have been studied and adapted extensively for the design and implementation of distributed swarm-based intelligence systems in computer science. The coordination of activities of these social insects have been studied to be both flexible and robust. These two features respectively allow their adaptation to dynamically changing situations while keeping the colony functioning even when some insects refuse to perform their tasks.

This work identifies the absence of centralized processing in optimization solutions using Ant Colony Optimization as a key advantage of ACO that makes it a possibly fit algorithm for adaptation to the load balancing optimization problem in mobile edge computing. Adapting ACO for the above optimization problem requires that artificial ants are defined and the optimization problem formulated in a way that can be used by the defined artificial ants to build a solution.

Objectives

1. Design load balancing algorithms to ensure that some node resources in a collaborative computational network are not overburdened while at the same time, other nodes are relatively idle.

2. Design load balancing algorithms to ensure that local node activities are not adversely affected by global tasks during collaborative computing.

Materials and Methods

The load balancing optimization explored in this work adopts the ACO following the steps outlined below:

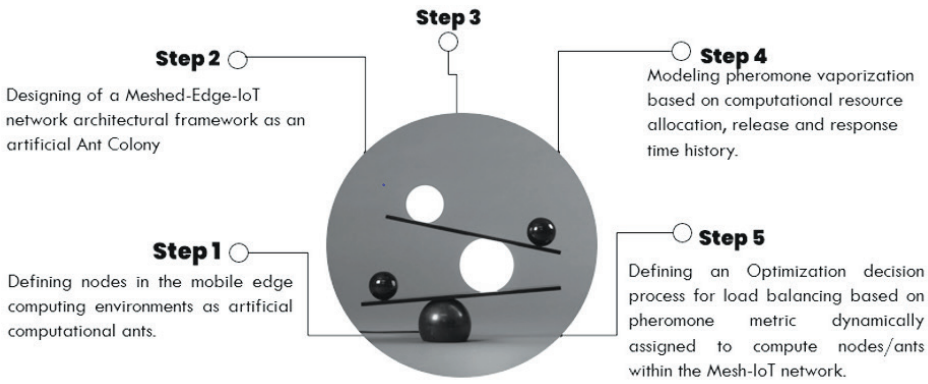


Fig 2.14 Modeling of pheromone as an ant computation capacity and availability metric

Results Achieved So Far

1. Definition Of Edge-IoT Node Structure – An Ant

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

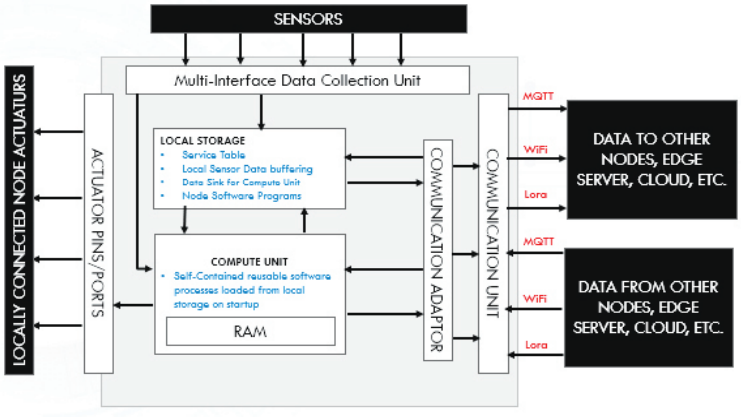


Fig 2.15 Framework of Ant Colony inspired approach to Decentralized Data Processing for Load Balancing in IoT

2. Conceptual Design of Meshed-Edge-IoT Network Architecture – Artificial Ant Colony

The proposed Mesh-IoT Network as an Ant Colony consists of Radio or wireless nodes with embedded multifaceted wireless and/or wired network interface modules and interconnected by a hybrid mesh network architecture having three data processing tiers logically represented as below:

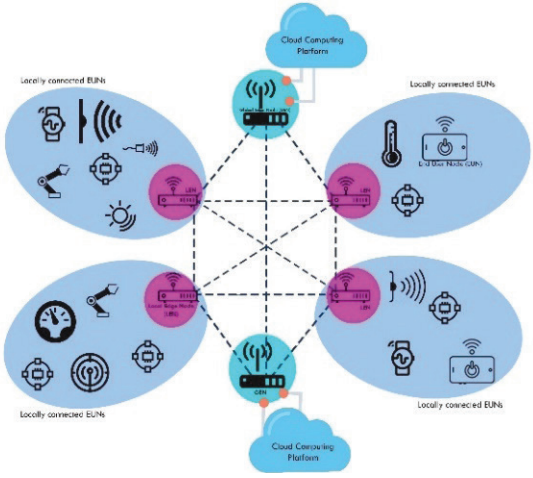


Fig 2.16 Meshed-Edge-IoT Network Architecture - Artificial Ant Colony

3. Meshed-Edge-IoT Computational Load Balancing – Aco Inspired Decision Making Process

Step 1 – Initialization

All ants within the ME-IoT colony are assigned an initial compute pheromone value of zero when they join the network.

Step 2: Task definition

Computational tasks are defined with a header specifying an estimated number of instruction sets required to execute the job and the Turnaround Time Constraint (TTC) for job's execution.

Step 3: Task assignment handshake

- A requesting ant sends a Turnaround Time Resolution Call (TTRC) containing only the job header to all directly reachable ants.
- Each receiving ant will compute an Estimated Turnaround Time (ETT) using its current pheromone value and its available compute resources (minus resources being used by local and other global jobs)
- Only ants with ETT value below the turnaround time constraint of the RTRC will respond to the call with an RTRC_ACK message containing their Ant ID (MAC Address), current pheromone value and the computed ETT value.

Step 4: Task Assignment

The requesting ant uses the Roulette Wheel genetic selection method to select one of the responding ants after computing the probability of each ant to complete the task on time using their pheromone values and ETT.

Step 5: Pheromone Update

After the job is completed and submitted, the difference between the estimated response time and actual response time is modeled into a pheromone deposition or vaporization metric by the receiving ant and sent as feedback to update (vaporize or deposit) the

responding ant's pheromone value.

Step 6: Task Forwarding

- In a case where, no reachable ant within the local mesh responds within a specified time. The RTRC expires and the requesting ant sends another RTRC to its connected Local Edge Nodes (Master Ants).
- Steps 3-5 are repeated for the Master Ants. Failure to get a Master Ant with the ability to satisfy the TTC for the request triggers a fallback to cloud servers for task processing.

Modeling of Compute Pheromone

Pheromone Deposition has been modeled as below:

- $\Delta\tau^{k}_{i,j} = 1 - \frac{Ra-Re}{TTC-Re}$, for Re > Ra < TTC
- $\Delta\tau^{k}_{i,j}$ = 1 , for Ra < =Re
- $\Delta\tau^{k}_{i,j}$ = 0 , for Ra >= TTC

Without any vaporization, the total pheromone deposition on an ant will be as shown below:

$\Delta\tau^{k}_{i,j}$ $\Delta\tau^{k}_{i,j}$

$\Delta\tau^{k}_{i,j}$ represents the amount of pheromone deposited by the kth request ant on the ith processing ant for processing its jth job.

R_e is the estimated turnaround time received from ant "i" in response to ant "k's" TTRC.

R_a is the actual measured turnaround time after job "j" was assigned to ant "k".

Way Forward

Final two stages of the proposed methodology are yet to be completed after which conferences will be attended to present the work for reviews and comments. Journal publications with technical details of the entire work will be written and submitted for publication. Finally, an attempt will be made to prototype the proposed load-balancing algorithm on a local network within a Lab environment. A successful prototype will aim at a patent for the solution.

2.4.3 Design of a Paperless Memo System for Corporate Communication in CSIR, Ghana

Research Team:	Adjah, J., Wilson, M., Sawyerr, A., Kalognia, J., Laryea,B. L.,Prikutse, F. L., & Asiamah, K.
Start Date:	October 2019
Duration:	18 months
Sponsors:	Self-sponsored
Collaborating Institution:	Nil
Location:	CSIR-INSTI

Introduction

In this technological age, great strides are continuously made at cutting down timelines in the corporate world. In the area of communication today, many media are incorporated to allow the sending and decoding of messages at a fast rate.

Memos or Memoranda are the main form of communication within an organization. Even though paper systems are still relevant, it has its demerits of paper wastage and long channels of information sharing from sender to receiver. In order to create a working ecosystem in which management reduce the use of papers and time spent printing and sending memos to every department, this project seeks to design and test an Electronic Memo System for CSIR-INSTI.

Objectives

- To develop, test and deploy a paperless memo system for CSIR-INSTI
- To commercialise a successfully tested and deployed electronic memo system for other institutes in CSIR and others.

Materials and Methods

- Assessment of current Memos
- Interviews with Administrative staff

- Designing the framework
- Piloting

The following steps will be adopted for the implementation.

- An evaluation and appraisal of the CSIR email system through data collection
- Identification and testing of email features for designing, sending, receiving and archiving memos
- Testing for efficiency and effectiveness
- Recommendation to administration for user training to be carried out to prepare respective staff.

Results Achieved so Far

Following a consultative meeting with the administration staff, the initial interface has been developed as demonstrated below. This interface has user-friendly features and comprises three primary sections tailored for different types of memos: Institutional, Divisional, and Personal. Each section has been meticulously designed to align with the hierarchical clearance levels observed in the traditional paper system. With these preparations in place, the system is now poised for piloting at the institutional level.

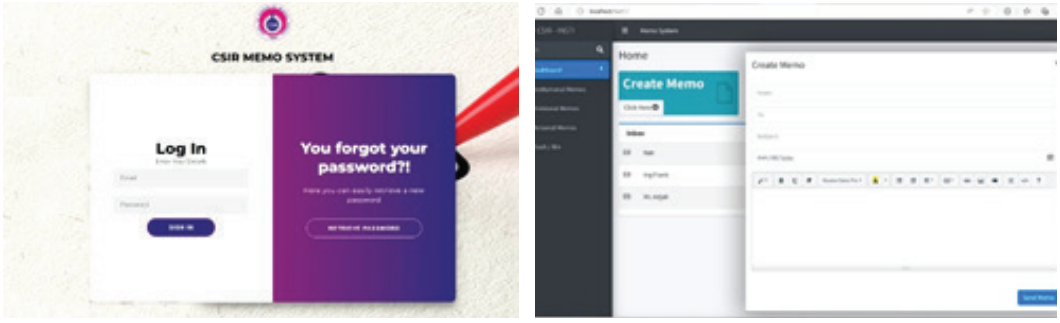


Fig 2.17 Screenshots of Paperless Memo System Interface

Way Forward

The project team is working to pilot it at the Institute level.

2.5 Science and People

2.5.1 Assessment of Cargo-Container Drivers Knowledge on Radiation Protection Rules and Procedures in the Scanning of Cargo-Containers: A Case Study of the Tema Port of Ghana.

Research Team: Sackey, T. A., Allotey, N. M., & Abdulai, S. M.

Start Date: January 2022

Duration: 18 months

Sponsors: CSIR-INSTI

Collaborating Institution: Ghana Ports and Harbours Authority

Location: Tema Port

Introduction

Radiation undoubtedly is one of the most diversely beneficial energy applications found in almost every sector of industrialization. From Agriculture where radiation is used to control or eliminate pests to Nuclear Power Generation which forms 20% of US electricity.

Scanners at the ports and harbours use relatively high doses of radiation to carry out non-invasive inspection of goods and products coming into or leaving the country. This technology has over the years helped save time and money. Radiation used at the ports are usually either X-rays or Gamma Rays. The Tema Harbour is one of the 2 main harbours in Ghana. The facility contributes to GDP through collection of duty from importers and freight forwarders.

Three main scanning ports are available at the Tema Harbour operating under the companies; Nick TC-Scan, Gateway Services Limited and Meridian Port Services.

Operators of the machinery involved in the scanning of cargo containers at the ports and harbours need to be adequately informed and protected in their line of duty. Protection includes wearing of personal protection and radiation measuring equipment, appropriate operation of warning audio and visual signs as well as following laid down radiation protection rules and regulations all with the aim of ensuring that the occupationally

exposed workers are adequately protected. Protection of the cargo-container drivers, considered as the public, who convey containers to the scanning site and remain seated in the truck during the non-invasive process of assessing the contents via exposing the container to gamma rays/x-rays of high energy, is also important. The understanding of the various rules and regulations by the cargo-container drivers may be a factor affecting how well these guidelines are obeyed.

Objectives

As per the rules of radiation protection, the main aim in usage of radiation is to keep radiation doses As Low As Reasonably Achievable (ALARA), in line with this, the main aim of this research is to assess the extent to which cargo-truck drivers understand and implement rules and regulations ensuring their adequate protection from the harmful effects of ionizing radiation during their line of duty as goods-containers transporters, to the barest minimum. Objectives include;

- To find out the current knowledge of cargo truck drivers on radiation protection rules and regulations/guidelines in the scanning of cargo-containers at the port
- To assess the extent to which cargo-truck drivers obey laid down rules and regulations related to radiation scanning at the port.
- To physically observe operation of the scanning facilities

Materials and Methods

Data to be collected will be in both quantitative and qualitative form.

Quantitatively, questionnaires distributed would be in two forms:

The first set would be issued out to operators of scanners to give a fair overview of scanning procedures at the port.

The second set, probing knowledge on radiation protection and safety would be designed and distributed among drivers of cargo vehicles whose line of work involves using the facilities of any of the radiation scanners. Questions asked will test radiation knowledge under the categories of Training, Rules and Regulations, Warning Signs, Protection Measures and Economic Measures.

Qualitative data would involve on-site surveys of procedures being followed in scanning of cargo-containers.

Results Achieved so Far

Preliminary discussions have been held with the Ghana Ports and Harbours Authority (GHPA), a representative of the Joint Association of Port Transport Unions (JAPTU), Staff and Management of the scanning companies. The discussions ensured official permission from Management and provided an overview of some institutional procedures.

Data collection has commenced. Set one of the questionnaires have been filled with operators of the scanners at the port. Distribution and completion of set two of the questionnaires which probes the knowledge of cargo-drivers on radiation protection and safety has commenced and is 50% complete.

Fig 2.18 Interactions with a cargo-truck driver

Way Forward

Data collection using set two of the questionnaires would be completed. Data would be analysed and information drawn from it. A technical report would be written and copies presented to management of GPHA and the scanning companies. Also, a manuscript would be drafted using obtained information.

2.5.3 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, but are not the same. Land cover relates to the physical nature or form of the land surface. In its broadest sense, it encompasses vegetation, water, desert, ice and other physical features of the land including those created by man. Land use, on the other hand, describes the way and the purposes for which human beings employ the land and its resources.

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. 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 made use of 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 was used to analyse population dynamics.

The study area is contained within the Landsat path 194, row 55. Selection of the satellite images was greatly influenced by the quality of the image especially for those with limited or low cloud cover.

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

The subset images were then classified using the supervised classification technique and a classification scheme adopted from CERSIGS.

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

Major Findings

1. Over 31 years, built-up category recorded the highest percentage change (260.2%) with an annual rate of 7.7%.
2. Forest cover recorded a loss of 66.3% of area coverage with an increase in farmland from 50.8% in 1986 to 68.5% in 2020.
3. Lake Bosomtwe was contracted by 0.76 km2 over the period under review.
4. High population density (more than 200 per km2) from 1970 to 2021 was identified as one of the factors that contributed to the LULC changes observed.

Expected Beneficiaries/Potential Impact

- Promote environmental monitoring of the Lake, as a biosphere reserved
- Promote Eco-tourism by the District Assembly
- Help to provide alternative livelihood for the communities located within the 5 km buffer

Publications from Project

Allotey, A. N. M., Annor, J. & Kofie R. Y. (2022). Spatio-Temporal Mapping of Land Use/ Cover and Population Change in a Biosphere Reserve: The Case of Lake Bosomtwe Basin in Ashanti Region, Ghana. International Journal of Applied Geospatial Research (IJAGR).

3.0 PROGRAMMES AND 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. The Communications and Electronics Div isions work in close collaboration with each other to execute programmes and activities.

Grow With Google Scholarship Programme/ Consultancy Project (Sub Grant to the CSIR-INSTI Makerspace)

The sub-grant agreement between Junior Achievers (JA) Ghana and CSIR-INSTI on the Grow with Google Scholarship Programme kick-started on the 14th July 2022. The Programme trained youth between 18 and 35 years in Data Analytics, IT Support, Project Management and UX Design mainly via the Coursera platform, over a period of 3 months. Key attendees and speakers at the kick-off event included Mr. Joshua Andrews Adjei, on behalf of the Executive Director of JA Ghana, Dr. Paul Asante Danquah, CSIR-INSTI; Project Lead for the Grow with Google Scholarship Programme, Mr. Leslie Joppa, Programmes Officer at JA Ghana and Ing. Michael Wilson, Principal Investigator of the Grow with Google Scholarship Programme at CSIR-INSTI.

Fig. 3.1 Participants at the launch of Grow with Google Scholarship Programme

CSIR Online Quarterly Report Management Platform

An Online Reporting Management Platform, being developed in collaboration with the Electronics Division aims to digitally permit submission, tracking and retrieval of quarterly Research and Development, and Activities Reports, within the Institute. The software is in the late-developmental stage.

3.2 Electronics

The mandate of the Electronics 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.

Kosmos Innovation Centre Mentorship

The Head of Electronics Division, Ing. Michael Wilson served as a mentor for the Kosmos Innovation Challenge, an annual event held for Agribusiness startups. The training programme held virtually on 10th January 2022 served as a basis for possible future partnerships.

Partnership with MAXLAB

A strategic partnership between the Makerspace under the Electronics Division and MAXLAB was formed during the year. Final year tertiary students were accepted into a hardware incubation programme to undergo trainings and work on institutional applied research projects. The aim of the partnership was to transition applied research to commercialization stage.

Website Development

The Electronics Division continued with the design and development of the website for the Plant Genetic Resources Research Institute (CSIR-PGRRI). Technical and non-technical training on effective management of the website was carried out from 25th to 26th August 2022. The training covered a wide range of topics, including website design, content creation, search engine optimization, and analytics.

Ghana Portal Mobile App

The Ghana Portal Mobile App is a software developed to drive tourism in 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. Features of the App include web-view, geofencing, maps and clusters and QR Code scan, as well as a location-based tourism advertising and a direction and navigation map service that guides users to tourism sites. During the year, new posts were uploaded unto the platform, generated QR codes have been printed and framed. Discussions are on-going with the Ayawaso West Municipal Assembly for allocation of space for mounting of the QR codes.

MAG Platform Moderation and Outreach Programme

Kuafo Marketplace, Agritech Advisor, CSIR DSpace and CSIR Technologies, the 4 deliverables under the Modernizing Agriculture in Ghana, MAG, programme are all available online to the general public. Moderation of product uploads, new sign ups and management of the platforms were carried out by staff of the Electronics and Communications Divisions. Updates for the Apps will include new features such as rating and redesign of user interfaces. The Electronics Division organised visits to Techiman and Goaso in the Bono East and Ahafo Regions respectively. Farmers and Agricultural Extension Officers from close-by vicinities were educated and trained on usage of the 4 deliverables, with focus on the Kuafo Marketplace.

Fig 3.2 MAG Outreach at Goaso


Fig 3.3 MAG Outreach at Techiman

Hosting of Students from the United States Navy Academy:

The Electronics Division hosted members of the United States of America Navy from on the 13th July 2022. During their profound visit to the Institute, members of the Division took them through ongoing research activities as well as activities of its Makerspace. There were demonstrations on robot-based solutions and 3D printing by the Makerspace operations team. Two American navy badges were designed using sketch up and the 3d printer (fender).

Fig 3.4 Some CSIR-INSTI Staff with US Naval Students

Hosting of Students from the University of Ghana Agricultural Extensions Department

During the students' visit to the institute, members of the Electronics Division took them through ongoing research activities as well as activities of its Makerspace with a focus on how technology has been and can be used to increase productivity through a transformed Agriculture Extensions delivery.

Fig 3.5 Some CSIR-INSTI Staff with Students of UG Agricultural Extensions Department

MAG 2023 Deliverables

Preliminary discussions for the MAG 2023 Deliverables were held, the development of an E-learning portal was agreed upon. Stakeholder consultations led to the development of a project plan and identification of target audience, scope and objectives, timelines, a budget and resources required.

Partnership with AICCRA on the Ghana Agricultural Data Hub (AG-Data Hub)

Creating seamless access to data and information along the agricultural value chain promises a radical change in transforming agriculture and food systems around the world, towards eliminating hunger and poverty, creating truly sustainable climate smart systems and meeting the 2030 Sustainable Development. It is in the light of this that the Ghana Agricultural Data Hub (Ag-Data Hub) is being developed as a secure mission-critical, reliable, multi-tier and multipurpose digital data exchange backbone for information

and data sharing among stakeholders and for the development of fact-based decision support systems to drive policy-making and to trigger a move towards sustainable climate smart agricultural practices.

The Electronics Division facilitated a partnership bound by an MOU which positions CSIR-INSTI as the Host Institution implying. CSIR-INSTI will house the physical servers, associated accessories and provide day to day administration and operational support for the Ag-data Hub. This establishes CSIR-INSTI as a key partner on the AICCRA project for the coming year and makes the Institute eligible to receive funding from other stakeholders for the development of data tools.

Participation and hosting of session at GDIW 2022

The Electronics Division hosted a session on "Accelerating the Glocal Impact of Research in Ghana & Beyond" at the Ghana Digital Innovation Week (GDIW) held from 26th to 28th October 2022. The session engaged key stakeholders on how CSIR-INSTI is well positioned to translate research output into informative products and tools addressing pressing 21st Century needs.

Fig 3.6 GDIW 2022 Poster advertisement for CSIR-INSTI

Fig 3.7 CSIR-INSTI Presenters and general participants at the Accelerating the Glocal Impact of Research in Ghana & Beyond Session of GDIW 2022

3.3 Fluid Science

The mandate of the Fluid Science Division is 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: Statistical summary of materials received in 2022

Type of Material		№ of Copies Received	Percentage
Theses		86	3.95
Journals		101	4.64
Annual Reports		15	0.69
Books		4	0.18
Newspapers	Daily Graphic	837	38.41
	Ghanaian Times	848	38.92
	Weekly Spectator	144	6.61
	Weekly Mirror	144	6.61
Total		**2179**	**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.

3.4.2 Geographic Information Systems 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.

Mapping Activities

1. **Regional Maps**

   All 16 Regional Administrative maps of Ghana have been finalized. The Maps contain the following information;

   i. Districts in the region

   ii. Regional capitals

   iii. District capitals

iv. Towns

v. Rivers

vi. Road network

vii. Contours

viii. Insert map of Ghana showing location of the region

ix. CSIR logo

2. Ghana Districts Database:

This involved the creation of a database for all MMDA's in Ghana. The database contains the following information;

i. Settlements,

ii. Rivers,

iii. Road network

iv. District boundaries

v. Contours

The following 132 MMDA's databases and base maps were created with draft maps available.

a. Upper East region - 15 MMDA's

b. Upper West region - 11 MMDA's

c. Northern region - 16 MMDA's

d. Savannah region - 7 MMDA's

e. Volta region - 18 MMDA's

f. Bono region - 12 MMDA's

g. Oti region - 9 MMDA's

h. Bono East region - 11 MMDA's

i. Eastern region - 33 MMDA's

3. Mining Districts in Ghana

Composition and design of Mining districts of Ghana has begun.

4. Updating the District Administrative map of Ghana (MMDA's)

A second draft map of the 261 MMDA's in Ghana has been produced and their database established. Additionally, Fastest routes to flood hotspots have been generated in ArcGIS and the Adentan study site has been validated.

5. Regional land use / cover database development

A draft technical report was started. About 70% of the work has been completed

Classification was performed for the 2022 satellite image.

6. The Agricultural statistics database

Agric statistics for crops produced in the country has been updated from 2021 to cover 2020 and 2008.

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:

Fig 3.8 Some designs by the CSIR-INSTI Printing Section

Table 3.2: List of main projects implemented by printing division

№	Client	Description of Job
1.	CSIR – BRRI	Call Cards Strategic Plan
2.	CSIR – CCST	Certificates Letterheads 3rd Congregation Brochures
3.	CSIR – CRI	Letterheads Call Cards - Director
4.	CSIR – FRI	Flat folders Flyers (A5) 2021 Annual Report
5.	CSIR – Head Office	Picture Frame (Director-General) Send-off invitation cards (Director-General) Send-off programme (Director-General) Post retirement book (Director-General) Flyer - Intellectual Property Launch and Seminar Programme – Intellectual Property Launch Backdrop Banner – Intellectual Property Launch Programme: Day of Scientific Renaissance of African Celebration GJAS Volume 55(1)
6.	CSIR – IIR	Call Cards (Dr. Ampomah-Benefo) Certificates – Soap and Cosmetics Training Labels - Soap and Cosmetics Training

7.	CSIR – INSTI	2021 Annual Report
8.	CSIR – RSA	AGM Annual Report
9.	CSIR – SARI	Annual Report
10.	CSIR – OPRI	Annual Report
11.	CSIR – STEPRI	CSIR Annual Thanksgiving Programme 2021 Annual Report
12.	CSIR – WRI	Call Cards – Marketing Unit Call Cards – Director
13.	Seventh Day Adventist Church	Welfare Constitution

3.5.2 Science Publishing Section

The Science Publishing 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)

8 articles each under the Ghana Journal of Agricultural Science Vol. 57 (1) (2022) and Vol. 57 (2) (2022) were published on the AJOL website. Details of published articles are given below:

Table 3.3: Articles published in Vol 57 (1) (2022) of the GJAS

№	Title	Authors
1	Physiological Response of Rabbits to Organic Selenium: Serum Metabolites, Liver and Kidney Function Tests and Haematological Indices	E. Ewuola D. E. Akinyemi
2	Pathogenicity of Colletotrichum coccodes causing anthracnose disease and its effect on growth and yield of sweet potato (Ipomoea batatas (L.) Lam	V.O. Dania
3	Using Renewable Energy to Meet the Energy Needs of Smallholder Farmers: Are there Policies to Promote Adoption in Ghana?	R. T. V. Karbo L. J. Frewer F. Areal E. Yu
4	Gender Differentials in the Determinants of Usage of Climate Change Adaptation Strategies in Farming Communities of Ekiti and Ogun States, Southwest Nigeria	K. O. Ogunjinmi E. O. Fakoya T. A. O. Banmeke O. E. Fapojuwo A. A. Ogunjinmi
5	Economics of Bio-fortified Cassava Varieties (BCVs) Adoption and its Gender Implication Among Farmers in Oyo State, Nigeria	O. T. Olupona A. D. Kehinde
6	The Effect of Farmyard Manure and Urea on Grain Yield and Agronomic Characteristics of Maize (Zea mays)	A. Olowoake I. Afe J. A. Ojo T. M. Yusuf S. K. Subair
7	Using Benzyl Adenine or Coconut Water to Induce Taro Sucker and Stolon Production for Increased Planting Material Progation	M. O. O. Asante S. Yeboah J. Sarkodie-Addo E. O. Danquah F. Frimpong A. Amoah

8	Fungi Associated with Sweet Potato Tuber Rot at CSIR – PGRRI, Bunso, Eastern Region, Ghana	E. G. Gyasi S. Akrofi B. A. Adongo E. A. Osafo D. A. Kotey A. Mohammed

Table 3.4: Articles published in Vol 57 (2) (2022) of the GJAS

№	Title	Authors
1	Perceptions and Socio-economic Determinants of the Willingness to Pay for The Market Information System Services: The Case of Cashew Producers in Benin	G. A. Maboudou C. H. Sossou V. Codjo
2	Predictability of Live Body Weights of Locally Adapted Rabbit Kits Using Their Linear Body Measurements	J. K. Hagan B. O. Owusu B. A. Hagan
3	Domesticating Baobab Tree: A Baseline Study on Trade and Usage in Adaklu District and Ho Municipality	K. F. Egbadzor P. N. Adzoyi E. K. Ayimey D. Asante-Donyinah C. M. Klutse
4	Comparison of Single and Double-Stage Drying Methods for Processing Tropical Foods: A Case Study with Banana and Ginger	N. N. Idun-Acquah P. T. Akonor L. C. Baffour D. Mensah P. N. T. Johnson

5	Effects of Feed Restriction and Early Age Thermal Conditioning on growth Performance and Carcass Characteristics of Meat-Type Chickens	I. O. Anane K. Adomako J. A. Hamidu O. S. Olympio
6	Suitability Assessment of soils developed in Coarse-Grained Granite and Gneiss in Humid Rainforest Area of Southwestern Nigeria, for Maize and Cassava Production	R. O. Adegbenro J. O. Ojetade S. A. Muda A. A. Amusan
7	Drivers of Initial Adoption, Continuous Adoption and Dis-Adoption of Selected Rice Varieties Among Rice Farmers in Northern Ghana	C. Y. Lamptey S. A. Donkoh N. Sulemana A. Zakaria S. B. Azumah
8	Effects of Cassava Peel-Leaf Mixture Supplemented With Enzyme and Organic Acid on Growth Performance, Serum Indices and Haematological Parameters of Growing Pigs	O. S. Akinola G. A. Ajayi O. E. Oke A. T. Amos M. Sogunle-Olajide C. P. Njoku

Ghana Journal of Science (GJS established in 1968)

The Ghana Journal of Science published 9 articles in GJS Vol. 62 (2) (2021) and 7 articles in GJS Vol. 63 (1) (2022) on the AJOL website. Details of published articles are given below:

Table 3.5: Articles published in Vol 62 (2) (2021) of the GJS

№	Title	Authors
1	In Vivo Anti-Inflammatory and Analgesic Activities Of Methanol And N-Hexane Extracts Of Phoenix dactylifera Fruits	I. O. Yunusa B. B. Musa A. N. Asmau Y. S. Ruqaya H. R. Unekwu
2	Microplastics in Silver Catfish (Chrysichthys nigrodigitatus) from New Calabar River in Niger Delta, Nigeria	I. Ilechukwu G. I. Ndukwe B. E. Ehigiator C. S. Ezeh S. L. Asogwa
3	Record Of Medicinal Jew's (Auricularia auricula-judae (Bull.) Quél) Ear Mushroom Growing in The Greater Accra Region, Ghana and its Possible Health Values	G. T. Odamtten J. Addo M. Wiafe-Kwagyan
4	Knowledge on Sexually Transmitted Infections Among School-Going Adolescents in The Sunyani West District of Ghana	J. El-Duah M. J. Harris E.Appiah-Brempong

5	Occupational Hazards and Injuries Among Oil Palm (Elaeis guineensis Jacq.) Farmers in the Kwaebibirem District in The Eastern Region of Ghana	E. Decker B. Folitse S. Manteaw F. Swanzy E. Larbi S. Mahama
6	Air and Noise Pollution Effects on Air Quality in Peacock Paint Industry, Ikot Ekan, Etinan, Akwa Ibom State, Nigeria	M. N. Chukwu T. L. Akpan C. G. Okoli
7	Assessing The State of Forensic Support to Criminal Investigations in Ghana: A Case Study in The Greater Accra Region	Y. S. Sulley L. Quansah
8	Effect Of Gamma Radiation on Morphological and Molecular Character of Sphenostylis stenocarpa (Hoechst. ex. A. Rich.) Harms.	C. D. Eze A. I. Adesoye C. A. Adeosun
9	Automated Classification of African Embroidery Patterns Using Cellular Learning Automata and Support Vector Machines	K. O. Jimoh A. A. Adigun A. O. Ajayi A. R. Iyanda

Table 3.6: Articles published in Vol 63 (1) (2022) of the GJS

№	Title	Authors
1	Mycofloral Diversity and Molecular Characterization of Species Isolated from Farmer-Saved Rice Seeds in the Irrigated Rice Production Districts of the Coastal Savannah Zones of Ghana	J. Honger C. Oppong C. Amoatey

2	Growing Pleurotus ostreatus (ex. Fr) Kummer Using Gamma Radiation in Southern Ghana and its Associated Pests	D. Marri M.Y. Osae L. Quansah N. K. Kortei
3	Biogeography of snakes in Liberia: Review and Synthesis of Current Knowledge	P.J. Senter J. P. Cippaux
4	Modelling the Kinetics, Thermodynamic and Physical Properties of Coconut (Cocos nucifera L.) during Convective Drying	F. Sarpong F. Dwumfour M.T. Rashid T. Aly
5	SSR-Based Genetic Structure Study of Seventy-Eight Cowpea (Vigna unguiculata (L.) Walp) Genotypes	P. A. D. Zoryeku I. K. Asante I. K. Blay E. Ajara Seidu F. Oppong
6	Observations on Some Fairy Ring Forming Lepiota Mushrooms (Basidiomycota; Agaricales) in Ghana	G. T. Odamtten M. Wiafe-Kwagyan N. K. Kortei
7	Incidence of Blood and Meat Spots in Eggs from a Commercial Poultry Farm	M. Boateng P. Y. Atuahene K. O. Amoah Y. O. Frimpong D. B. Okai

3.6 Internal Seminars

Internal Seminars on various subject matters were organised for staff. Details are captured in Table 3.7

Table 3.7: Internal Training/Workshops 2022

№	Date	Topic	Resource Person(s)
1	Feb-March 2022	Remote Sensing and Geographic Information Systems	Dr. Albert N.M. Allotey
2	11th – 12th April 2022	In-house review Seminar	Senior Members
3	31st May 2022	Proposal Funding Attendance Tracking Online Reporting	Mr. Ezekiel Odonkor Mr. Bryan Laryea Mr. John P. Awotwi Mr. Benjamin Ohene-Affih
4	30th Aug 2022	Research Presentation	Dr. Roger Ahiadormey Mr. Ezekiel Odonkor Ing. Victor Gordon
5	15th September	Knowledge Management Strategies	Mr. Ezekiel Odonkor
6	15th Nov 2022	Thinking Statistically as a Statistician	Mr. Fred Fosu Agyarko

4.0 ADMINISTRATION AND 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

- There was a seven-member Management Board governing the Institute for the year 2022. The Board was inaugurated on 18th May 2022 at the Conference Room (1st Floor). A Management Board meeting was held on 29th September 2022.
- The eleven-member Internal Management Committee with Dr. Seth Awuku Manteaw; Director, as Chairman, saw to internal issues of the Institute for the period. Meetings dates were 15th February 2022, 23rd August 2022 and 29th November 2022.
- Additionally, staff durbars were held on 22nd February, 2nd June, 1st September and 8th December 2022.

Fig 4.1 Swearing-in of the Management Board by the Council Chair, Prof. Robert Kingsford Adaboh

4.1.2 Staff Strength

As at 31st December 2022, the staff strength of the Institute stood at eighty-six (86), which consists of twenty-nine (29) Core and two (4) Non-core Senior Members totalling thirty-three (33), thirty-five (35) Senior Staff and eighteen (18) Junior Staff. Gender distribution is indicated in Table 4.1 with details outlined in Appendix III.

Table 4.1: Staff Strength: Gender Distribution

Category/Gender	Males	Females	Total
Senior Members	26	7	33
Senior Staff	22	13	35
Junior Staff	14	4	18
Total	62	24	86

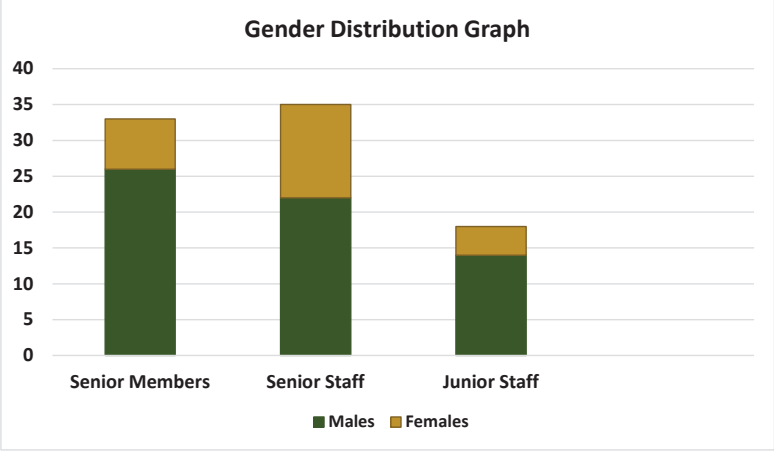


Fig 4.2 Staff Strength: Gender Distribution Graph

4.1.3 Appointments

Messrs Akilakpa Sawyerr, Atta Senior Ampofo-Addo and William Akpakli were appointed Head of Science Publishing, Scientific Information Management and Security Sections Respectively.

4.1.4 Staff Transfer

- Mr. Stephen Kwaku Asante Jnr., Accountant, was transferred from CSIR Head Office to the Institute on 10th January 2022.
- Ms. Angela Adika-Ababio, Principal Auditing Assistant, was transferred from CSIR Head Office to the Institute on 10th January 2022.

4.1.5 Newly Employed Staff

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

Table 4.2: List of Newly Employed Staff

№	Name	Grade	Division/Section
1	Dr. Derek Asiedu Pobi	Research Scientist	Electronics
2	Dr. Dennis Nana Agyemanh Gookyi	Research Scientist	Electronics
3	Mr. Alhassan Michael Arafat	Principal Technologist	Electronics
4	Mr. Cyril Nyarko Tawiah	Technical Officer	Printing & Publishing
5	Ms. Winifred Taylor	Accounting Assistant	Accounts
6	Ms. Stephanie Adwoa Nyinaku	Senior Accounts Clerk	Accounts
7	Mr. Precious Daniel Attih	Security Officer	Administration
8	Mr. Bright Kojo Yankey	Driver Mechanic Grade II	Administration
9	Mr. Simon Dunyo	Security Assistant Grade I	Administration
10	Mr. Amos Gyekye	Security Assistant Grade I	Administration

4.1.6 National Service Personnel

Sixteen (16) graduates were accepted to have their National Service with the Institute. They assumed duty in November 2021. Details of their enrolment are captured in Table 4.3

Table 4.3: National Service Personnel

№	Name	Institution	Division
1	Glover Daniella Sarah Adukwei	University of Ghana	Administration
2	Adotey K. Emmanuel	University of Professional Studies, Accra	Communications
3	Freeman Belinda	Methodist University College	Communications
4	Nyamekye Serwaa Hephzibah	University of Professional Studies, Accra	Communications
5	Abban George	University of Ghana	Electronics
6	Adambiik Angel Gabriel	Kwame Nkrumah University of Science & Technology	Electronics
7	Agor Issac Kwasi	University of Development Studies	Electronics
8	Asiedu-Gyan Prince	University of Ghana	Electronics
9	Mensah Arhin Elisha	University of Energy and Natural Resource	Electronics
10	Mensah Ephraim Akuetteh	University of Ghana	Electronics
11	Okine Morris Ayitey	University of Professional Studies, Accra	Electronics
12	Tsekpo Edwin Kofi	University of Energy and Natural Resource	Electronics
13	Hine Linda	University of Ghana	Geospatial & Info. Sc.
14	Sekoh A. Andy	University of Ghana	Geospatial & Info. Sc.
15	Jackie Michael	Kwame Nkrumah University of Science & Technology	Printing & Publishing
16	Osei Kodua Bernice	University of Ghana	Printing & Publishing

4.1.7 Study Leave

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

Table 4.4: Staff on full-time/ partial study leave with pay

№	Name	Programme/Institution	Duration
1	Mr. Mohammed N. Zainudeen	PhD Nuclear and Environmental Protection/University of Ghana	4 yrs partial study leave
2	Ing. Michael Wilson	PhD Computer Engineering/ Kwame Nkrumah University of Science and Technology	4 yrs partial study leave
3	Mrs. Maame Birago Kessey	PhD Computer Engineering/ Kwame Nkrumah University of Science and Technology	4 yrs full time study leave
4	Ms. Yvonne Dzifa Azuma	BCom Human Resource Management/ University of Cape Coast (Distance Education)	2 yrs partial study leave
5	Ms. Samiratu Mamah Abdulai	MSc Project Management/ Kwame Nkrumah University of Science and Technology	2 yrs partial study leave
6	Mr. John Paapa Awotwi	MSc Information Technology/ Kwame Nkrumah University of Science and Technology	2 yrs partial study leave
7	Ms. Naa Aku Mingle	PhD Agricultural Extension/ University of Ghana	4 yrs full time study leave
8	Mr. Samuel Ankrah	MBA Finance/ Central University College	2 yrs partial study leave
9	Mr. Eric Sam	MA Theatre Arts / University of Ghana	2 yrs full time study leave
10	Ing. Victor Dela Gordon	PhD Computer Engineering/ University of Cape Coast	4 yrs full time study leave

4.1.8 Professional Development

Ing. Michael Wilson and Ing. Frank Lemdi Prikutse were officially inducted as Professional Engineers by the Ghana Institute of Engineering on 28th March 2022 at the Ghana Academy of Arts and Sciences. Ing. Michael Wilson was awarded as Best Engineer for

the Electrical/ Electronic Engineering Division. Congratulations on their well-deserved success is extended.

4.1.9 Resignation

One member of staff resigned from service of the Council:

- Dr. Derek Asiedu Pobi, Research Scientist of the Electronics Division with effect from 23rd August 2022.

4.1.10 Retirement

Three (3) members of staff proceeded on leave during the year, they are:

- Dr. Mahamuda A. Mahamadu, Scientific Information Officer, retired from service of the Council on 7th March 2022. He began his career at the Institute as a Junior Computer Programmer on 1st October 1990. Dr. Mahamadu was a key team member of the GHASTINET Project.
- Mr. Emmanuel E. Davidson, Chief Technical Officer, retired from service of the Council on 2nd June 2022. He was employed as a Cartographic Technician (Draughtsman) on 1st June 1997. Mr. Davidson was a principal member in digitisation of identified themes into computer readable format under the then Thematic Mapping Division.
- Mr. Enos Awusie, Traffic Supervisor, retired from service of the Council on 18th May, 2022. Mr. Awusie commenced work at CSIR on 1st October 1994 as a Literate Helper. He was a major member of the Transportation Unit under the MAG Project between 2019 and 2022.

4.2 Accounts Division

Objectives of the Accounts Division for the year 2022 are listed below;

- 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 2022

Total receipts for the year under review amounted GH¢6,121,840.13 and payments totaled GH¢6,023,905.71 with a surplus net receipt of GH¢97,934.42

The receipts are made up of salaries paid by GOG from the Consolidated fund amounting to GH¢4,762,737.35. Internal Generated Fund (IGF) amounted to GH¢1,008,840.35 and Donor Funds of Gh¢350,262.43. The IGF activities included Printing, Hiring of facilities, and Consultancy.

The Institute projected to earn GH¢522,376.88 from IGF for 2022. The Payment of Gh¢5,952,991.32 for the period is made up of Compensation for Employees of GH¢4,762,737.35 as well as Goods and Services of GH¢1,190,253.97.

There was no GOG subvention received for Goods and Services during the year 2022.

Below is summarized Statement of Receipts and Payments and the Financial Position as at December 31, 2022.

Table 4.5: CSIR-INSTI Statement of Receipts and Payments for the year ended December 31, 2022

	ACTUAL 2022	ACTUAL 2021
	GH¢	GH¢
TOTAL RECEIPTS	6,121,840.13	5,743,900.52
TOTAL PAYMENTS	6,023,905.71	5,684,058.97
EXCESS/(DEFICIT)	97,934.42	59,841.55

Table 4.6: CSIR-INSTI Summary State of Affairs as at December 31, 2022

	2022	2021
CURRENT ASSETS	594,667.73	403,425.41
NON-CURRENT ASSETS	175,680.65	131,165.33
LIABILITIES	271,960.56	233,571.26
NET ASSETS/(LIABILITIES)	498,387.82	301,019.48
NET WORTH	498,387.82	301,019.48

APPENDIX I

Publications

Refereed Journal Papers

Andreasen, M.H., Agergaard, J., **Allotey, A.N.M.** & Oteng-Ababio, M. (2022) Built-in Flood Risk: The Intertwinement of Flood Risk and Unregulated Urban Expansion in African Cities. *Urban Forum 34*(12). https://doi.org/10.1007/s12132.022.09478-4

Danquah, P., Bekoe, S & Gordon, V. (2022) An empirical assessment of information security best practices and information technology disaster recovery readiness in Ghanaian micro-finance sector, I*nternational Journal of Business Continuity and Risk Management, Vol.12* No.1, pp.42-61, DOI: 10.1504/IJBCRM.2022.121647

Danquah, P., Kani, J.A. & Bibi, D. (2022), Internet fraud: The influence of Identity Flexibility and Dissociative Anonymity, *East African Journal of Information Technology, Vol. 5* No 2, pp. 39-52

Frempong, M.A. & **Danquah, P.A.** (2022), Reliability of Digital Evidence and Legal Matters: Ghana in Perspective, *International Journal of Computer Applications (0975 – 8887), Volume 184,* Issue No.8, pp. 9-17.

Manteaw, S.A. (2022), Small-scale Farmers' Information Needs and Obstacles: Evidence from the Volta Region, Ghana, *Fayoum Journal of Agricultural Research and Development, VOL. 36,* NO. 2. PP. 175-192 (2022)

Manteaw, S. A., **Folitse, B. Y**., Mahama S. & **Mingle, N. A.** (2022) Information Sources and Needs among Mango (Mangifera Indica L.) Farmers in the Shai Osudoku District, Greater Accra Region, Ghana – *Agricultural and Food Science Journal of Ghana, Volume 15*

Manteaw, S. A., **Folitse, B. Y.** and **Agyarko F. F.** Exploring the constraints of accessing agricultural credit by small-scale oil palm processors: evidence from the Kwaebibirem municipal assembly, *Fayoum Journal of Agricultural Research and Development, Vol. 37*, NO. 2. PP. 156-168 (2022)

Trepekli, K., Balstrøm, T., Friborg, T., Fog, B., **Allotey, A. N., Kofie, R. Y** & Møller-Jensen, L. (2022). UAV-borne, LiDAR-based elevation modelling: a method for improving local-scale urban food risk assessment. *Natural Hazards* https://doi.org/10.1007/s11069.022.05308-9

Conference Papers

Allotey, A. N. M., Annor J. & Kofie, R.Y. (2022, October 18-20) *Spatio-temporal mapping of land use/cover change in a biosphere reserve: The case of Lake Bosomtwe Basin in Ashanti Region, Ghana* [Poster Presentation]. 33rd RSA Annual General Meeting and 4th Scientific Conference, Kumasi

Asiamah, T. A., **Allotey, A.N.M**., Limantol, A.M. & Wiafe, E.D. (2022, September 21-23) *Changes in ecosystem services in riparian forests amidst Climate Change: A case of the Densu River Basin.* All-IUFRO Conference: Forests in a Volatile World – Global Collaboration to Sustain Forests and Their Societal Benefits, Vienna, Austria,. event092022(at)iufro.org

Trepekli, K., Friborg, T., Balstrøm, T., Fog, B., **Allotey, A., Kofie, R. Y.,** and Møller-Jensen, L. (2021): UAV-LiDAR observations increase the precision of urban flood modelling in Accra by detecting critical micro-topographic features, EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-10457, https://doi.org/10.5194/egusphere-egu21-10457, 2021.

Zainudeen, M.N. (2022, July 30). *A Comparative Review of the Mineralogical and Geochemical Composition of African Major Bauxite Deposits and their Economic Benefit,* [PowerPoint], GHASKA (Ghanaian Students in Korea and Associates) Innovation Conference.

Zainudeen, M.N., (2022, October 18-20). *A comparative review of the mineralogical and chemical composition of African major Bauxite deposits.* 33rd RSA Annual General Meeting and 4th Scientific Conference, Kumasi

Technical Reports

Kofie, R.Y. Allotey, A. N. M., Gyekye, P. M., **Annor, J. K.** (May, 2021) 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 Adentan (CLIMACCESS Project Report)

APPENDIX II

External Training Workshops/ Conferences/ Seminars & Others

Abdulai S.M. participated in a workshop on The UNESCO Recommendation on Science and Scientific Researchers on (RS|SR) 21st December 2022 at CSIR-STEPRI

Adjah J. served as a Resource Person for;

- The 7th Edition of the Cosmetics and Soap Production Training Programme on 28th July 2022 at CSIR-IIR.

Participated in;

- A workshop on The UNESCO Recommendation on Science and Scientific Researchers on (RS|SR) 21st December 2022 at CSIR-STEPRI

Agyarko F. F. participated in;

- The 2022 NEF Africa Science Week Science Communication workshop on 2nd June 2022 at CSIR-STEPRI
- The CSIR Intellectual Property Launch on 3rd November 2022 at CSIR-STEPRI.

Ahiadormey R. K. participated in;

- The 2022 NEF Africa Science Week Science Communication workshop on 2nd June 2022 at CSIR-STEPRI
- A Ghana Digital Economy Policy stakeholder consultation workshop from 15th to 24th November 2022 at the Accra Digital Centre

Allotey A. N. M. served as resource person/facilitator for the Stakeholder workshop on "The Role of Emergency Responders During Floods in Accra" on 17th August 2022 at CSIR-INSTI

Participated in;

- A stakeholder forum on Data for Coastal Adaptation Planning on 11th March 2022 at Miklin Hotel, Accra.

- A stakeholder forum on Data Coastal Adaptation Planning Report on 14th March 2022 at Mensvic Hotel, East Legon.

Ampofo-Addo A.S. participated in;

- A book launch and celebration of 2022 World Intellectual Property Day on 26th April 2022 at Kofi Annan ICT Centre, Accra.
- The CSIR Intellectual Property Launch on 3rd November 2022 at CSIR-STEPRI.

Annor J. served as rapporteur for the Stakeholder workshop on "The Role of Emergency Responders During Floods in Accra" on 17th August 2022 at CSIR-INSTI

Asante S.K. participated in;

- A refresher workshop on MAG Financial Guidelines on 25th January 2022 at CSIR Head Office.
- The Annual Accountants meeting to strengthen the Financial Management and Reporting system from 29th to 20th November 2022 at CSIR-PGRRI

Asiamah K. participated in;

- The 2022 NEF Africa Science Week Science Communication workshop on 2nd June 2022 at CSIR-STEPRI
- The 2nd Ghana Digital Innovation Week from 26th to 28th October 2022 at the Accra Digital Centre

Awanyo D. participated in the CSIR Administrators Conference on from 30th November to 1st December 2022 at CSIR Head Office.

Awotwi J.P. participated in;

- The Digital Hub for West African Food Resilience Programme on 28th July 2022 at the Airport View Hotel, Accra
- The 2nd Ghana Digital Innovation Week from 26th to 28th October 2022 at the Accra Digital Centre

Azuma V.Y. served as rapporteur for the Stakeholder workshop on "The Role of Emergency Responders During Floods in Accra" on 17th August 2022 at CSIR-INSTI

Danquah P.A participated in;

- The Digital Hub for West African Food Resilience Programme on 28th July 2022 at the Airport View Hotel, Accra
- The 2nd Ghana Digital Innovation Week from 26th to 28th October 2022 at the Accra Digital Centre, as a presenter

Decardi-Nelson A. participated in;

- A workshop on Learning Best Practices of Publishing Processes/Management organised by the Ghana Publishers Association on 25th March 2022 at CSIR-STEPRI.
- The CSIR Intellectual Property Launch on 3rd November 2022 at CSIR-STEPRI.
- The Learning Best Practises of Publishing Processes/Management on 25th March 2022 at CSIR-STEPRI

Dziwornu M.G.;

- Served as rapporteur for the Stakeholder workshop on "The Role of Emergency Responders During Floods in Accra" on 17th August 2022 at CSIR-INSTI

Participated in;

- The RSA Southern Zone's Webinar Series 1 on Cyber Security and Artificial Intelligence for Research and Development on 18th March 2022, as an organiser and presenter.
- The 2022 NEF Africa Science Week Science Communication workshop on 2nd June 2022 at CSIR-STEPRI
- The virtual 10th Architecture Biennale from 22nd September to 13th November 2022 at Rotterdam, Netherlands.

Folitse B.Y. participated in; The Science Barcamp on "Making Science Matter: Moving from Research to Policy" on 2nd November 2022 at CSIR-STEPRI

Gordon V. D. participated in;

- The GRASAG Thesis Series and Data Analysis Workshop from 23rd to 24th August 2022.

- A workshop on E-resources, Anti-plagiarism Software (TURNITIN), Electronic Thesis Submission Repository and Mendeley for First Year Graduate Students on 29th September 2022 at the University of Cape Coast
- The Ghana Science Association 18th Biennial Workshop on Achieving Ghana Beyond Aid: Positioning TVET to Drive Ghana's Industrialisation in a Post Covid Era on 12th October 2022 at Koforidua Technical University
- The International Conference on Frontiers in Cyber Security from 13th to 15th December 2022 at Golden Tulip, Kumasi

Kofie R.Y. served as resource person/facilitator for the Stakeholder workshop on "The Role of Emergency Responders During Floods in Accra" on 17th August 2022 at CSIR-INSTI

Kwofie E.A. participated in a 3-day workshop on Disaster Telecommunications from 19th to 22nd May 2022 at the World Food Programme/UNHRD, Accra

Lettu C. served as rapporteur for the Stakeholder workshop on "The Role of Emergency Responders During Floods in Accra" on 17th August 2022 at CSIR-INSTI

Manteaw S.A. participated in;

- A study tour of Agricultural Biotechnology Policy, Regulatory and Commercialisation Infrastructure for PBR-Cowpea from 4th to 8th April 2022 in Abuja, Nigeria, on behalf of the Director-General.
- The 2nd Africa-Wide Science, Technology and Innovation (STI) Conference from 26th to 28th April 2022 at the Kigali Convention Centre, Rwanda.
- The CORAF Symposium in the framework of the TARS Project from 19th to 21st July 2022 in Benin.
- A Nationwide Baseline Social and Economic Survey on the Generation of Electricity Using Nuclear Technology in Ghana Dissemination workshop on 16th August 2022 at the University of Ghana
- The 2022 West and Central Africa Agricultural Research Leaders' Forum from 19th to 21st October 2022 in Yaounde, Cameroon.

- The Technologies for African Agricultural Transformation (TAAT) Phase 2 and TSF Programme Launch from 2nd to 4th November 2022 in Cotonou, Benin

Mingle N.A participated in;

- A forum on Science Communication for Policy on 30th November 2022 at the University of Ghana
- A workshop on The UNESCO Recommendation on Science and Scientific Researchers on (RS|SR) 21st December 2022 at CSIR-STEPRI

Odonkor E. participated in;

- An Online Course on Knowledge Management for Agricultural Development (KM4AgD) Challenge from 10th June to 16th September 2022.
- A webinar on Publishing Ethics on 16th October 2022.
- The Online RSA Statistical Analysis using SMART PLS on 15th and 16th November 2022.
- The Digital Climate Advisory Services (DCAS) Training from 8th to 9th December 2022 at Sunlodge Hotel, Accra

Opoku E. participated in;

- A training workshop on Industrial Involvement and Human Resource Development for Ghana Nuclear Power Programme at the Ghana Atomic Energy Commission on 9th March 2022.
- The CSIR Administrators Conference on from 30th November to 1st December 2022 at CSIR Head Office.

Prikutse F.L. participated in;

- A workshop on the use of MOFA web-based M&E Portal for Data Management from 21st to 25th February 2022 at Miklin Hotel, East Legon.
- The RSA webinar on Cyber Security and Artificial Intelligence for Research and Development on 18th March 2022
- The Official Launch of the Tertiary Digital Innovation Programme as part of the 5th

Anniversary Celebration of the Ghana Digital Centre on 28th July 2022 at the Accra Digital Centre.

- The 2nd Ghana Digital Innovation Week from 26th to 28th October 2022 at the Accra Digital Centre.

Sackey T.A. served as rapporteur for;

- The Stakeholder workshop on "The Role of Emergency Responders During Floods in Accra" on 17th August 2022 at CSIR-INSTI
- The 2nd Ghana Digital Innovation Week from 26th to 28th October 2022 at the Accra Digital Centre

Participated in;

- The virtual Right to Information Training for Focal Persons on 29th June 2022.
- The CSIR Intellectual Property Launch on 3rd November 2022 at CSIR-STEPRI.
- A workshop on The UNESCO Recommendation on Science and Scientific Researchers on (RS|SR) 21st December 2022 at CSIR-STEPRI

Sawyerr A. participated in;

- The 2022 NEF Africa Science Week Science Communication workshop on 2nd June 2022 at CSIR-STEPRI

Twum-Barimah Y. participated in;

- A stakeholder's forum on the National Energy Transition on 23rd May 2022 at Alisa Hotel, Ridge.

A virtual training session on Renewable Energy Systems on 25th July 2022.

A virtual training session on Renewable Energy Systems on 6th September 2022.

Wilson M. participated in;

- A 5-day training workshop on M&E Web-Based Portal at Hephzibah Christian Centre from 21st to 25th February 2022.

- A workshop to develop the Senior High School Curriculum from 26th June to 2nd July 2022 at Tomreik Hotel, East Legon.

Zainudeen M. participated in;

- A workshop on Infrastructure Development for NPP; Introduction-Localisation on 16th February at the Ghana Atomic Energy Commission
- A virtual workshop on Infrastructure Development for NPP; Nuclear Human Resource Development on 9th March 2022
- A training workshop on Industrial Involvement and Human Resource Development for Ghana Nuclear Power Programme on 9th March 2022 at the Ghana Atomic Energy Commission
- A virtual workshop on Leadership and Management for Nuclear Safety on 13th July 2022
- A webinar on Environmental Impact Assessment on 10th August 2022
- A webinar on Nuclear Power Plant Design against Natural Disasters on 14th September 2022

APPENDIX III

List of Staff as at 31st December 2022

SENIOR MEMBERS

№	NAME	PRESENT DESIGNATION	QUALIFICATION
1	Dr. Seth Awuku Manteaw	Principal Research Scientist/ 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	Ing. Michael Wilson	Chief Technologist/ Head of Electronics	MPhil. (Computer Engineering); PostGrad. (Wireless & Mobile Computing); CDAC; BSc. Computer Eng.;
9	Mr. Stephen Kwaku Asante Jnr.	Accountant/ Head of Accounts	MBA (Accounting & Finance) BSc (Economics & Bus. Adm.) CA Ghana
10	Ms. Naa Aku Mingle	Senior 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	Dr. Roger Kwao Ahiadormey	Research Scientist	PhD (Electronic Engineering) MA (Electronic Engineering) BSc (Electrical/Electronic Engineering)

15	Dr. Dennis Nana A. Gookyi	Research Scientist	PhD (Info. & Comm. Engineering) MA (Info. & Comm. Engineering) BSc (Computer Engineering)
16	Mr. Yaw Twum-Barimah	Chief Technologist	MSc. (Telecom); BSc. Elec. &Computer Engineering
17	Mr. Victor D. Gordon	Chief Technologist	MSc. (Telecommunications & Internet Technologies) BSc. (Computer Engineering)
18	Mr. Mohammed N. Zainudeen	Chief Technologist	MSc. (Chemical Eng.); BSc. (Hons) Chemical Eng.
19	Mr. Akilakpa Sawyerr	Chief Technologist	MPhil (Radiation Protection); BSc. (Physics)
20	Mr. Christian K. Lettu	Chief Technologist	MPhil (Dev. Geography); BA (Hons) Geography & Resource Development
21	Mr. John Annor	Chief Technologist	MPhil (GIS & Remote Sensing); B.A. (Geography)
22	Ing. Frank Lemdi Prikutse	Principal Technologist	MSc. (Telecom Engineering); B.Eng. (Telecom Engineering)
23	Mr. John Adjah	Principal Technologist	MA (Communication Design); BA (Publishing Studies)
24	Ms. Maame Birago Kessey	Principal Technologist	MSc. (Information Technology); BSc. (Computer Engineering)
25	Ms. Tracy Adjeley Sackey	Principal Technologist/ Scientific Secretary	MPhil (Radiation Protection); BSc. (Physics &Computer Science)

26	Mr. Buertey Essegbey	Principal Technologist	MA (Business Administration) BSc (Management Studies)
27	Mr. Kenneth Asiamah	Principal Technologist	MSc (Information & Communication Technology) BSc (Information & Technology Management
28	Mr. Fred Fosu Agyarko	Principal Technologist	MPhil (Statistics) BSc (Actuarial Science)
29	Mr. Oliver Nortsu	Principal Technologist	MPhil (Geography & Regional Planning) BED (Mathematics)
30	Mr. Ezekiel Narh Odonkor	Principal Technologist	MPhil (Agricultural Administration) BSc (Agric Crop Science)
31	Mr. Michael Araphat Alhassan	Principal Technologist	MSc (Computer Engineering, Computer Systems & Networks) BSc (Computer Engineering)
32	Ms. Esther Opoku	Administrative Officer	MBA (Human Resource Mgt.) BA (Information Studies and Sociology); Diploma (Librarianship)
33	Mrs. Akua Boateng Agyenim	Marketing Officer	MBA (Marketing) BA (Publishing Studies)

***On Contract**

SENIOR STAFF

№	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	Mr. William K. Akpakli	Chief Security Officer	BA (Social Work &Psychology)
5	Mrs. Margaret Ivy Koranteng	Chief Library Assistant	Diploma (Librarianship)
6	Mrs. Sarah G. Sarpong	Chief Accounting Assistant	Dip. (Public Finance and Accountancy)
7	Ms. Angela Adikah Ababio	Principal Auditing Assistant	BSc (Business Adm.-Accounting) ACCA Part II
8	Ms. Risikatu Lawal	Principal Accounting Assistant	BSc. (Accounting); DBS (Accounting); CIPS Cert. (Purch. & Supply)
9	Mr. Alex K. I. Ocansey	Principal Assistant Printer	Cert. (ITS) Snr. Sup/ Mgt; N.V.T.I. Grade I Cert.
10	Mr. Eric Sam	Principal Technical Officer	BFA (Animation) HND (Graphic Designing)
11	Mr. Samuel Ankrah	Principal Accounting Assistant	Bachelor of Commerce; HND (Accountancy);
12	Mr. Robert Abomoi	Senior Security Officer	Security Trg. Module 3; M.S.L.C.

13	Mr. Eric K. Acquaye	Technical Officer	Advanced Certificate in Microsoft Certified Systems Eng. (GIMPA)
14	Mr. Benjamin Ohene-Affih	Technical Officer	B.Eng. (Computer Science)
15	Mr. John Paapa Awotwi	Technical Officer	BSc. (Information Technology)
16	Ms. Samiratu A. Mamah	Technical Officer	BA (Communication Design)
17	Mr. Yaw Owusu-Ayirebi	Technical Officer	BA (Graphic Design)
18	Mr. Irvyne Jojo Blisset	Technical Officer	BSc (Information Technology)
19	Mr. Emmanuel A. Kwofie	Technical Officer	BSc (Engineering Physics)
20	Mr. Edward Aggrey-Fynn	Technical Officer	BA (Computer Science & Management)
21	Mr. Godwin Aborgeh	Technical Officer	BSc (Industrial Chemistry)
22	Ms. Victoria Yayra Azuma	Technical Officer	BA (Sociology & Geography)
23	Mr. Cyril Nyarko Tawiah	Technical Officer	BSc (Information Technology)
24	Mr. Moses Dusi	Library Assistant	BA (Information Studies & Computer Science)
25	Ms. Esther Ohenewaa Nyarko	Library Assistant	BA (Adult Education & Information Studies) Dip (Youth Development Work)
26	Ms. Anne Hawa Breh	Library Assistant	BA (Information Studies & Sociology)
27	Mr. Patrick Folitse	Marketing Assistant	BSc (Business Administration (Marketing))

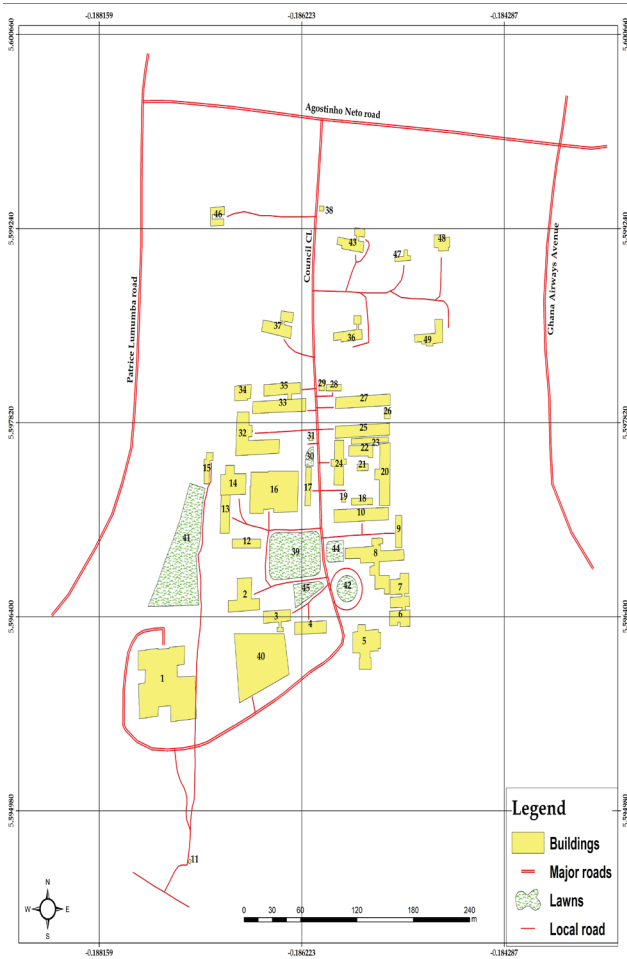
28	Ms. Doris Kumiwa	Administrative Assistant	Dip (BCom Management) DBS (Secretariaship); Nat. Banking Coll. (Cert Cashier & Frontline Exec)
29	Ms. Yvonne D. Azuma	Administrative Assistant	Dip (Public Administration) SSSCE
30	Ms. Winifred Taylor	Accounting Assistant	BSc Accounting
31	Mr. Cephas Awusie	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. Precious Daniel Attih	Security Officer	BSc (Agricultural Engineering)
35	Mr. Timothy Kwamena	Assistant Transport Officer	Cert. (Trans Mgt); Intercity STC Coaches Ltd.; MSLC

JUNIOR STAFF

№	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	Ms. Stephanie N. Nyinaku	Senior Accounts Clerk	HND (Accounting)
5	Mr. Charles Kulley	Junior Library Assistant	SSSCE
6	Mr. Bancie Habila Hussein	Junior Library Assistant	SSSCE
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. Bright K. Yankey	Driver Mechanic Grade II	NVTI GD II
11	Mr. Simon Dunyo	Security Assistant Grade I	SSSCE
12	Mr. Amos Gyekye	Security Assistant Grade I	SSSCE
13	Mr. Razak Ayidana Akambase	Supervisor Grade I	B.E.C.E.
14	Mr. Kojo Asanaab	Supervisor Grade I	B.E.C.E.
15	Mr. Isaac G. Amponsah	Supervisor Grade I	NVTI GD II

16	Mr. Robert Achandi	Supervisor Grade I	M.S.L.C.
17	Mr. Francis Ayarik	Supervisor Grade I	Nil
18	Mr. Abdul Wahab Usman	Supervisor Grade II	Nil

CSIR-INSTI Office Location Map



1 - CSIR-INSTI/LIBRARY
2 - Geographical Information System Section/Fluid Science lab
3 - Science Publishing Division
4 - Printing Division
5 - ASSIP Block, Research Scientist
6 - CSIR-Canteen
7 - Human Resource Department
8 - CSIR Head Office
9 - Car Park
10 - Kopia Ghana Center
11 - Security Post II
12 - Uncompleted Building
13 - Provident/Superannuation Division
14 - CSIR Stores
15 - Bush Canteen
16 - Maintenance Department
17 - Car Park
18 - WASCAL Car Park I
19 - WASCAL Security Post
20 - WASCAL
21 - WASCAL Car Park II
22 - IITA Annex Building
23 - Car Park
24 - IITA Main Building
25 - AGRA
26 - AGRA Security Post
27 - CAB International/Encyclopedia Africana Project
28 - Car Park
29 - Security Post I
30 - Lawn
31 - IWMI Security Post
32 - IWMI
33 - Biomedical and Public Health Research Unit
34 - Biomedical Building
35 - Covid-19 and Other Infectious Diseases Research and Diagnostics Lab
36 - Bungalow III
37 - Bungalow II
38 - Main Security Post
39 - Lawn
40 - Greenhouse Yard
41 - Farm Yard
42 - Roundabout
43 - Bungalow I
44 - Lawn
45 - Lawn
46 - Drivers Apartment
47 - CSIR Club House
48 - CSIR Guest House
49 - Bungalow IV

Source of data: Google Earth Pro
Credit: GPS Locations