

# Annua Report

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION (CSIR-INSTI)

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## 2024 ANNUAL REPORT

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION

(CSIR-INSTI)

#### COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

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### LIST OF ACRONYMS & ABBREVIATIONS

AI	-	Artificial Intelligence
AJOL	-	African Journals Online
ARI	-	Animal Research Institute
CCST	-	CSIR College of Science and Technology
CIE	_	Centre for Innovation and Entrepreneurship
CNN	-	Convolutional Neural Networks
CRI	-	Crop Research Institute
CSA	-	Climate Smart Agriculture
CSIR	-	Council for Scientific and Industrial Research
DAIH	-	Digital Agriculture Innovation Hub
DBMS	-	Database Management System
EIA	_	Excellence In Agronomy
FAIR	-	Findable, Accessible, Interoperable and Reusable
FARA	-	Forum for Agricultural Research in Africa
FRI	-	Food Research Institute
FPGAs	-	Field Programmable Gate Arrays
GIS	-	Geographic Information System
GISS	-	Geographic Information Systems Section
GJAS	-	Ghana Journal of Agricultural Science
GJS	-	Ghana Journal of Science
ІСТ	-	Information and Communication Technology
IFSC	-	International Friendly Skills Competition
IIR	-	Institute of Industrial Research
IITA	-	International Institute of Tropical Agriculture

INSTI	-	Institute for Scientific and Technological Information
ΙοΤ	-	Internet of Things
ITS	-	Intelligent Transport Systems
JASIT	-	Journal of Applied Science and Information Technology
KNUST	-	Kwame Nkrumah University of Science and Technology
MoFA	-	Ministry of Food and Agriculture
NGO	-	Non-Governmental Organisation
OPRI	_	Oil Palm Research Institute
R&D	-	Research and Development
S&T	-	Science and Technology
SARI	_	Savanna Agricultural Research Institute
SDR	-	Software-Defined Radio
STEPRI	-	Science and Technology Policy Research Institute
WRI	-	Water Research Institute

#### **2024 MANAGEMENT BOARD MEMBERSHIP**

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Dr. Mrs. Wilhemina Quaye	-	Member	Director, CSIR-STEPRI,
			Cognate Director, CSIR-INSTI
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Ing. Michael Wilson	-	Member	Head of Electronics
Mr. Mohammed Zainudeen	-	Member	Ag. Head of Fluid Science
Mr. Stephen Kwaku Asante	-	Member	Head of Accounts
Mr. John Paapa Awotwi	-	Member	Ag. President of Senior Staff Association (local)
Mr. Eric Acquaye	-	Member	Chairman of Trade Union Congress (local)

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### FOREWORD

he year 2024 saw substantial advancements in ongoing research and development initiatives. Among other research and development outputs, the Excellence in Agronomy initiative resulted in the development of an intelligent cropping calendar software and the training of stakeholders within the value chain. The Agro-Advisory Services software solution was also developed by the institute, and stakeholders within the value chain were trained on its utilisation. The Next-Gen tinyML Smart Weather Station, a lowcost, low-power, reliable, and accurate weather station that can measure a variety of weather conditions, with a particular emphasis on wind and rain intensities, was effectively developed by the institute.

The weather station is devoid of mechanical moving parts. The projects' output provides substantial advantages to stakeholders in the agricultural value chain, as well as emergency and disaster management service providers. The institute looks forward to more of such research outputs in the future.

### **EXECUTIVE SUMMARY**

CSIR-INSTI throughout the year 2024 carried out research projects, development of software and organised training programmes with the aim of driving the dissemination of scientific information. These activities were carried out in collaboration with key partners and sponsors, including the Alliance for Bioversity International and CIAT (ABC), International Institute of Tropical Agriculture (IITA) and Kwame Nkrumah University of Science and Technology (KNUST). Outlines of these activities are provided in sections two and three of this report, with summaries below.

In the area of Electronics and ICT, an Agricultural Advisory platform was built embedded with a cropping calendar and map service with focus on maize and cowpea for farmers and agricultural extension officers. Also, content was developed and uploaded unto the Farm Academy e-learning platform. Additionally, a framework for generating ideal deep learning models based on hardware-specific parameters was developed based on a published dataset of crop and pest diseases in Ghana. Research on decentralised data processing for load balancing in IoT using an Ant Colony inspired approach revealed that bio-inspired strategies could lead to more efficient and reliable IoT data processing solutions. Meanwhile, the following research and development projects are at various stages of completion: Development of a geospatial inventory system for sustainable mobility in Ghana, the hosting and technical support of the Ghana Agricultural Data Hub, an analysis, design and simulation of high gain microwave power amplifier, physical layer key generation for secure wireless networks, software defined radio implementation of power saving design for full-duplex wireless self-Backhauling and research into the effectiveness of online career development, adding to the achievements of the Institute during the year under review. Staff served as mentees for the Indian Financial System (IFSC) and Olympiad robotics competitions held in Iran and Turkey respectively.

Material science and manufacturing is an area still under development by the Institute. Irrespective of that, the Institute successfully researched into the economic viability of gallium extraction from the Sefwi Awaso Bauxite mine. Findings indicated the need for Ghana to renegotiate the value of its Bauxite due to the presence of critical raw material such as gallium.

Core to the Institute's functions is the dissemination of scientific information. Based on this, research is ongoing regarding the scientific research findings dissemination pathways of CSIR scientists. The Institute, under broad thematic area of climate change, environmental management and green technology, conducted a study titled 'Peri-Urban Expansion and its effect on the mountainous landscape of Akuapem ridge: A case study of Ayi-Mensah'. The study resulted in the generation of land use and land cover statistics. Also, climate smart agriculture practices in Ghana were mapped.

During the year, the Institute launched the Journal for Applied Science and Information Technology and published volume 1(1) containing four articles. Volumes 65(1) and 59(1) of the Ghana Journal of Science and Ghana Journal of Agricultural Science were also published with eleven and nine articles respectively. Various S&T literature were designed for the scientific community, and specialised maps were created.

The staff strength of the Institute stood at 76 with details outlined in Section 4.1.2 and Appendix III.

Total receipts for the year under review amounted GH¢10,215,132.02 and payments totalled Gh¢10,199,524.26 with a surplus net receipt of Gh¢15,607.76. The receipts are made up of salaries paid by Government of Ghana (GOG) from the consolidated fund amounting to Gh¢9,133,960.95. Internal Generated Fund (IGF) amounted to Gh¢438,620.89 and donor funds of Gh¢642,550.18. The IGF activities included printing, hiring of facilities, rental of office space and consultancy.

### INTRODUCTION

The CSIR-Institute for Scientific and Technological Information (CSIR-INSTI), is mandated 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 of 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 continues 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 include:

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

Supporting divisions:

- Accounts
- Administration

### 2.0 RESEARCH & DEVELOPMENT OUTPUT

The Council for Scientific and Industrial Research (CSIR) is mandated to generate and apply innovative technologies, and efficiently and effectively exploit 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

During the year under review (2024), CSIR-INSTI carried out research under four of the seven thematic areas:

- Climate Change, Environmental Management and Green Technology
- Materials Science and Manufacturing
- Electronics and ICT
- Science and People

### **2.1 COMPLETED PROJECTS**

### 2.1.1 Assessment of the economic viability of gallium extraction from the Ghana's Sefwi Awaso bauxite mine, Awaso, Western-North Region

Mohammed N. Zainudeen, Latifatu Mohammed, Andrew Nyamful, Dennis K. Adotey and Shiloh K. Osae

Start: August 2019 End: Oct 2023 Thematic area: Materials Sc. & Manufacturing

The project discovered that the Awaso Bauxite ore deposit contains gallium to the tune of 61.46 ppm, comparing satisfactorily within the reported global average of 57 ppm. Also, using the solvent extraction technique with Kelex-100 as the main extractant, the mean levels of Ga extracted from the liquor obtained after autoclave digestion of the ore was 38.934 mg/kg. This corresponds to about 63.5 per cent of the Ga concentration in the ore. Also, the 63.5 per cent Ga obtained in the pregnant liquor is comparable to the 68 per cent and 65 per cent reported by (Vind and Alexandri et al., 2018; Vind et al., 2017). Hopefully, these findings should assist the Government of Ghana to consider renegotiation of the value of its bauxite due to the awareness that it contains critical raw material (for example Ga; an important raw material in the electronic industry) that have been ignored in the valorisation of Ghanaian Bauxite except the aluminium content.

### 2.1.2 An ant colony inspired approach to decentralised data processing for load Balancing in IoT

#### Michael Wilson, Prof. K.O Boateng and Dr. Henry Nunoo-Mensah

Start: September 2023 End: August 2024 Thematic area: Electronics & ICT

Key findings from the research highlight that the deployment of mission-critical IoT solutions requires end-to-end data processing latency of a few milliseconds with over 99 per cent reliability. Current cloud and edge-based IoT data processing methods fail to meet these stringent requirements due to reliance on congested Radio Access Networks, resulting in network delays that hinder the implementation of critical IoT applications. To address this issue, the study proposed a bio-inspired approach to computational task offloading, mimicking stigmergy and self-organisation seen in social ant colonies. This approach uses a pheromone-inspired protocol that enables dynamic task allocation among local IoT nodes, reducing latency by processing data within the local network rather than relying on remote servers. The method employs a six-step decision process

to optimise resource usage, achieving up to 53.45 per cent improvement in response time and 44.90 per cent enhancement in turnaround time, significantly reducing end-to-end latency. These findings suggest that bio-inspired strategies could lead to more efficient and reliable IoT data processing solutions, aligning with the needs of advanced IoT applications.

#### 2.1.3 Development and deployment of agricultural advisory platform

#### Michael Wilson, Paul A. Danquah, Dennis N.A Gookyi, John P. Awotwi, Roger K. Ahiadormey and Michael G. Dziwornu

Start: February 2023 End: December 2024 Thematic area: Electronics & ICT

The development and deployment of agricultural advisory platform project is aimed at developing a digital platform that will serve as a one-stop shop for extension officers, farmers, researchers and policy makers, to easily access relevant data and information that is readily applicable to their respective needs. The project commenced with the creation of a cropping calendar and map service tailored to maize and soybean cultivation in Ghana. Recommendations were then gathered from experts in the field to enhance message content by collaborating with the SRID of MoFA for specifying crop varieties per agricultural zone and encouraging interdisciplinary collaboration between soil and crop scientists. Future planning includes the integration of district-specific risk percentages into the app and the development of comprehensive video courses in partnership with Farm Academy, alongside exploring certification opportunities with Stanbic Bank. The app's final version will undergo a review by scientists before field testing and launch.

#### Excellence in agronomy cropping calendar

The excellence in agronomy programme supports CSIR-INSTI in enhancing productivity and quality in targeted farming systems by 2030. The primary focus of this project is to create and enhance a cropping calendar and bundled agro-advisory tools, dashboards, and a mobile app to support farmers in target geographic zones. A week-long training programme was held in the Northern sector of Ghana to educate agricultural extension officers and farmers on the effective use of the EIA Cropping Calendar, a tool designed to help farmers plan cropping activities for optimum yields. The hands-on sessions focused on the practical application of the tool, emphasising the use of local data and climatic conditions to plan crop (maize and cowpea) schedules.



Fig 2.1 Group photograph of agricultural extension officers and participants during the training on usage of the Cropping Calendar – Tamale



Fig 2.2 Group photograph of agricultural extension officers and participants during the training on usage of the Cropping Calendar – Damongo



Fig 2.3 Group photograph of agricultural extension officers and participants during the training on usage of the Cropping Calendar – Wa



Fig 2.4 2024 CSIR-INSTI Cropping Calendar training team

### 2.1.4 Enabling deep learning inference on low-cost edge devices: A case study of crop pest and disease identification

### Dennis N. A. Gookyi, Michael Wilson, Roger K. Ahiadormey and Paul A. Danquah

Start: January 2023 End: December 2024 Thematic area: Electronics & ICT

Enabling deep learning inference on low-cost edge device is a project which aimed to publish a dataset of crop pests and diseases in Ghana, develop a framework for generating ideal deep learning models based on hardware-specific parameters and deploy the deep learning network on a low-cost FPGA platform. To achieve this, the research leveraged edge impulse to deploy multiple deep learning models on a single edge device, improving efficiency in agricultural settings. The study begun by assembling a large dataset of tomato leaf images, categorised by disease type and healthy leaves. The data was enhanced using preprocessing techniques to ensure model robustness. Various convolutional neural network (CNN) architectures, including MobileNet and EfficientNet, were trained using TensorFlow to maximise disease detection accuracy while ensuring computational efficiency. Models were then optimised for edge deployment by converting them to TensorFlow Lite format and applying int8 guantisation to reduce their size and increase inference speed. The deployment of multiple models on a single edge device demonstrates real-time disease detection capabilities, with performance evaluations ensuring the models' accuracy and efficiency in real-world agricultural applications.

### **2.2 PROJECTS IN-PROGRESS**

#### 2.2.1 A geospatial inventory system for sustainable mobility in Ghana

#### Michael G. Dziwornu and Bryan N. L. Laryea

#### Start: July 2022

#### Thematic area: Electronics & ICT

This project proposes a mapping system to detect road anomalies such as potholes for pedestrian and driver safety. The end result would be a multiplatform GIS system to provide real-time information to road users about the risk level of a road segment. The system will also provide road management operators with significant data on road segments requiring priority maintenance interventions. Furthermore, the platform will help transport planners identify and monitor high accident locations. Pothole data for the project is being crowd-sourced from the public. Furthermore, data on road accidents in Ghana has been obtained from the Ghana Police Service for correlation with data obtained from the platform.

#### **2.2.2 Dissemination pathways for scientific research findings;** Evidence from the perspectives of CSIR, Ghana Scientists

#### Ezekiel N. Odonkor, Seth A. Manteaw, Atta S. Ampofo-Addo and Moses Dusi

#### Start: January 2023

Thematic area: Science & People

The aim of the project is to assess the pathways for disseminating research outputs in terms of strengths and control in the institutes of the CSIR. The study emphasises the critical role of research institutions in information access and preservation, highlighting INSTI as CSIR's central reference library, which facilitates the processing and distribution of Scientific and Technical Information (STI). This study adopted a quantitative research design, employing mainly survey method of enquiry via an online questionnaire administration. The study population is 580 which includes all CSIR research scientists and with a sample size of 237 determined using Yamane's (1967) formula. The research however settled on 121 respondents due to lack of data from some respondents. The research underscores the importance of effective dissemination of research findings for Ghana's socio-economic development. Data analysis is on-going.

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CSIR STRATEGIC PLAN M&E	Threat: Thread2 Thread3 Threads Simo	Q Search		
About	Thrust Id Description	Institute	Year Tag	Activity Count
Reports	SHMP-INSTI Stakeholder Management Plan	INSTI	2024	8
Projects	Thrust1-INSTI Private Sector Driven R&D and Technological Innovation	INSTI	2024 2023	35
Technologies	Thrust2-INSTI CSIR Re-Branding and Visibility Improvement	INSTI	2024 2023	30
	Thrust3-INSTI Finandal Resource Mobilisation.	INSTI	2024 2023	25
	Thrust4-INSTI Staff and Systems Performance Improvement	INSTI	2023 2024	34
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Fig 2.5 User interface of Strategic Plan Online Reporting Platform

#### Research4Life training programme

CSIR-INSTI, in collaboration with Research4Life, organised a two-day training workshop for sixty (60) research scientists, including librarians. The training aimed to equip participants with the knowledge and skills to effectively utilise the various Research4Life databases, thereby enhancing their research capabilities.



Fig 2.6 Participants of the Research4Life training programme

### **2.2.3 Hosting and technical support of the Ghana Agricultural Data Hub**

### Michael Wilson, Dennis N. A. Gookyi, Paul A. Danquah, Yaw Twum-Barimah, John P. Awotwi and Ben Ohene-Affih

#### Start: January 2023

Thematic area: Electronics & ICT

The hosting and technical support of the Ghana Agricultural Data Hub has the aim of implementing a support infrastructure for traditional data migration into Findable, Accessible, Interoperable and Reusable (FAIR) data formats. A structured methodology will be applied to achieve this aim involving the design and implementation of a support infrastructure for data migration into FAIR formats, the engineering of a robust data flow architecture that integrates advanced analytical tools, the design of APIs that adhere to industry standards and the development of an application-layer decision support systems and interactive dashboards tailored to the specific needs of stakeholders.



Fig 2.7 Reworked technical architecture of the DAIH

### 2.2.4 Analysis, design and simulation of high gain microwave power amplifier

#### Yaw Twum-Barimah, Paul A. Danquah and Frank L. Prikutse

Start: January 2023

Thematic area: Electronics & ICT

The project aims to develop various gain design techniques and mathematical equation for appropriate gain models in microwave spectrum. An Advance Design

Systems (ADS) software tool will be employed as the main tool for RF simulation and Matlab simulation tool for various gain analytical simulation.

#### 2.2.5 Physical layer key generation for secure wireless networks

#### Paul A. Danquah and Roger K. Ahiadormey

Start: February 2023 Thematic area: Electronics & ICT

The physical layer key generation for secure wireless networks has the aim of implementing novel physical layer key generation designs on the software-defined radio (SDR) platform for performance validation. System modelling, problem formulation, solution design, and performance evaluation would be applied to achieve the stated aim. Additionally, a test-bed based on SDR hardware will be implemented in a real-world wireless propagation environment. The SDR will be deployed for design validation and performance evaluation.

### **2.2.6** Software defined radio implementation of power saving design for full-duplex wireless self back-hauling

#### Roger K. Ahiadormey and Paul A. Danquah

Start: February 2023 Thematic area: Electronics & ICT

The aim of the project is to implement the power-saving design for wireless backhauling on the SDR hardware platform. The software solution to implement the wireless self back-hauling design would be built and the novel solution will be evaluated using test radio signals. Additionally, a testbed based on SDR hardware will be implemented in a real-world wireless propagation environment. The SDR and associated software will be deployed for design validation and performance evaluation.

### 2.2.7 Effectiveness of online career development – A case study of the Grow with Google Ghana project

#### Michael Wilson, Paul A. Danquah, Dennis N. A, Gookyi, Roger K. Ahiadormey, Michael G. Dziwornu, Yaw Twum-Barimah and John P. Awotwi

#### Start: July 2023

Thematic area: Electronics & ICT

The aim of this project is to assess the impact and effectiveness of online courses for practical skill acquisition and career development. Implementation of the project has commenced with a multi-phase approach, beginning with the targeted recruitment of participants aged 18-35 years from low socio-economic backgrounds within Greater Accra for the Google Career Certificate Scholarship Programme. An impact assessment framework would be executed to evaluate the effectiveness of the online courses in promoting practical skill acquisition and career development, utilising surveys, interviews, and performance tracking to analyse participant progress, course completion rates, and their subsequent career outcomes.

#### **Robotics training**

The year saw a collaboration between the CSIR-Makerspace, Mikrobot Academy, KNUST, CITSYS and the Ghana Robotics Academy Foundation, resulting in the formation of a Cyber-Physical Systems Research group. The research collaboration is open for partnerships beyond this initial collaboration with the aim of becoming a co-innovative space where like-minded persons gather to work on projects, share tools and expertise as well as learn from each other. Stemming from this, staff of CSIR-INSTI served as mentors for students representing Ghana at the 2024 International Friendly Skills Competition (IFSC) held in Iran in May, and the World Robot Olympiad held in Izmir, Turkey in November 2024.



Fig 2.8 2024 Ghana Olympiad Team



Fig 2.9 2024 IFSC Team

#### Farm academy audio-visual platform

Content on the farm academy platform – an e-learning portal – was expanded to include real-life demonstrations, expert interviews, and instructional videos to guide farmers in adopting best practices.

#### **Our Courses**



### 2.2.8 Enhancing the crime data management capabilities of the Ghana police service

### Michael G. Dziwornu, Fred F. Agyarko, Bryan N. L. Laryea, Michael Wilson and Michael A. Alhassan

#### **Start:** September 2023

Thematic area: Science & People

This project aims to design a comprehensive training programme for officers on crime data management and analytics using statistical methods. The project will develop an online portal for officers to take lessons on statistics and award certificates upon completion. Additionally, a robust web-based Database Management System (DBMS) would be devised for the collection of crime data taking into consideration the geographical location of the incident scene. The DBMS will be enhanced with Artificial Intelligence (AI) technology to enact new ways of policing crime including pattern identification and predictive policing.

#### 2.2.9 Mapping climate smart agriculture practices in Ghana

Michael G. Dziwornu, Fred F. Agyarko, Ezekiel N. Odonkor, Tracy A. Sackey, Samiratu A. Mamah, Sandra S. Inusah, Isaac B. Akpatsu, Bryan N. L. Laryea, Anne H. Breh, Michael Wilson and John P. Awotwi

Start: September 2023 Thematic area: Climate change, Env. Mgt. & Green Tech.

The overall objective of the project is to develop strategies to improve CSA practice adoption. The methodology combines organisational mapping, spatial analysis, and suitability modelling to guide CSA expansion planning. Surveys were administered to leading CSA implementing agencies across government, research institutions and NGOs to document their geographic coverage, technologies used, and outcomes achieved. The collated organisational insights reveal capabilities, influence areas, and coordination needs. The spatial datasets and stakeholder directory will inform the development of a suitability model to identify priority areas for scaling CSA.

#### 2.2.10 Mechanics Project

#### Michael G. Dziwornu, Bryan N. L. Laryea, Fred F. Agyarko, Kenneth Asiamah, John P. Awotwi and Edward Aggrey-Finn

Start: October 2023

Thematic area: Science & People

The initiative aims to build digital skills and upgrade business practices within Ghana's automotive repair sector. By facilitating parts tracking and forecasting, the technology solution will strengthen shop capabilities and service quality. The project aligns with national policy priorities around stimulating small enterprises, formalising informal sectors, and spreading digital innovation. The project involves the development of a minimal viable product through iterative prototyping using flexible software frameworks, with accompanying instructional e-modules on inventory system usage, maintenance and digital literacy foundations. The end result would be a tailored, user-friendly inventory management software.

### 2.2.11 Leveraging IoT sensors to monitor and mitigate noise pollution in Accra, Ghana

#### Bryan N. L. Laryea, Michael G. Dziwornu, Kenneth Asiamah and Michael A. Alhassan

#### Start: March 2024

Thematic area: Electronics & ICT

The project aims mainly to develop a comprehensive noise pollution monitoring platform, integrating data from the deployed sensors and generating real-time visualisations and analytics. The project will employ a multifaceted approach, combining cutting-edge IoT sensor technology, data analytics, and community engagement. So far, two noise pollution sensors have been successfully procured and calibrated according to industry standards. Also, a preliminary dashboard has been developed to monitor and visualise noise pollution data.

### 2.2.12 Implementing an incentive-based smart IoT system for plastic waste management: A cost – effective, technology-driven approach

#### Michael A. Alhassan and Kenneth Asiamah

Start: March 2024

Thematic area: Electronics & ICT

The project aims to develop a Smart IoT system for efficient plastic waste collection and classification using advanced sensors and AI models such as YOLO. It includes designing a user-friendly software application for monitoring contributions and redeeming rewards. The incentive system will provide real-time feedback based on the quantity, weight, and type of plastics deposited, incorporating environmental impact metrics. The project will assess the social, economic, and environmental impacts through surveys and data analytics, and explore scalability across different contexts. The methods to be employed involve hardware prototyping with microcontrollers and sensors, AI model training for plastic identification, and software development for data storage and user interaction. The incentive system will be optimised through pilot tests and collaboration with recycling agencies. Impact assessment will include qualitative research, and scalability analysis will involve developing a deployment framework and engaging stakeholders for wider adoption.

### 2.2.13 Urban sprawl and land use dynamics in the Akuapem ridge region, Ghana: A remote sensing analysis

#### Michael G. Dziwornu, Christian Lettu, John Annor, Oliver Nortsu and Victoria Y. Azuma

#### Start: April 2024

Thematic area: Science & People

This project aimed to assess the changes in the mountain landscape since 2000, using GIS Tools. The research applied a combination of quantitative and qualitative methods to address the objectives. Remote sensing and GIS techniques were used to monitor changes in land use and land cover. Questionnaires were also administered to some residents in the target communities. Land use and land cover statistics have been generated from the three classified multi-temporal images. A manuscript from the project is being finalised for submission to a journal for publication.

#### 2.2.14 CSIR-INSTI map library project

#### Michael G. Dziwornu, Anne Breh, Christian Lettu, John Annor, Atta S. Ampofo-Addo and Oliver Nortsu

Start: April 2024

Thematic area: Science & People

This project mainly aims to establish a state-of-the-art Map Library that serves as a repository for thematic maps produced by CSIR-INSTI and other relevant institutions. The establishment of the Map Library will involve a multifaceted approach, encompassing meticulous preservation techniques, cutting-edge digitisation processes, and innovative technological integrations. Initially, a comprehensive inventory of historical maps will be conducted, followed by their careful restoration and digitisation using state-of-the-art scanning equipment. Rigorous quality control measures will be implemented to ensure the accurate representation of map details and symbology. Subsequently, a secure digital repository will be developed, employing robust data management systems and advanced search functionalities. The physical infrastructure for the library is currently in preparation, ensuring a seamless transition to the next phase of the project. The next phase of the project would involve the digitisation process.



Fig 2.11 Visual Impression of the map library

#### 2.2.15 Ghana geospatial information hub

### Bryan N. L. Laryea, Michael G. Dziwornu, Kenneth Asiamah and Michael A. Alhassan

Start: June 2024

Thematic area: Science & People

The central focus of the Ghana Geospatial Information Hub is to establish a centralised repository for spatial data from various institutions and organisations within Ghana. The establishment of the Geospatial Information Hub will employ a multifaceted approach, involving extensive stakeholder engagement, data acquisition, and technological integration. Initially, a comprehensive survey will be conducted to identify relevant institutions and organisations within Ghana that generate or manage spatial data. This will be followed by outreach initiatives to secure their participation and obtain necessary data sources. Concurrently, a robust data management framework will be developed, ensuring seamless integration, standardisation, and quality assurance of the acquired spatial data.

# 2.2.16 From data to decisions: An AI and IoT powered network of agrometeorological stations providing real-time information and predictive analytics for unconnected rural farmers

Michael Wilson, Dennis N.A Gookyi, Paul A. Danquah, Yaw Twum-Barimah, John P. Awotwi, Roger K. Ahiadormey and Michael A. Alhassan

#### Start: April 2024

Thematic area: Electronics & ICT

The project aims to develop an AI-based decision support tool for the assessment and prediction of plant's observable characteristics and traits in response to soil type and biotic/abiotic stress (e.g., heat, water, nutrients, wind, salinity, drought, flood, parasites, and weeds). The decision tool will be used by farmers in the assessment and selection of the right varieties that maximise yield based on historic climatic parameters and real time soil composition in their respective farm location. The methodology involved the development and testing of lowcost sensors and locally developed low-cost weather stations for the collection and mapping of agronomic/agrometeorological parameters to observable phenotypic traits at different stages of crops' growth. Collected data will be shared with relevant stakeholders who require this data for further research and for use in the development of agroadvisory tools and improvement in plant breeding programmes. The developed sensor kits and local weather stations will be scaled and deployed on smallholder to medium scale farms to support precision in farming activities. The potential impact of this research is significant. Rural farmers, who often lack access to advanced technologies and weather information services, could significantly benefit from real-time data and forecasts.

#### Map development

The following digital specialised maps were developed for clients. They cut across the sectors of environment and urban planning.

- 1. Elevation maps
- 2. 3D contour map of the Eastern Region of Ghana
- 3. Street intersection map of GAMA
- 4. Shaded relief map of Ghana
- 5. 3D contour elevation map
- 6. Hexagon population map of Ghana

- 7. Population Density map of Greater Accra
- 8. Heat map of basic schools in Ghana
- 9. Relative Elevation Model (REM) map of the Volta Lake
- 10. Earthquake events near populated areas (Ghana)
- 11. Dasymetric map of population density (GAMA)



Fig 2.12 Elevation map of Ghana



Fig 2.13 A 3D elevation map of the Eastern Region of Ghana



Fig 2.14 Street network intersection in GAMA – Greater Accra Metropolitan area



Fig 2.15 A shaded relief map of Ghana

### **3.0 PRINTING AND PUBLISHING**

The printing section of the institute carried out the designing and printing of various materials, most of which are related to the dissemination of scientific information emanating from the CSIR. Samples of such materials are presented in Figure 3.1.



Fig. 3.1 Some designs by the CSIR-INSTI Printing Section

Table 3.1: List of main projects implemented by printing section

No.	Client	Description of Job	
1.	CSIR-ARI	2023 Annual report	
2.	CSIR-CCST	CIE Certificates	
3.	CSIR-CRI	Letterheads	
4.	CSIR-FRI	2023 Annual Report	Letterheads

5.	CSIR-Head Office	2023 Abridged annual report	Envelopes
		Letterheads	Citations
		Endowment brochure	Files
		2025 Calendars and diaries	
6.	CSIR-IIR	Call cards	Letterheads
7.	CSIR-INSTI	2023 Annual Report	Citations
8.	CSIR-SARI	2022 Annual Report	
9.	CSIR-STEPRI	2023 Annual Report	
10	CSIR-OPRI	2023 Annual Report	
11.	CSIR-WRI	Call cards	

In addition to the designs, the Science Publishing Section of the Institute publishes three journals in multiple issues annually. They are the; Ghana Journal of Agricultural Science (GJAS), Ghana Journal of Science (GJS) and the Journal of Applied Science and Information Technology. The articles in the journals are available on the AJOL website and via the links; http://insti.csir.org.gh/gjas.php and http://insti.csir.org.gh/gjs.php

#### **Ghana Journal of Agricultural Science**

The Ghana Journal of Agricultural Science published 9 articles in GJAS Vol. 59 (1) (2024). Details of published articles are listed in Table 3.2.

Table 3.2: Articles published in Vol 59 (1) (2024) of the GJAS

N⁰	Title
1	Peri-urban lettuce production in the Kumasi metropolis-disease and farmers' management strategies
	Abu, E., Kwoseh, C., Moses, E.
2	Baseline Survey and Promotion of Grain – Producing Amaranth (Amaranthus spp.) Crop among vegetable Growers <b>Darfour, B., Appiah, A. S., Nunoo, J.</b>
3	Prevalence and antimicrobial resistance pattern Staphylococcus aureus and Methicillin Resistance Staphylococcus aureus isolated from waste bin handles in the Tamale Metropolis and Tolon District <b>Yeboah, I., Kpordze, S. W., Saba, C. K. S.</b>

4	Response of oil palm ( Elaesis guineensis Jacq.) nursery seedling to NPK and Urea based gel liquid fertilizers in oil palm belt in Nigeria
	Ekhator, F., Okeke, C. O., Aduramigba-Modupe, V. O., Ikueobe, C. E.
5	The effect of the 20-week pullet weight on full-sexual maturity characteristics in a parent-stock layer strain
	Jesuyon, O. M. A.
6	Elemental contents of Gliricidia-Megathyrsus mixtures
	Dele, P. A., Yusuf, T. O., Akinyemi, B. T., Aiyesa, O. L., Akinlolu, A. O., Anotaenwere, C. C., Enwete, F. E., Jolaosho, A. O., Arigbede, O. M.
7	Perception of negative externalities emanating from oil and gas exploitation in Nigeria
	Ukpong, I. G., Owutuamor , Z. B., Agom, D. I.
8	Extension workers' perception of the Farmer Field School and Training and Visit system for transfer of agricultural technologies to farmers in South-west Nigeria.
	Oyegbami, A.
9	Profit Efficiency of the Integrated Crop-Livestock Production Systems in the Transitional belt of Ghana
	Ameyaw, I. O., Wongnaa, C. A., Aidoo, R., Asante, B. O.

#### **Ghana Journal of Science**

The Ghana Journal of Science published 11 articles in GJS Vol. 65 (1) (2024). Details of published articles are listed Table 3.3.

 Table 3.3: Articles published in Vol 65 (1) (2024) of the GJS

N⁰	Title
1	Comparative Influence of mycorrhiza and phosphorus on the growth of bombax costatum pellegr and vuilet from different provenances <b>Asinwa, O., Ojo, M. O</b> .
2	Antibiotics susceptibility profile of the escherichia coli isolated from poultry environment Makinde, O. A.

3	Consumer food safety knowledge in the homes of residents of Ho municipality, Ghana
	Kortei, N. K., Ahlidobu, O., Asante-Donyinah, D., Boadi, M., Zaazie, P., Pobee, N. O., Annan, S. N. Y., Osei-Tutu, C.
4	Disease survey of cnidoscolus aconitifolius (mill) I. M. Johnston in Rivers State, Nigeria
	Ogbuji, N. G.
5	Growth chlorophyl content and fruit yield of cayenne pepper as affected by seedling age and weed interference period
	Osunleti, S. O., Oni, O. E., Falade, A. A., Ajani, O. A, Olatunde, E. O., Aghemwenhio, I. S.
6	Synthesis and characterization of styrene-divinyl based molecularly imprinted polymer for the remediation of phthalate contaminated waste water
	Awokoya, K. N., Oninla, V. O., Ogunfowokan, A. O., Akinjokun, A. I., Adekoya, C. O.
7	Phytochemicals and biological activities from the constituents of cassia angolensis growing in Tanzania
	Ndoile, M. M, Wimba, J. M.
8	A retrospective update on the Auricularia species in Ghana and their nutritional ethnomycological and pharmalogical values for health
	Odamtten, G. T., Addo, J., Wiafe-Kwagyan, M., Kortei, N.K.
9	Effects of planting dates and fertilizer application on selected soil chemical properties and cassava parameters
	Adebayo, O. E., Ologunde, O. H., Oni, O. E., Busari, M. A.
10	Integrated geochemical and geophysical characterization of tourmaline- bearing pegmatites from Ijero-Ekiti, Southwestern Nigeria
	Afolabi, A. O., Jimoh, R. O., Ajade, J., Onawola, B. R., Ologe. O.
11	Phytochemical and synergestic antimicrobial effects of Morinda lucida.
	Anogeissus leiocarpus and Sarcocephalus latifolius leaf extract
	Imosi, C., Okhale, S. E., Okoli, C. P., Aliyu, A., Kazeem, T., Josiah, J. G., Egbeneje, V. O., Sa'ad, M.

### Journal of Applied Science and Information Technology (JASIT established in 2024)

The Journal of Applied Science and Information Technology is a journal focussed on publishing information relating to the areas of Applied Science, Technology Related Case Studies, Information Technology and Computer Science. It was launched in June 2024 with its maiden edition – GJS Vol. 1 (1) (2024) – containing four articles. Details of published articles are listed in Table 3.4.

N⁰ Title 1 Comparative analysis of tiny machine learning models for maize crop disease identification Wulnye, F. A., E. E., Gookyi, D. A. N. 2 Influence of Protection Motivation Theory on Information Security Practices. The case of Ghanaian Mobile Banking Merchants Danquah, P., Matey, H. A., Asiamah, K. 3 Stimulated comparison of packet transmission over large scale network: Open shortest path first (OSPF) versus routing information protocol Oppong, D. B., Lartey, J. D., Kani, J. A., Danquah, P. 4 Topic modelling of the "fix the country" protest in Ghana using the Latent Dirichlet Allocation (LDA) and Jaccard Similarity approach Laryea, B. N. N., Asiamah, K., Araphat, A. M., Mensah, E. A., Tsekpo, E. K., Hawa, A. B., Inusah, S. S.

Table 3.4: Articles published in Vol 1 (1) (2024) of the JASIT

### **4.0 ADMINISTRATION AND FINANCIAL ISSUES**

#### **4.1 ADMINISTRATIVE MATTERS**

#### 4.1.1 Management of INSTI

To steer the internal affairs of the Institute, there was an eight-member Management Board governing the Institute for the year 2024, and an elevenmember Internal Management Committee chaired by the Director.

#### 4.1.2 Staff Strength

The staff strength of the Institute as at 31st December 2024, stood at 76 with qualifications outlined in Appendix III. Categorical breakdown are as follows with gender distribution displayed in Table 4.1 and Figure 4.1.

- 25 Core and 5 Non-core Senior Members
- 30 Senior staff
- 16 Junior staff

Catagory	Gender		Tatal	
Category	Males	Females	TOLAI	
Senior Members	24	6	30	
Senior Staff	18	12	30	
Junior Staff	12	4	16	
Total	54	22	76	

 Table 4.1 Distribution of staff strength given gender



Fig 4.1 Distribution of staff strength given gender

#### **4.1.3 National Service Personnel**

Thirteen graduates were accepted as National Service Personnel at the Institute. They assumed duty on 1st October 2024.

#### **4.2 FINANCIAL STATEMENT FOR 2024**

Total receipts for the year under review amounted GH¢10,215,132.02 and payments totalled Gh¢10,199,524.26 with a surplus net receipt of Gh¢15,607.76.

The receipts are made up of salaries paid by GOG from the Consolidated fund amounting to Gh¢9,133,960.95. Internal Generated Fund (IGF) amounted to Gh¢438,620.89 and Donor Funds of Gh¢642,550.18. The IGF activities included Printing, Hiring of facilities, Rental of office space and Consultancy.

The Payment of Gh¢10,199,524.26 for the period is made up of Compensation for Employees of Gh¢9,133,960.95, Non-Current assets of GH¢359,247.80 and a Net worth of GH¢288,047.91.

There was no GOG subvention received for Goods and Services during the year 2024.

Below is summarised Statement of Receipts and Payments and the Financial Position as at December 31, 2024

	ACTUAL 2024	ACTUAL 2023
	(GH¢)	(GH¢)
Total Receipts	10,215,132.02	3,819,815.20
Total Payments	10,199,524.26	375,584,153
Excess/(Deficit)	15,607.76	63,973.67

Table 4.2: INSTI Statement of Receipts and Payments for the year ended December 31, 2024

**Table 4.3:** Summary State of Affairs as at December 31, 2024

	2024	2023
	(GH¢)	(GH¢)
Current Assets	382,979.41	875,115.81
Non-Current Assets	359,247.80	357,931.94
Liabilities	514,179.30	509,039.59
Net Assets/(Liabilities)	288,047.91	742,008.16
Net Worth	288,047.91	742,008.16

### **APPENDIX I: PUBLICATIONS**

#### **Refereed Journal Papers**

- Adjah, J., Bekoe, S., Decardi-Nelson, A., Ry-Kottoh, L. A., Kalognia. J. (2024), Colour preferences among selected adults in Ghana, Journal of Graphic Engineering and Design 15(1).
- Adjah, J., Ry-Kottoh, L. A., Decardi-Nelson, A., Mamah, S. A. & Sam, E. (2024). Complexities of fonts in disfluent experiments. Communicare Journal for Communication Studies in Africa, 43(2), 19–30. https://doi. org/10.36615/9pb78q28
- Amofah, K., Dziwornu, M. G., Rachwał, T., Saladrigues, R., & Agyarko, F. F. (2024). Environmental support and entrepreneurial intentions: Exploring the mediating role of attitude and behavioural control and moderating effect of family background. Entrepreneurial Business and Economics Review, 12(1), 195-213.
- Amofah, K., **Dziwornu, M. G.**, Rachwał, T., Saladrigues, R., & Agyarko, F. F. (2024). Entrepreneurial intentions among female senior high school students in Ghana. International Entrepreneurship Review, 10(2), 101-119.
- Attah, J., Mohammed, L., Nyamful, A., Donkor, P., Asamoah, A., Zainudeen, M. N.,
  Adjah, J., Klutse, C. K., Birikorang, S. A., Agyemang, F., & Gyampo, O. (2024).
  Oxy-Hydrogen gas as a sustainable fuel for the welding industry: Alternative for Oxy-Acetylene gas. Cleaner Energy Systems, 9, 100160. https://doi.org/10.1016/j.cles.2024.100160
- **Danquah, P.,** Matey, H., & **Asiamah, K.,** (2024). Influence of Protection Motivation Theory on Information Security Practices: The Case of Ghanaian Mobile Banking Merchants. Journal of Applied Science and Information Technology, 1(1).
- **Dziwornu, M. G.,** Stanek, Ł., & Don-Arthur, E. (2022). Artist Intervention: Asutsuare Rebound. Future Anterior: Journal of Historic Preservation History, Theory, and Criticism, 19(2), 147-155.
- Dziwornu, M. G. (2024). The 'Container Menace': unpacking household perceptions of container urbanism in Ghana. GeoJournal, 89(1), 40.

- Dziwornu, M. G. (2024). Global Container Urbanism and Sustainable Urban Development. Home Cultures, 1-19. <u>https://doi.org/10.1080/17406.315.2024.2</u> <u>377882</u>
- Dziwornu, M. G., Mponela, P., Inusah, S. S., Agyarko, F. F., Yeboah, S., Damba, O. T., ... & Abera, W. (2024). Institutional efforts and regional distribution of climate-smart agriculture initiatives in Ghana. Climate Smart Agriculture, 100038.
- Gookyi, D. A. N., Wulnye, F. A., Arthur, E. A. E., Ahiadormey, R. K., Agyemang, J. O., Agyekum, K. O. B. O., & Gyaang, R. (2024). TinyML for Smart Agriculture: Comparative Analysis of TinyML Platforms and Practical Deployment for Maize Leaf Disease Identification. Smart Agricultural Technology, 100490.
- Gookyi, D. A. N., Wulnye, F. A., Wilson, M., Danquah, P., Danso, S. A., & Gariba, A.
   A. (2024). Enabling Intelligence on the Edge: Leveraging Edge Impulse to Deploy Multiple Deep Learning Models on Edge Devices for Tomato Leaf Disease Detection. AgriEngineering, 6(4), 3563-3585. https://doi.org/10.3390/ agriengineering6040203
- Laryea, B., Asiamah, K., Alhassan, M., Mensah, E., Tsekpo, E., Hawa, A., & Inusah, S. (2024). Topic modelling of the "fix the country" protest in Ghana using the Latent Dirichlet Allocation (LDA) and Jaccard Similarity approach. Journal of Applied Science and Information Technology, 1(1).
- Munonye, J. O., Onyeneke, R. U., Ankrah, D. A., Agyarko, F. F., Onyeneke, C. J., Nejad, J. G., & Chikezie, C. (2024). Do climate change, access to electricity and renewable energy consumption matter in aquaculture production in Africa?. In Natural Resources Forum. Oxford, UK: Blackwell Publishing Ltd.
- Oppong, D., Lartey, J., Kani, J., & **Danquah, P.** (2024). Simulated comparison of packet transmission over large-scale network: Open shortest path first (OSPF) versus routing information protocol (RIP). Journal of Applied Science and Information Technology, 1(1).
- Wilson, M., Nunoo-Mensah, H., Boateng, K.O. (2023). A Review of Computational Load-Balancing for Mobile Edge Computing. In: Arai, K. (eds) Intelligent Computing. SAI 2023. Lecture Notes in Networks and Systems, vol 711. Springer, Cham. <u>https://doi.org/10.1007/978-3-031-37717-4\_7</u>
- Wulnye, F. A., Arthur, E. A. E., & Gookyi, **D. A. N.** (2024). Comparative analysis of tiny machine learning models for maize crop disease identification. Journal of Applied Science and Information Technology, 1(1).

Yakar, M., & **Dziwornu, M. G.** (2024). Visualizing Population Policies: An Iconographic Analysis of Turkish Postage Stamps (1927-1965). Amme Idaresi Dergisi, 57(3).

#### **Book Chapters**

 Gookyi, D. A. N., Wulnye, F. A., Ahiadormey, R. K., Wilson, M., Twum-Barimah, Y.
 & Danquah, P. (2024). Use case – 49: AI-enabled Soil Analysis and Weather Station for Local Farmers. ITU Publications, AI for Good Final Report 2024. (https://www.itu.int/en/publications/Pages/default.aspx)

#### **Conference Papers**

- Asiedu, D. K. P., Ofori-Amanfo, K. B., Bennin, K. E., Benjillali, M., Lee, K. J., Gookyi,
  D. A. N., & Saoudi, S. (2024, July). Precision Agriculture Deep Neural Network Driven Multi-hop Plant Image Noisy Data Transmission and Plant Disease Detection. International Symposium on Signal, Image, Video and Communications (ISIVC), Marrackech, Morocco (<u>https://www.isivc.org/isivc2024/</u>)
- Arthur, E. A. E., Wulnye, F. A., Gookyi D. A. N., Agyekum, K. O. B. O., Danquah,
   P., Gyaang, R. (2024) Edge Impulse vs TensorFlow: A Comparative Analysis of TinyML Platforms for Maize Leaf Disease Identification. Conference on Information Communications Technology and Society, ICTAS 2024, Durban, South Africa (http://www.ictas.org/ictas2024.html)
- Damba, O. T., Dziwornu,, M. G., Agyarko, F. F., Inusah, S. S., Odonkor, E. N. Abera,
   W. (2024, July). Assessing the Policy Coherence and Coordination for
   Effective Climate-Smart Agriculture Strategies in Ghana. The 3rd Biennial
   Africa Climate Smart Agriculture Stakeholders Conference 2024, Kigali,
   Rwanda
- E. A. Essanoah Arthur, F. Aabangbio Wulnye, D. A. Nana Gookyi, K. O. B. Obour Agyekum, P. Danquah and R. Gyaang, (2024). Edge Impulse vs TensorFlow: A Comparative Analysis of TinyML Platforms for Maize Leaf Disease Identification, 2024 Conference on Information Communications Technology and Society (ICTAS), Durban, South Africa, 2024
- Laryea, B. L., Dziwornu,, M. G., Inusah, S. S., Asiamah, K. (2024, July). From noise to data: Harnessing Innovation for Sustainable Urban Development in Africa. Future urban sustainability: Lessons learnt from the SDGs and perspectives for a post-2030 agenda. University of Vienna, Austria.

Wulnye, F. A., Arthur, E. A. E., Gookyi, D. A. N., Asiedu, D. K. P., Wilson, M., Agyemang, J. O. (2024) TinyML Implementation on Microcontrollers: The Case of Maize Leaf Disease Identification. Conference on Information Communications Technology and Society, ICTAS 2024, Durban, South Africa (<u>http://www.ictas.org/ictas2024.html</u>)

#### **Technical Reports**

Gookyi, D. A. N., Wulnye F. A., Ahiadormey R. K., Wilson M., Twum Barimah Y., Danquah P. Use case – 49: Al-enabled Soil Analysis and Weather Station for Local Farmers In ITU Publications, Al for Good Final Report 2024. <u>https://</u> www.itu.int/net/epub/TSB/2024-Al-for-Good-Innovate-for-Impact-finalreport/index.html#p=1

#### **Feature Article**

Ampofo-Addo, A. S. (Thursday, November 14, 2024). Digital Transformation in Professional Librarianship: The Case of Modern-Day Ghana. Ghanaian Times, p. 7

#### **Data Publication**

Mponela, P., **Dziwornu, M. G.,** Inusah, S., **Agyarko-Fosu, F., Odonkor, E. N., Sackey, T. A.,** & Akpatsu, I. B. (January 2024). Data for the report-Towards optimising climate-smart agriculture resource investment decisions: Mapping program impact areas, policy support and mitigation feasibility.

#### **Exhibits (Digital Art Presentations)**

Adjah, J. (2024) DDCDA 2024 Reutlingen International Design Invitation Exhibition

Adjah, J. (2024) 2024 Long Beach International Design Invitation Exhibition

### **APPENDIX II: STAFF LIST**

Staff list as at 31st December 2024

Table II1

#### **Senior Members**

No. NAME		PRESENT DESIGNATION	QUALIFICATION
1.	Dr. Paul Asante Danquah	Principal Research Scientist/ Acting Director	PhD Info. Technology; MSc Info. Security; BSc (Hons) Computing
2.	Dr. Seth Awuku Manteaw	Principal Scientific Information Officer	PhD Agricultural Extension; MSc Agronomy; PG Dip. Communication Stds.; MA Communication Studies
3.	Mr. Stephen Kwaku Asante Jnr.	Snr. Accountant/ Head of Accounts	MBA Accounting & Finance; BSc Economics & Bus. Adm; CA Ghana
4.	Dr. Agnes Decardi-Nelson	Research Scientist/ Head of Printing & Publishing	PhD African Art & Culture; BFA Graphic Design
5.	Dr. Roger Kwao Ahiadormey	Research Scientist/ Head of Communications	PhD Electronic Engineering; MA Electronic Engineering; BSc Electrical/Electronic Engineering
6.	Dr. Ing. Michael Wilson	Research Scientist/ Head of Electronics	PhD Computer Engineering; MPhil Computer Engineering; PostGrad Wireless & Mobile Computing; CDAC; BSc. Computer Eng.
7.	Mr. Mohammed N. Zainudeen	Research Scientist/ Head of Fluid Science	MSc Chemical Eng.; BSc (Hons) Chemical Eng.
8.	Ms. Anita Adusah	Snr. Administrative Officer/ Head of Administration	MBA Human Resource Mgt; BSc Mgt with Computing (HR); HRM Certificate Level 3
9.	Ms. Naa Aku Mingle	Snr. Librarian	MPhil Information Studies; BA Psychology & Linguistics

10.	Mr. Atta Senior Ampofo- Addo	Librarian/ Head of Geospatial & Information Science	MSc Management Information Systems; CIM-UK (Level 1; BA Info. Studies & Sociology
11.	Mr. Bryan Nii Lartey Laryea	Research Scientist	MBA Management Information Systems; BA Information Studies & Geography
12.	Dr. Michael Dziwornu Gameli	Research Scientist	PhD Urban Studies; MA Geography; BA Geography & Resource; Development & Information Studies
13.	Dr. Dennis Nana A. Gookyi	Research Scientist	PhD Info. & Comm. Engineering; MA Info. & Comm. Engineering; BSc Computer Engineering
14.	Dr. Ezekiel Narh Odonkor	Research Scientist	PhD Agricultural Extension; MPhil Agricultural Administration; BSc Agric Crop Science
15.	Mr. Yaw Twum-Barimah	Research Scientist	MSc Telecom; BSc Elec. & Computer Engineering
16.	Ing. Victor D. Gordon	Research Scientist	MSc Telecommunications & Internet Technologies; BSc Computer Engineering
17.	Mr. Akilakpa Sawyerr	Research Scientist	MPhil Radiation Protection; BSc Physics
18.	Mr. Christian K. Lettu	Research Scientist	MPhil Dev. Geography; BA (Hons) Geography & Resource Development
19.	Mr. John Annor	Research Scientist	MPhil GIS & Remote Sensing; BA Geography
20.	Ing. Frank Lemdi Prikutse	Ass. Research Scientist	MSc Telecom Engineering; B.Eng. Telecom Engineering
21.	Mr. John Adjah	Ass. Research Scientist	MA Communication Design; BA Publishing Studies
22.	Ms. Tracy Adjeley Sackey	Ass. Research Scientist / Scientific Secretary	MPhil Radiation Protection; BSc Physics & Computer Science
23.	Mr. Buertey Essegbey	Ass. Research Scientist	MA Business Administration; BSc Management Studies

24.	Mr. Kenneth Asiamah	Ass. Research Scientist	MSc Information & Communication Technology; BSc Information & Technology Management
25.	Mr. Fred Fosu Agyarko	Ass. Research Scientist	MPhil Statistics; BSc Actuarial Science
26	Mr. Oliver Nortsu	Ass. Research Scientist	MPhil Geography & Regional Planning; BED Mathematics
27.	Mr. Michael Araphat Alhassan	Ass. Research Scientist	MSc Computer Engineering, Computer Systems & Networks; BSc Computer Engineering
28.	Mrs. Akua Boateng Agyenim	Marketing Officer	MBA Marketing; BA Publishing Studies
29	Ms. Risikatu Lawal	Accountant	MBA Finance; BSc Accounting; DBS Accounting; CIPS Cert. Purch. & Supply
30.	Mr. Samuel Ankrah	Accountant	MBA Finance; Bachelor of Commerce; HND Accountancy;

#### Table II2

#### **Senior Staff**

No.	NAME	PRESENT DESIGNATION	QUALIFICATION
1.	Mr. Edwin Adotevi	Snr. Technologist	BA Communication Studies
2.	Mrs. Janet Otoo-Abedi	Chief Accounting Assistant	Diploma Public Finance and Accountancy
3.	Ms. Cordellia Akua Busumtwi	Chief Administrative Assistant	Cert. Private Secretary
4.	Mrs. Margaret Ivy Koranteng	Chief Library Assistant	Diploma Librarianship
5.	Mrs. Sarah G. Sarpong	Chief Accounting Assistant	Diploma Public Finance and Accountancy
6.	Ms. Angela Adikah- Ababio	Principal Auditing Assistant	BSc Business AdmAccounting ACCA Part II
7.	Mr. Alex K. I. Ocansey	Principal Assistant Printer	Cert. (ITS) Snr. Sup/ Mgt; N.V.T.I. Grade I Cert.

8.	Mr. Eric Sam	Principal Technical Officer	BFA Animation HND Graphic Designing
9.	Ms. Doris Kumiwa	Snr. Administrative Assistant	Dip BCom Management DBS Secretariaship; Nat. Banking Coll. Cert Cashier & Frontline Exec
10.	Mr. Benjamin Ohene- Affih	Snr. Technical Officer	B.Eng. Computer Science
11.	Mr. John Paapa Awotwi	Snr. Technical Officer	BSc Information Technology
12.	Ms. Samiratu A. Mamah	Snr. Technical Officer	BA Communication Design
13.	Mr. Yaw Owusu- Ayirebi	Snr. Technical Officer	BA Graphic Design
14.	Mr. Eric K. Acquaye	Technical Officer	Advanced Certificate in Microsoft Certified Systems Eng.
15.	Mr. Irvyne Jojo Blisset	Technical Officer	BSc Information Technology
16.	Mr. Emmanuel A. Kwofie	Technical Officer	BSc Engineering Physics
17.	Mr. Edward Aggrey- Fynn	Technical Officer	BA Computer Science & Management
18.	Mr. Godwin Aborgeh	Technical Officer	BSc Industrial Chemistry
19.	Ms. Victoria Yayra Azuma	Technical Officer	BA Sociology & Geography
20.	Mr. Cyril Nyarko Tawiah	Technical Officer	BSc Information Technology
21.	Mr. Moses Dusi	Library Assistant	BA Information Studies & Computer Science
22.	Ms. Esther Ohenewaa Nyarko	Library Assistant	BA Adult Education & Information Studies Dip Youth Development Work
23.	Ms. Anne Hawa Breh	Library Assistant	BA Information Studies & Sociology
24.	Mr. Patrick Folitse	Marketing Assistant	BSc Business Administration (Marketing)
25.	Ms. Yvonne D. Azuma	Administrative Assistant	Dip Public Administration SSSCE
26.	Ms. Winifred Taylor	Accounting Assistant	BSc Accounting
27.	Mr. Cephas Awusie	Security Officer	Security Training Module I; G.C.E. 'O' Level

28.	Mr. Abdul Rahaman Iddrisu	Security Officer	Security Training Module I; M.S.L.C.
29.	Mr. Fuseini Inusah	Security Officer	SSSCE
30.	Mr. Precious Daniel Attih	Security Officer	BSc Agricultural Engineering

#### Table II3

#### **Junior Staff**

No.	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. Bancie Habill Hussein	Junior Library Assistant	SSSCE
6.	Mr. Joseph Lamptey	Traffic Supervisor	Intercity STC Def. Driving Course; BECE
7.	Mr. Seth Asare	Artisan	Special Junior Tech. Super. Mgt Course, ITS – Accra; MSLC
8.	Mr. Mathew Narteh Amoatey	Driver Inspector	Course on Road Safety Mgt. (ATS) City & Guild Mech. Eng. Craft Practice; BECE; Drive. Lic "C"
9.	Mr. Bright K. Yankey	Driver Mechanic Grade II	NVTI GD II
10.	Mr. Razak Ayidana Akambase	Supervisor Grade I	B.E.C.E.
11.	Mr. Kojo Asanaab	Supervisor Grade I	B.E.C.E.
12.	Mr. Isaac G. Amponsah	Supervisor Grade I	NVTI GD II
13.	Mr. Francis Ayarik	Supervisor Grade I	Nil
14.	Mr. Abdul Wahab Usman	Supervisor Grade II	Nil
15.	Mr. Samuel Adjabeng	Security Assistant Grade II	WASSCE, BECE
16.	Mr. Bismark Quansah	Security Assistant Grade II	WASSCE, BECE