CSIR - INSTI

Institute for Scientific and Technological Information

2017

ANNUAL REPORT

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION

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INSTITUTE FOR SCIENTIFIC AND TECHNOLOGICAL INFORMATION (CSIR-INSTI)

2017 ANNUAL REPORT

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CSIR - INSTI

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List of Acronyms

CARLIGH	-	Consortium of Academic and Research Libraries in Ghana
CID	-	Commercialization Information Division
CRI	-	Crop Research Institute
CSIR	-	Council for Scientific and Industrial Research
DAES	-	Directorate of Agricultural Extension Services
DANIDA	-	Danish International Development Agency
DMC	-	Directors' Management Committee
DNS	-	Domain Name System
ECRI	-	Electronics and Communications Research Institute
EIFL	-	Electronics Information for Libraries
FRI	-	Food Research Institute
GAINS	-	Ghana Agricultural Information Network System
GIS	-	Geographic Information Systems
GISD	-	Geospatial and Information and Science Division
GJAS	-	Ghana Journal of Agricultural Science
GJS	-	Ghana Journal of Science
GOG	-	Government of Ghana
GOVNET	-	Government Network
GPS	-	Global Positioning System
ICT	-	Information and Communications Technology
INASP	-	International Network for the Availability of Scientific Publications
INSTI	-	Institute for Scientific and Technological Information
ITOCA	-	Information Training & Outreach Centre for Africa
KML	-	Keyhole Markup Language
MMDA	-	Metropolitan, Municipal & District Assemblies
MoFA	-	Ministry of Food and Agriculture

NASA	-	National Aeronautics and Space Administration
NITA	-	National Information Technology Agency
OWC	-	Optical Wireless Communication
PGRRI	-	Plant Genetic Resources Research Institute
R&D	-	Research and Development
S&T	-	Science and Technology
SARI	-	Savanna Agricultural Research Institute
STEPRI	-	Science, Technology and Environmental Policy Research Institute
STI	-	Science, Technology and Innovation
TEEAL	-	The Essential Electronic Agricultural Library
WRI	-	Water Research Institute

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(As at 31st December 2017)

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Mr. Joseph Anyen	-	Head, Account Division
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Mr. Benjamin Folitse	-	President, Research Staff Association
Mrs. Ivy Koranteng	-	Representative, Senior Staff Association
Mrs. Dorothy Awanyo	-	Secretary

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EXECUTIVE SUMMARY

The list of research projects and training programmes organised below are extracted from the various Divisions and were carried out by the Institute during the period under consideration. Details of the projects are presented in this report.

Assessment of the Use of Grasscutter (*Thryonomys Swinderianus*) Production Technologies in the Agona West Municipal in the Central Region of Ghana

Grasscutter production technologies disseminated through video in the catchment had been effective and also improved upon the livelihood capitals of respondents in the area of study. The findings make a strong case for the inclusion of grasscutter rearing in Government's employment creation strategy.

How the Policy Environment Influences Value Chain Linkages: A Comparative Study of Cocoa and Pineapple in Ghana

Private sector leadership in value chain functions and service provision can engender the kind of linkages that promote choices and create more space for complex systems of interactions and learning behaviours for actors to translate their challenges into innovative activities. A policy environment that promotes public sector leadership in value chain functions and support services offers little motivation for actors, especially small-scale producers, to forge linkages horizontally and vertically. A strong case is made for participation of private sector actors as it is more likely to expand the platform for more interactive learning among actors for their mutual benefit.

Urban Vegetable Farmers' Appreciation of Insurance in the Greater Accra Region of Ghana

Results demonstrated that majority of the farmers upheld the idea of crop insurance due to diseases and pest menace in vegetable farming and therefore wished to purchase insurance contracts. Most of the respondents who did not wish to participate in such a crop insurance programme stated that given the current increase in general price levels of vegetable products in Accra, the onus was on the state government to provide them with the required financial support and to compensate all the financial losses of the vegetable crops caused by natural diseases and pests instead of collecting money from them.

The Geospatial Dimension of Soil Suitability Categorization for Agricultural Improvement in South Tongu District of Ghana

Satellite imagery was used to develop a new land cover/use map of South Tongu District and it was realized that the FAO soil classification did not coincide with the types of crops cultivated on such soils, however; soil suitability data from CSIR-SRI generally conformed to the types of crops being cultivated in most parts of the area.

Information Sources and Needs among Mango (*Mangifera Indica L.*) Farmers in the Shai Osudoku District of the Eastern Region of Ghana

Mango farmers in Shai Osudoku district need various types of information for mango farming, and they access their required information from, radio, agricultural input dealers, leaflets, NGOs/CBOs and family/friends, however, mango farmers in the study area have challenges in accessing agricultural information properly due to lack of information centres/Libraries, inadequate number of extension agents, lack of awareness of information sources and information not easily accessible.

Willingness to Pay for Agricultural Extension Services by Small-scale Pineapple Farmers in Ghana: A Case Study of Akuapem South District

Though the services were rated good, the small scale pineapple farmers in the study area were willing to pay for better extension services. This was confirmed by the results of the chi-square analysis. Nevertheless, as strongly agreed by farmers in the study area, there were some problems facing small scale pineapple farmers and extension service. It is therefore important that a workable fashion for the implementation of a policy be designed for the Pay for agricultural extension services by small-scale pineapple farmers in Ghana. This is expected to improve extension services and farmers' productivity.

Assessing Farm Record Keeping Behaviour among Pineapple Farmers in the Akuapem South District, Ghana

The study showed that records kept by small–scale pineapple farmers in the area were mainly those pertaining to sales and production. They preferred to keep their farm records daily and through manual storage. The socio-economic factors affecting record keeping in the study area were educational level, years of experience and farm size. Small-scale pineapple farmers in the study area agreed that keeping of farm records will enable them to make productivity projections and will help manage change and improvements in agribusiness. In the same way farmers designated that they had no formal training in record keeping and also indicated that, they are not able to keep farm records due to time constraints.

Ghana Journal of Science & Ghana Journal of Agricultural Science

Volume 51 (2017) of the Ghana Journal of Agricultural Science (GJAS) made up of nine (9) articles and Volume 57 (2017) of the Ghana Journal of Science (GJS) made up of 6 articles were published.

Information resources

The information resources collected by the Scientific Information Management Section for 2017 stood at 1699. These included journals/magazines, theses, annual reports, books and newspapers which were acquired through exchanges, donations and data collection.

Number of persons who used the library

A total of three thousand two hundred and sixty-seven 3,267 clients made up of students and researchers visited the library throughout the year.

Staff strength

The staff strength of CSIR-INSTI stood at 66 as at 31st December 2017, comprising 20 senior members, 26 senior staff and 20 junior staff. Three (3) staff members resigned and two (2) retired. Four (4) new staff were also employed during the year.

Income Generated

The Institute generated **GH₵3,277,311.06** from its services and contract research activities, while the total expenditure for the same period amounted to **GH₵3,293,249.02.** The surplus for the year was **(GH₵15,937.96).**

1.0 INTRODUCTION

The mandate of the Institute is to develop a national capacity and capability for the efficient and effective provision of scientific and technological information on demand for the benefit of research scientists, policy decision makers, industrialists, etc. in an appropriately packaged form for national development.

The Institute's operative objectives were to:

- 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 STI facilities through effective networking and collaborative activities at the national and international levels, and develop strategies to improve access to information
- Produce thematic maps that depict in cartographic form, the contemporary geographical knowledge and data concerning the physical conditions, natural resources, population, environmental and socio-economic characteristics of the country
- Sustain a national S&T publishing and printing facility that publishes for distribution, scholarly works in the agricultural, industrial and S& T sectors of the economy
- Design and implement activities that educate and inform the Ghanaian public about CSIR-generated technologies for easy adoption, and in so doing, help establish linkages with the private sector

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

The year under review marked further discussions and consolidation of the new orientation of the institute as envisaged in the vision of the Director General of the CSIR which is to incorporate electronics and communications research into mainstream activities.

Activities were undertaken by the following divisions:

- Electronics/Communications
- Information Technology Section
- Library and Documentation
- Printing/CID
- Science Publishing
- Thematic Mapping

The supporting divisions were:

- Accounts
- Administration

RESEARCH PROJECTS

2.1 FOOD SECURITY AND POVERTY REDUCTION

COMPLETED RESEARCH PROJECTS

2.1.1 Assessment of the Use of Grasscutter (*Thryonomys Swinderianus*) Production Technologies in the Agona West Municipal in the Central Region of Ghana

Principal Investigator: Folitse, B.Y.

Participating Scientists: Dzandu, L., Osei, S., Mensah, E.

Start Date: March 2017

Duration: 1 year

Location: CSIR-INSTI

Objectives

The specific objectives of this study were to:

- Identify the socio-economic characteristics of respondents.
- Assess the impact of the technologies on respondents' production.
- Assess the extent to which the socio-economic characteristics of respondents influence the use of grasscutter production technologies.
- Determine the impact of grasscutter production technologies on respondents' livelihoods.

Beneficiaries

Agricultural Extension Agents (MOFA), Farmers, Research Scientists and Policy makers.

Materials and Methods

An interview schedule was used to elicit information from 140 selected respondents.

Conclusion and Recommendations

The study showed that respondents were adopting grasscutter production technologies disseminated through video in the area of study. Generally, grasscutter production technologies disseminated through video in the catchment have been effective and also improved upon the livelihood capitals of respondents in the area of study. In terms of policy implication, the findings make a strong case for the inclusion of grasscutter rearing in Government's employment creation strategy.

Recommendations made included the need to ensure that research outputs are not confined to the shelves of researchers. A participatory approach in technology development and use should be adopted to ensure that problems that are targeted by research emanate from farmers, and as such, solutions proffered are carried out with the interest of farmers at heart. Also, there is the need for the Ministry of Food and Agriculture to collaborate with the Council for Scientific and Industrial Research for upscaling of technologies generated by the latter.

The paper has been submitted to Journal Tropical Agriculture for consideration and publication.

2.1.2 How the Policy Environment Influences Value Chain Linkages: A Comparative Study of Cocoa and Pineapple in Ghana

Principal Investigator: Manteaw, S.A.

Participating Scientists: Anaglo, J.N., Boateng, S.D., Folitse B.Y.

Start Date: March 2016

Duration: 1 year

Location: Eastern Region

Objectives

The paper sought to provide some clarity about ways in which policy environment determines the nature of linkages within agricultural value chains within the framework of the agricultural innovation system.

Beneficiaries

Cocoa Farmers, Pineapple Farmers, Agricultural Extension Agents, Ministry of Food and Agriculture.

Materials and Methods

The study was largely conducted nationwide; however, the Eastern Region of Ghana served as the information-rich location where the researchers spent a considerable amount of time in the data gathering work. Two specific locations in the Eastern Region, namely the Akuapem South District and the Tafo Cocoa District, were further selected as the specific study sites for the data gathering work, given their importance in respect of the production of the two commodities. Being a case study, the research employed a combination of quantitative and qualitative data gathering methods to make for triangulation. The sampling methods were similarly a combination of probability and non-probability methods.

Conclusion and Recommendations

The findings adduced by this paper indicated how private sector leadership in value chain functions and service provision can engender the kind of linkages that promote choices and create more space for complex systems of interactions and learning behaviours for actors to translate their challenges into innovative activities. The paper further supports the argument that a policy environment that promotes public sector leadership in value chain functions and support services offers little motivation for actors, especially small-scale producers, to forge linkages horizontally and vertically. In terms of policy implication, the paper makes a strong case for more participation of private sector actors as it is more likely to expand the platform for more interactive learning among actors for their mutual benefit. To build the needed competitiveness through the forging of linkages, it may be necessary to reduce the space for public sector participation in value chain functions and provision of support services as this may reduce the motivation and desire for actors to integrate into networks to address challenges.

The paper has been submitted to Journal of Developing Societies for consideration and publication.

2.1.3 Urban Vegetable Farmers' Appreciation of Insurance in the Greater Accra Region of Ghana

Principal Investigator: Folitse, B.Y.

Participating Scientists: Manteaw, S.A., Akpotsu, B.W., Dzandu, L.P., Koranteng, M.I., Bancie, H.H.

Start Date: July 2017

Duration: 1year 8months

Location: CSIR-INSTI

Budget: GH₵1,800.00

Sponsors: GOG

Collaborating Institutions: Department of Agriculture, Nsawam Adoagyiri Municipal Assembly, Nsawam, Ghana

Objectives

The objectives of the study were to:

- Determine the demographic characteristics of urban vegetable farmers in Accra
- Determine the level of appreciation of insurance by urban vegetable farmers' in the Greater Accra region
- Find out the reasons of insurance coverages for vegetable farmers'
- Determine the willingness to pay for insurance premium

Major Findings

The results demonstrated that majority of the farmers upheld the idea of crop insurance due to diseases and pest menace in vegetable farming and therefore wish to purchase insurance contracts. Even though they generally wanted to avoid crop losses caused by the extreme weather-related disasters, the percentage of the farmers willing to participate in and pay for an insurance scheme was only nearly 60.0%, which indicates a high demand for crop insurance. Most of the respondents who did not wish to participate in such a crop insurance programme stated that given the current increase in general price levels of vegetable products in Accra, the onus was on the

state government to provide them with the required financial support and to compensate all the financial losses of the vegetable crops caused by natural diseases and pests instead of collecting money from the them.

Publications from Project

A research paper has been developed and submitted to Journal of Agricultural Communications for consideration and publication.

2.1.4 The Geospatial Dimension of Soil Suitability Categorization for Agricultural Improvement in South Tongu District of Ghana

Principal Investigator: Lettu, C.

Participating Scientists: Kofie, R., Allotey, A.N.M.

Start Date: January 2014

Duration: 1 year

Location: CSIR-INSTI

Budget: GH₵3,500.00

Sponsors: CSIR

Collaborating Institutions: South Tongu District Assembly & CSIR-SRI Objectives

To depict soil and soil suitability information in a map form in order to aid agricultural planning and policy decision-making that would help improve and increase agricultural productivity.

Beneficiaries

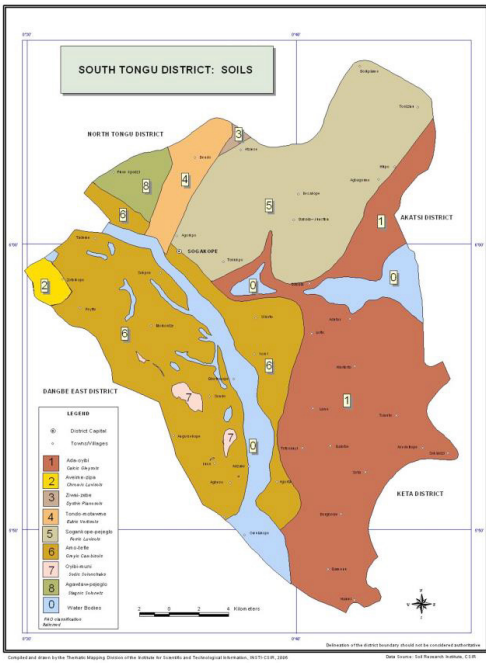
The report intends to benefit the Ministry of Food & Agriculture officials in the district, agricultural investors, local farmers and researchers.

Major Findings

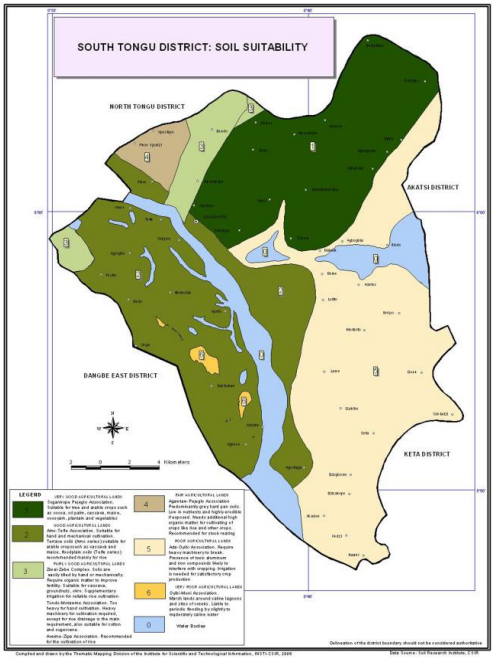
- A new land cover/use map of South Tongu District has been developed using satellite imagery.
- The FAO soil classification does not coincide with the types of crops

cultivated on such soils.

- Soil suitability data from Soil Research Institute of The Council for Scientific and Industrial Research generally conform to the types of crops being cultivated in most parts of the area.



South Tongu District Map on Soils



South Tongu District Map on Soil Suitability

Publications from Project

A research paper has been extracted and submitted to the Ghana Journal of Geography, awaiting response.

ON-GOING RESEARCH PROJECTS

2.1.5 Solar Incubator

Principal Investigator: Twum-Barimah, Y.

Participating Scientists: Peh, B., Gordon, V., Wilson, M.

Start Date: May 2017

Duration: 3.5 years

Location: CSIR-INSTI

Budget: GH₵25,000.00

Sponsors: Not yet found

Background Information & Justification

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

Objective

To provide affordable Incubator for Poultry Farmers as well as increasing bird production to support food security and sustainability.

Methodology

To have the design structure model such that the top lid has the possibility to receive and heat the inner chamber of the system. Also, the power interface is designed to have Solar Power as main Power Input.

Results Achieved so far

So far some literature notes are been reviewed together with other related documents of system design. Additionally, some components for construction of the incubator have been acquired for the initial experimental setup.

Way Forward

Setting out the design test model for the initial experiment to be carried out. Also, we seek some sponsors to assist with the financial constraint of the research work.

2.2 CLIMATE CHANGE, ENVIRONMENTAL CONSERVATION & GREEN TECHNOLOGY

ON-GOING RESEARCH PROJECTS

2.2.1 Climate Change Adaptation Practices by Food Crop Farmers in Ghana: The Case of Kintampo North Municipality

Principal Investigator: Allotey, A.N.M.

Participating Scientists: Lettu, C., Adotevi, E., Akpa-Yeboah, S.

Start Date: October 2015

Duration: 3years

Location: CSIR-INSTI

Budget: GH₵51,506.00

Sponsors: CSIR-INSTI

Collaborating Institutions: Meteorological Agency and Presbyterian University College, Faculty for Development Studies, Akropong Campus.

Background Information & Justification

In an effort to sustain the ever increasing human population, the issue of food crop production is inevitable. Food crop production in developing countries is very sensitive to climate because climate determines almost all the operations undertaken in agriculture. Such agricultural activities include land preparation, planting periods, crop growth, harvesting and post-harvesting.

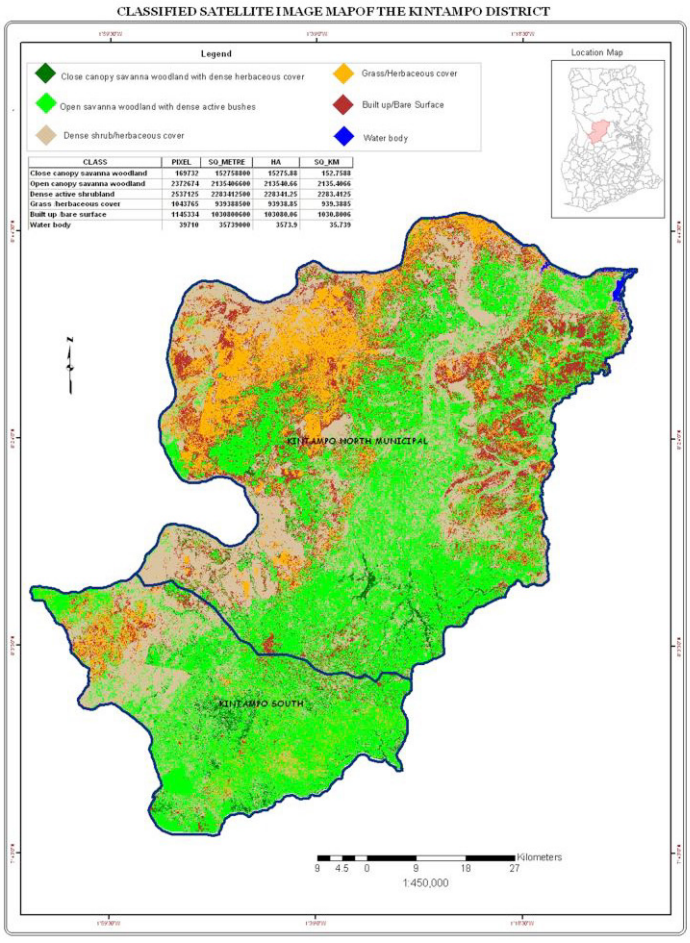
Since agriculture in developing countries is rain fed, changes in climate has an adverse effect on food crop production, which threatens food security with negative effect on livelihoods of millions of subsistence farmers in the developing world (IPCC, 2009; Rosenzweig & Parry , 1994; Richardson, 2011;). Changes in climate, indicated by extreme weather conditions, rising temperatures, flood, drought and desertification would continue to threaten agricultural production.

Climatic role in setting limits for crop production and in determining harvesting periods therefore cannot be over-emphasized. Hence, climate change is

now a real concern for sustainable development of global agriculture and particularly agriculture development in the developing world. This is because agriculture as a complex and highly evolved sector is still directly dependent on climate; since heat, sunlight and water are the main drivers of crop growth.

In view of these developments, the Scientific Basis reports of the Intergovernmental Panel on Climate Change IPCC (1995, 2001, 2007); Allison et.al. (2009); Richardson et.al. (2011), have indicated that regardless of international efforts to reduce emissions of the greenhouse gases that cause climate change, the climate system will continue to adjust to these emissions so long as anthropogenic activities persist. Therefore, the unavoidable climate change impacts on natural and human systems have presented great challenges of a second response to climate change called adaptation.

Adaptation to climate change impacts according to IPCC (2007) is the initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Adaptation measures are therefore important to help rural farming communities to better confront extreme weather conditions and associated climatic variations (Adger et al. 2003). According to Kandlinkar and Risbey (2000), adaptation has the potential to significantly contribute to reductions in negative impacts from changes in climatic conditions as well as other changes in socio-economic conditions, such as volatile short-term changes in local and international markets. Furthermore, the Kintampo North Municipality, is among the twenty-two (22) Municipal/Districts located in the Brong-Ahafo Region which is economically agrarian and used to be one of the major producers of food crops in Ghana to feed the over growing population. Major food crops produce include, maize, cassava, plantain, cowpea, groundnut, rice, yam and cocoyam. There has been a steady decline in food crop production in the area during the past few years. Climate change has been identified as one of the major causative factors to the observed situation. In effect, some farmers have adapted various farm practices which has kept them in business while others are adversely affected. The adaptive strategies when documented and can be used to educate the majority, especially women which would promote food crop sufficiency and improve livelihood of the people in the area.



Classified Satellite Image Map of the Kintampo District

Objective

The main objective of this project is to identify, document and educate farmers on best adaption practices being undertaken by other farmers within the same agro-ecological zone (savanna and semi-deciduous forest).

Methodology

Two (2) methods would be used namely: geospatial techniques (which include Remote Sensing (RS), Geographic Information Systems (GIS) and the use of Global Positioning System) and socio-economic survey, which would involve questionnaire administration.

Results Achieved so far

Concept note prepared. Identified collaborators and funding agencies. Besides, identified some funding agencies like West African Science Service Center on Climate (WASCAL), UNFCCC and Horizon 2020.

Way Forward

Literature is being reviewed while proposal is being revised. Additionally, searching for other potential funding agencies. Looking forward to receiving favourably from the funding agencies.

2.2.2 Climate Change Resilience in Urban Mobility in Accra Metropolitan Area

Principal Investigator: Allotey, A.N.M.

Participating Scientists: Kofie, R.Y.

Start Date: March 2017

Duration: 5 years

Location: CSIR-INSTI & Department of Geography and Resource Development, University of Ghana

Budget: US$270,480.00

Sponsors: DANIDA

Collaborating Institutions: Department of Geography and Resource Development, University of Ghana & University of Copenhagen, Department of Geology & Geography, Denmark

Background Information & Justification

Mobility and accessibility to urban locations are paramount parameters for securing livelihoods and reducing vulnerability of local communities in Sub-Saharan African cities challenged by unsustainable spatial development practices and increased frequency of extreme weather events.

Most climate scenarios foresee a relatively modest increase in precipitation amounts for the West African region although there is a high degree of uncertainty associated with these predictions (IPCC, Niang et al). There is, however, strong evidence that the number of extreme rainfall events will

become more frequent as a consequence of climate change. Rainfall intensity and drainage capacity of soil and infrastructure are very important factors for the risk and damages of flooding in the affected areas. The combined effects imply that the future risk of flooding in the low-lying Accra area is likely to be higher than what general trends in precipitation can explain.

Accessibility is a crucial factor shaping and constraining mobility of residents in cities of Africa (Behrens, Bryceson et al., Sohail et al.). In many African cities, including Accra, long-term under-investments have resulted in insufficient and over-stretched transport systems lagging far behind the demographic as well as the spatial growth of the cities.

The need to secure equal access to mobility is addressed by the UN-SDG for Sustainable Cities and Communities (Goal 11) and in multiple paragraphs of the "New Urban Agenda" of the 2016 Quito Declaration on Sustainable Cities for all (Habitat III). Moreover, the analysis of potential impacts of climate change (CC) and the resilience to these impacts are central themes in the UN agenda as well as in Danida's strategy for development collaboration with Ghana. At the country level, Ghana has recently adopted a National Climate Change Policy that recognizes "rainfall variability leading to extreme events" as a major concern and lists climate resilient infrastructure a policy focus area.

Objective

The objectives of the proposed project are to establish a comprehensive understanding of the physical and human factors that determine resilience to climate change impacts on mobility and accessibility in the Accra region.

Methodology

The project will seek to apply a combination of quantitative and qualitative methods to address the objectives of the different work packages. The quantitative methods include 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 drone co-financed from other sources 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 in-depths and focus group interviews at the community level as well as interviews with planners and other stakeholders. Both teams have a long record of collecting, processing and analyzing both qualitative and quantitative data in a Sub-Saharan urban context.

Results Achieved so far

The project proposal has been accepted and grant approved.

Way Forward

Administrative process has commenced and kick-off workshop is scheduled for June 2018, in Accra for all the participating researchers and stakeholders.

2.3 BIOMEDICAL AND PUBLIC HEALTH

ON-GOING RESEARCH PROJECTS

2.3.1 A Geospatial Approach to The Assessment of the Impact of Dumpsites on Human Health (At Household Levels) in Ghana: A Case Study of the Greater Accra Region

Principal Investigator: Allotey, A.N.M.

Participating Scientists: Kofie, R.Y., Lettu, C.

Start Date: October 2015

Duration: 3 years

Location: CSIR-INSTI

Budget: GH₵935,056.00, $325,803.48

Sponsors: CSIR-INSTI

Collaborating Institutions: Department of Environment, Health and Biology, School of Public Health, UG-Legon, Department of Geoscience and Natural Resources Management, University of Copenhagen – Denmark & Faculty of Development Studies, Presbyterian University College, Akropong Campus.

Background Information & Justification

The increase in populations and the rising demand for food and other essentials has led to a rise in the amount of waste being generated daily by each household and industrial, commercial, agricultural and other production. The waste is ultimately thrown into municipal waste collection points or centres from where it is collected to be further disposed of in designated places. While most economically advanced countries can boast that waste collection and treatment poses little or no health risk to their populations, the situation in developing countries is the contrary. Decades of research and investment has led to efficient management of waste with little detriment to populations in the advanced economies (ISWA, 2015). ISWA therefore advocates for the need by the international community to pay urgent attention to this predicament since it is the world's people who are breathing in the toxins released by burning on open dumps, notwithstanding the huge greenhouse gas emissions involved.

In Ghana, waste, or rubbish, trash, junk, or garbage end up as unwanted or undesired material substance in dumpsites. These unwanted materials may be classified as solid, liquid or toxic and may consist of left over from some manufacturing processes or from community and household activities. The problem is not so much with the undesired material substances, but lies with where they are finally disposed of or dumped, and the health hazards that they pose to populations living within the catchment areas or surrounding environment. The fact is that the materials are often discarded or accumulated, or stored without treatment either physically, chemically or biologically. Some of the dumps are located right in residential areas. For example, the Pantang dump (Abloradjei dump) is near the Pantang Psychiatric Hospital and is one of the oldest and largest dumpsites in Accra. It has undoubtedly become an obvious health hazard in the fast growing residential area. Started in the 1990s, it is currently the recipient of tons of waste generated in many parts of the capital city. It is estimated that the site receives an average of 249 tons of waste daily (GEMA Report, 2010). The dumpsite, approximately the size of two football pitches is covered with a mountain of solid waste. Clouds of thick smoke resulting from the constant burning of the waste at the dumpsite continuously hang over the entire community. Additionally, a stream of toxic liquid waste leaches from the of refuse pile, into residential homes whenever it rains (Myjoyonline.com, 2014). Yeboah & Allotey (2014) discovered that leachate has contaminated underground water sources of the Abloradjei environs, the source being the dumpsite.

The phenomenon of dump sites is not peculiar to Ghana, but is worldwide. The world's mega dump sites have been classified not only by their sizes but also by the type of waste they are composed of. This is important, since from our point of view, the type of health impact is contingent upon the substances being dumped. The Karakara dump site in Cochabamba in Bolivia mainly consists of municipal waste and covers 25 hectares or 36 football pitches. The Estrutural dumpsite in Brasilia, Brazil consists of municipal waste and covers an area of 136 hectares or 194 football pitches. The case of the Duquesa in Santo Domingo, Dominican Republic is that it consists mainly of municipal waste and is hazardous. It covers 128 hectares or 183 football pitches. The Dandora dump in Nairobi, Kenya is mainly composed of municipal and medical or healthcare waste and is considered hazardous. The Agbogbloshie in Accra, the capital of Ghana mainly consist of e-waste and covers 10.6 hectares or 15 football pitches (The Guardian, 2014)

Environmentalists and conservationists have decried the world's consumption patterns and opine that the presence of waste shows that materials are not being used efficiently. This recklessness is leading to the reduction of the earth's capacity to supply new materials in the future. To them the capacity

of the natural environment to absorb and process these materials is also under stress. Thus valuable resources in the form of matter and energy are lost during waste disposal, requiring that a greater burden be placed on ecosystems to provide these. The main problem is the sheer volume of waste being produced and how we deal with it.

Environmental health practitioners look at the problem posed by emissions, especially at the non-engineered dumpsites and the health hazards that they pose. These usually involve POPs (persistent organic pollutants), heavy metals and VOCs (volatile organic compounds). While some studies have concentrated on the effect on waste handlers or scavengers at the dumpsite (Kretchy et. al, 2015), others have looked at the health and wellbeing of the surrounding populations (ISWA, 2014). For example, a wide range of substances including methane, carbon dioxide, benzene and cadmium which are toxic to human health are released into the environment. The International Agency for Research on Cancer classifies exposure to cadmium and benzene as highly carcinogenic for humans. In addition, dumpsites are likely to contain highly hazardous compounds resulting from industrial production, for example asbestos and lead (IARC, 1993). Other studies have found that waste exposure in dumpsites lead to health outcomes including cancer and congenital malformations.

Dump site associated diseases vary and range from infectious diseases which come about as the result of the materials of which the wastes are composed. Flies, rats, mice and mosquitoes pose health problems including diarrhea, cholera, typhoid, malaria, lymphatic filariasis, leptospirosis, lassa and other hemorrhagic fevers. The problem posed to the food chain by dumpsites has also been discussed. For example open feeding by animals at the dumpsites or materials that might be affected by direct emissions of dangerous pollutants could be transferred into the food chain.

Smoke caused by burning of the waste materials is known to contain pollutants which lead to respiratory tract infections such as asthma, and chronic obstructive pulmonary diseases (COPD). Leachates could spread volatile organic compounds such as lead, mercury and cadmium. Lead poisoning could lead to neurological problems and mercury poisoning could lead to minamata diseases.

Significantly associated with dumpsites are odors from noxious fumes, especially those receiving biodegradable waste. Odors are typically associated with activities such as the handling of odorous wastes and the covering of biodegradable wastes or with the presence of trace components in gas or leachates. The odorous emissions are often accompanied by reports of ill-health from communities. Individuals may report a wide range of non-

specific health symptoms, attributing these to odor exposure, including nausea, headaches, drowsiness, fatigue and respiratory problems. (ISWA 2014).

The Problem

World attention to dumpsites has been largely due to the health hazards that they pose. While most economically advanced countries boast that waste collection and treatment poses little or no health risk to their populations due to decades of investment in research and innovation, the situation in less economically developed nations is the contrary. This raises much concern not only to the less economically developed nations but the entire world community. David Newman, ISWA President opined that "the international community has an urgent task ahead in closing waste dumps globally, for the sake of populations affected by them because they live in or near them, but also because all the world's people are breathing in the toxins released by burning on open dumps. And the greenhouse gas emissions involved are huge too, and unless we act, the growth of open dumping is inevitable" (ISWA, 2014).

With increasing populations, rapid urbanization and high consumption patterns, but less investment in research and innovation, it would appear that a solution to dumpsite/waste management problems in less developed economies will remain a mirage for a long time. It would mean therefore that the health effects would continue to be permanent features of the health status of the people. The situation in Ghana does not promise early solution to dumpsite menace in the face of limited resources and little investment in the sector. The problem posed by waste pile-up in the city of Accra and the attendant rumpus over dumpsites has been a source of concern in recent years (Ref to AMA), and attest to desperation of city authorities in arriving at any meaningful solutions.

Studies reviewed so far have shown a general focus on issues such as landfill leachate management systems, and leachate impact on groundwater (Keelson, 2014, Yeboah & Allotey, 2014), Other studies have shown types of exposure, protection and self-reported health problems among solid waste handlers (Kretchy et al. 2015). Tsiboe and Marbell (2004) enunciated the problems of urban waste disposal in Accra and the challenges posed to recyclers and communities around dumpsites. Little has however been reported on health impact on individual households within the environs of the dumpsites. It is important to address the healthcare challenges of dumpsites from the household levels where the finer details of diseases incidence could be obtained to aid policy and decision making. We argue that the disease

types may vary in endemicity among households and is dependent upon the distances from the dumpsites.

The aim of this research is to employ geospatial tools and techniques to do inventory of the spatial extent of the dumpsites and the surrounding areas, generate buffers based on specified distances from the dumpsites in order to know the households that fall within the buffers and kriging, a geostatical tool which is used for mapping of surfaces from limited sample data and the estimation of values at unsampled locations. It will show variation in density of the disease types based on interpolated values.

This study meets the global goals for sustainable development agendas 3 and 6, which targets good health and wellbeing, and clean water and sanitation respectively. The study contributes to the goal of reducing number of deaths and illness from hazardous chemicals and materials, and other forms of pollution and contamination from dumps.

Objective

The aim of this study is to carry out analysis of three major dumpsites located in the Greater Accra Region of Ghana with regard to their health impact on surrounding households using the distance decay model and employing geospatial techniques, specifically, GIS, Remote Sensing and GPS tools. The dumpsites are the Abloradjei near Pantang, Agbogbloshie and Kpone. The study will also test the assumption that the level of prevalence of the diseases associated with dumpsites decreases with distance away from the dumpsites.

Methodology

Field investigations and face to face interviews with members of households living within the environs of the three dumpsites and players in the waste management industry. Walkover surveys at the various dumpsites to determine their sizes, and source materials would be carried. Dumpsite workers would be randomly sampled for interviews to determine their experiences with disease types associated with their professions. Satellite imageries to determine spatio-temporal expansion of the dumpsites and the localities in which they are located. GIS-based spatial analysis – including the spatial distribution of disease types, buffering to determine distances and household/populations at risk and krigging (a statistical tool that uses point interpolation to determine trends).

Kpong landfill sites (Dumpsites)

Results Achieved so far

Concept notes/proposals have been prepared and discussed among researchers and collaborators for funding. While awaiting funding, literature search and possible expansion of the research are being discussed to include bio-medical aspects of the study.

Way Forward

The proposal has been sent to collaborating experts for its expansion to attract funding from health organizations and other funding agencies. Besides, we are seeking collaboration with the Faculty of Development Studies, Presbyterian University College, Akropong Campus.

2.4 ELECTRONICS AND ICT

ON-GOING RESEARCH PROJECTS

2.4.1 Congestion Aware Routing

Principal Investigator: Wilson, M.

Participating Scientists: Boateng, K., Twum-Barimah, Y., Gordon, V., Peh, B.

Start Date: August 2016

Duration: 24 months

Location: Accra

Budget: GH₵260,000.00

Sponsors: CSIR-INSTI & KNUST

Collaborating Institution: KNUST

Background Information & Justification

Many efforts have been made in different countries by different expertise in attempts to eliminate, control or reduce traffic congestion. The number of cars in Ghana will increase even exponentially as the country is struggling to achieve middle level income. The DVLA estimates about 1.2 million vehicles in Ghana, with 60% of these in the capital, Accra alone, Ghana's road network stretches about 1,632 kilometers out of which 1,310 kilometers is tarred.

The United States Department of Transportation estimates in work an annual indirect cost associated with traffic as follows:

- Productivity losses $38 billion
- Unreliability of road usage $38 billion
- Cargo and Goods delay costs $4.7 billion
- Environmental Safety $12.6 billion

Combining both the direct and indirect costs, totals more than $200 billion ($213.4 billion) of annual congestion cost. Not only does traffic congestions hamper economic activities but also threaten the health of inhabitants of the city. The total number of annual premature deaths caused by air

pollution solely from vehicular fumes in the United States as a result of traffic congestion is pegged over 2000 by a research paper published by the Harvard school of Public Health.

The main contributions of this work includes revealing the possibilities of modeling data network algorithms to improve the efficiency of vehicular networks, congestion metric formulation and adaptation/reengineering of Dijkstra's SPF algorithm for traffic decongestion on vehicular networks.

Objectives

The general objective of this research work is to address the congestion problem on road networks by adopting and reengineering a data network algorithm for use to manage road traffic congestion through fair routing of vehicular traffic on road networks. To achieve the objective the following specific objectives is set:

- To select a suitable routing algorithm for modification and adoption.
- To determine a suitable metric for the application of the dynamic algorithm.
- To formulate the method of congestion-aware routing and illustrate its use based on an assumed sensor network infrastructure.
- To implement the method as a mobile application and demonstrate its ease of use.

Methodology

The proposed solution identifies the Dijkstra's shortest path first algorithm as suitable for adoption and reengineering to device a fair routing for vehicles on road networks in order to manage vehicular traffic congestion. The investigation will employ the concept of classical Proportional Integral Derivative (PID) controllers to adjust road occupancy data acquired from a sensor network superimposed on the road network. Real-time vehicular occupancy data on road networks is collect and converged to a central database. It will explore principles of graph theory to attain topological design of a sub-section of the road network as a data structure (A MAP) implemented using the JAVA programming language. This map serves as a routing table for the reengineered SPF algorithm with nodes of a graph representing road intersections and the road links representing the edges of the graph. Estimated travel time for each road link is computed based on occupancy-speed relationship and speed/distance/travel-time dependencies. Fair routing is thus effected using real-time data. Routing information is presented in the form of which route provides the fastest set of interlinked

road segments between any departure-destination pair of nodes of road network. Routing traffic in such a way minimizes the overall traffic congestion on road networks.

Results Achieved So Far

This work has addressed the problem of routing vehicular traffic on road networks. Fair routing is effected using real-time data acquired from an assumed sensor network superimposed on road networks. Routing information is in the form of which route provides the fastest set of interlinked road segments between any departure-destination pair of nodes. Routing traffic in such a way minimizes the overall traffic congestion on road networks. Simulation has been performed to show the computations involved in deriving travel time estimates from road occupancy data. Also, a hypothetical road network (the Liberation Road - Accra) has been used to illustrate our vehicular traffic routing algorithm. Finally, a use case has been presented as a mobile application for a road sub-network in Accra, Ghana. It has been shown that the method is more practicable and easier to realize than a method in literature—Spatial and Traffic Aware Vehicular Routing (STAR).

A paper was submitted to the International Journal of Intelligent transports systems for publication. Review was received from three reviewers requesting modifications and further study. Minor modifications have been made to the paper and are in the process of being submitted to the Ghana Journal of Science for a second review and subsequent publication.

Way Forward

To team up with BRRI in a proposed future study on a telematics approach to computing the relative congestion contribution of each road sub-section to the overall traffic congestion for a chosen road segment. This study will help refine values for proportional, derivative and integral gains used in this study resulting in a more tailor made decongestion solution to the problem for different localities.

Avail research findings and prototype concept to interested implementers for the solution to be fully implemented.

2.4.2 Ubiquitous Computing for Location Based Tourist Attraction

Principal Investigator: Wilson, M.

Participating Scientists: Peh, B., Gordon, V., Twum-Barimah, Y.

Start Date: September 2017

Duration: 28 months

Location: Ghana (All 10 Regions)

Budget: GH₵556,000.00

Sponsors: CSIR-INSTI & MIPH Consult (still searching)

Background Information & Justification

The World Travel & Tourism Council (WTTC) expected Ghana's tourism industry to expand by 5.6% in 2016 and maintain an annual growth rate of 5.1% per annum from 2017 through to 2027. The tourism sector however recorded its worst performance in the first quarter of 2017. A growth in tourism has a corresponding growth on many aspects of the economy including the hospitality industry and the trade sector. With a number of internationally-branded hotels in Accra (As at May 2017, there were 2, 723 hotels and lodges in Ghana.), there is the expectation of an increase in the number of business travelers to the country as the government embarks on a number of initiatives to stimulate economic growth. Coupled with the government's intention concerning making improvements in transport infrastructure, with the construction of a third terminal at Accra's Kotoka International Airport and allocation of funds for the repair of roads to popular tourist destinations, the missing link there is an efficient platform to advertise these tourist sites to visitors who visit Ghana in any way possible.

Attracting tourists to our tourist sites seems to be a primary challenge to the tourism sector especially in the three northern regions. According to the Ghana statistical service report in 2015, domestic tourism was lowest in the three regions of the North. According to the report, 3,588,086 tourists travelled from one region to another within the year under study. Of this figure, only 12.1 percent or 434,000 persons travelled to the three regions of the North altogether. The survey, however, revealed that the Ashanti region attracted the highest number of domestic tourists. The region had as much as 670,972 tourists visiting in 2015.

In this proposed research work, we consider investigating the driving forces of tourism and looking into how ubiquitous and mobile computing coupled

with recent technologies like augmented reality, 3-D Printing, and GIS can be adopted for a location-based tourism advertising and an overall improved tourist experience.

Objective

To exploit the use of technology in unleashing a disruptive wave of new tourism experience in Ghana.

Methodology

In this work, we intend to be gathering documentation on both documented and undocumented tourist towns, festivals, heroes, etc. from indigenous people and other authentic sources. The gathered information will be investigated for authenticity and will be digitally associated with a QR codes. The generated codes will then be replicated and tagged on all artifacts and places connected to the documentation. We envisage the creation of local content on tourism from the people of Ghana. Drones will be used were applicable to capture a virtual tour of popular tourist sites and linked up to a web portal where tourists can have a feel of these places before a planned visit.

The amazing technology of 3-D printing will be used to print artifacts related to various tourist sites and these artifacts will bare tagged QR codes that link to documented information about the artifact. Location-based services will be used to advertise nearby tourist towns and sites through a custom mobile application.

Results Achieved so far

The project commenced in the last quarter of 2017 with the registration of the project's domain and hosting of the project's official website. Cost for domain registration and website hosting was paid by MIPH consult as part of its contribution to the project. Development of the project website is successfully completed by a team at CSIR-INSTI and is currently being managed by the same team with the help of three National Service persons. The website is available at www.ghanaportals.com.

Discussions on a mobile the development of a Ghana Portals mobile App is far advanced and implementation is set to begin in January 2018 by a joint team from CSIR-INSTI and MIPH consult.

Way Forward

The project is however, seriously challenged with financial support and is still looking out to engage a third party whose role will solely be to support the project financially. QR Codes for documented sites so far will be printed and a proposed launch date for the portal will be scheduled most likely in 2018.

A commercialization wing will also be setup to look into possible ways of generating revenue from the products of this project.

2.4.3 Design and Implementation of a LiFi Test-Bed

Principal Investigator: Gordon, V.

Participating Scientists: Wilson, M., Peh, B., Twum-Barimah, Y.

Start Date: November 2017

Duration: 22 months

Location: CSIR-INSTI

Budget: GH₵10,000.00

Sponsors: CSIR-CRGS

Background Information & Justification

Wireless technologies are largely used for data communication and networking. They have become an indispensable support and a driver for information flows in world economies and provide users with access to a very large quantity of information and services. With the popularization of the internet, the development of wireless technologies has greatly increased the possibilities of pervasive data access, making it possible to deliver multi-media content to consumers and incorporate the internet even further into business operations and services.

Humanity has depended on the visible light for vision and illumination due to the inherent affinity of the human eye to interpret the wavelengths associated with it. LiFi utilizes the vast potential of the underutilized, unlicensed, and bio-friendly visible light (VLC) portion of the electromagnetic spectrum. The wide bandwidth of this region, 380nm to 780nm in wavelength and 10,000 times larger than the entire radio frequency spectrum (RF), has almost no limitations on capacity.

Li-Fi is the green communication of the next generation wireless technology and a product compatibility standard for optical wireless communication protocol based on IEEE 802.15. The physical layer (PHY) and media access control (MAC) layer are defined by the IEEE 802.15.7 protocol standard .This delivers enough data rates to support audio video, and multimedia services for the short-range optical wireless communication. The Attributes of the MAC sublayer includes support for color function, color stabilization, dimming and visibility to maintain the illumination function in the idle state and mitigate flicker. It also handles layer 1 resource contention issues, addressing and data acknowledgement protocols. The physical layer, PHY is subdivided into PHY1, PHY2, and PHY3 sublayers. The PHY1 sublayer is for modelling outdoor applications that require low data rates, PHY2 sublayer is for modelling indoor applications that require high data rates and the PHY3 sublayer is used for applications where red, green and blue (RGB) LED detectors and sources are available. The network topologies currently supported are the Star, Peer-to-Peer, and Broadcast technologies. In the star topology, a single central point of contact, known as the coordinator establishes the communication between the devices whereas one of two devices can be the single point of contact in the peer-to-peer topology. Both the device and coordinator are assigned a 64bit unique address but can communicate via a short 16bit address during association. The coordinator is usually powered by the mains with the devices normally battery powered. The broadcast topology is independent of association hence, can operate without any device associated with it and vice versa.

The current trend of wireless communication with ever increasing demand for higher throughput and ubiquitous coverage is setting high demand for spectrum utilization of the radio frequency communication. It is estimated that mobile data traffic will build up at a compound annual growth rate (CAGR) of 61 percent from 2013 to 2018. This observation calls for alternative means for capacity provision and extra capability communication methods in the future. The visible light portion of the RF spectrum which provides about 400 THz of unlicensed frequency is a possible candidate that can be harnessed for voice and data communications purposes. It is envisaged to generate speeds up to 1Gbps. Results of ongoing research indicate that theoretical speeds of more than 10Gbps at very high data densities are achievable. The interest of VLC has increased concurrently with development and utilization of LED technology. High-intensity LEDs can provide a very high modulation bandwidth for communication with an energy efficient illumination. LEDs are widely utilized for indoor lighting, automotive and Public Street lights after the light intensities were developed in sufficient intensity levels. Legislation on energy efficiency for environmental sustainability has influenced the use of LED lamps to some appreciable level. This direction will free up the market for the LED technology providing a platform to implement VLC technology.

The market for VLC technology is estimated to reach more than 9 billion dollars by the year 2020, at a CAGR of 87.31 % from the year 2014 to 2020. VLC technology is related to the more researched infrared (IR) telecommunication technology. The infrared communication is a standardized technology and part of the Institute of Electrical and Electronics Engineers (IEEE) 802.11 wireless local area network (WLAN) standards. The infrared system can approach Gbps data rates with 10 Gbps data rates demonstrated. Infrared rays have been applied in areas such as wireless remote control, IrDA, Infrared wireless LAN, and infrared inter-building communication. In recent years, the academic and commercial interest in visible light communication has gained momentum. LED lights are more finely controlled than legacy incandescent bulbs and this makes optical technology more ideal and economically practicable for pervasive data transfer.

There have been a number of related research and projects in the study area recently within the research community.

Chatterjee et al., research on Scope and Challenges in Li-Fi Technology, J. Vucic et al., Investigation of visible light communications link based on discrete multitoned modulation (DMT) of a white LED, Cossu et al, Tsonev et al., the Ultra-Parallel Visible Light Communication (UP-VLC).

Wireless communications have become a utility like electricity; we use it in our everyday lives, and in our businesses. It is therefore this importance that calls for the need to look into the issues and challenges of this technology because it is very fundamental to our lives. These issues are capacity, efficiency, availability, and security.

The wireless ecosystem is so broad with a large stakeholder community such as Telecommunication services providers, the industrial scientific and medical band (ISM), the military, internet cafés and even coffee shops. The demand for the limited radio spectrum is increasing exponentially with an increasing demand for wireless data causing bandwidth limitations leading to spectral congestion. Does the RF spectrum have the flexibility to adjust to these ever-changing needs? The future of the RF spectrum in terms of bandwidth capacity and the provision of safe communication in RF controlled environments are other concerns that need to be addressed. LiFi will add spectra to the available bandwidth to carry the excess future demand. This will provide a more secure bio-friendly communication with improved data rates, improved efficiency and a significantly spatial reuse of bandwidth.

Objective

The main objective of the study is to set up a testbed to conduct experimental research into optical wireless communication (OWC) for the testing, demonstration and development of LiFi applications.

Methodology

A hybrid research approach will be employed to execute the research proposal. The designing methodology of the testbed architecture is based on three main blocks namely; the main LED unit (MLU) to which the data source is directly connected to, and the agent LED nodes (ALs), LED Lamps which receive optical signal from the MLU and distribute to the optical wireless enabled end devices for optical wireless internet access. The number of ALs depends on the requirements and internal structure of the mount point or ceiling. The architecture of the study was based on three ALs namely; AL1, AL2, and AL3 to provide coverage for the end devices at a direct field of view (FoV) of 370 ± 20 cm. Mirror technology is used to reflect the optical data signal to increase the coverage area. A constant alternating current (AC) will be applied to the base of the MLU housing the ALs to trigger the emission of a constant stream of photons observed as visible light. These are then modulated, converted into a data stream, demodulated and then transmitted to suitably adapted end devices. An open source software, DIALuxevo is used to configure the bliss ceiling mount-point for maximum illumination of the LEDs in the indoor testbed environment.

Results Achieved so far

- Funding approved by donor.
- Grant released and disbursed by donor.
- Commercial invoice for vital electronic components received from the manufacturers.
- Release of approved and disbursed research grant by CSIR-INSTI for payment of commercial invoice for vital electronic components pending.
- Literature review for research publication completed.

Way Forward

Research grant to be released by CSIR-INSTI to trigger payment of commercial invoice for vital electronics components.

2.4.4 Identification and Mapping of Poverty Endemic Areas in Ghana Using a Multi-Dimensional Poverty Index

Principal Investigator: Allotey, A.N.M.

Participating Scientists: Ampadu, R., Omari, R., Lettu, C.

Start Date: October 2015

Duration: 3 years

Location: CSIR-INSTI

Budget: GH₵116,200.00

Sponsors: CSIR-INSTI

Collaborating Institutions: CSIR-STEPRI

Background Information & Justification

Poverty has been widely debated, researched and documented subject since the past three decades (Jayaratne et al 2002). Scholars have defined poverty in multitude ways referring to different conditions and contexts through city, country, regional and global perspective. Among the poverty measures, one can distinguish between the conventional approach, which is money metric and uses income and/or expenditure data. Other approaches involve the use of socio-economic indicators, and a number of alternative or multidimensional approaches like the asset index approach applied to data from Demographic and Health Surveys (DHS). This approach has gained increasing popularity in recent years (Filmer & Pritchett, 1998; Sahn and Stifel, 2000; World Bank, 2000).

It is therefore understandable to know that the way we understand and measure poverty, importantly shapes how we analyze it and develop policies to arrest the canker. This therefore calls for some measurement methodologies which provide significant practical relevance. This is more important especially when poor people are usually found to experience a number of deprivations such as social exclusion, low living standards, lack of education, insecurity, poor health among others. Unfortunately, and more often, a single variable such as consumption expenditure or income levels have been used to describe the poor and poor communities in several countries including Ghana. This is in spite of the reality that no single poverty measure can capture all these deprivations and offer a tangible solution. A suitable metric of poverty creates the opportunity for policy and decision makers to better understand the phenomenon and therefore provide equally

practical solution that will ensure fruitful wellbeing of the citizenry.

Accordingly, the Millennium Development Goals (MDGs) brought the issue of poverty onto the global development agenda. This encouraged all nations to renew their commitment to the battle against poverty. As a result, governments and development agencies all over the world are now paying more attention than ever before to measures to improve the quality of life by reducing poverty. To achieve this, there is the need to first identify the poor.

Objective

The main objective of this project is to use the concept of plurality of poverty indicators to map out poverty endemic communities within the three northern regions identified as the poorest regions (Upper East, Upper West and Northern) in Ghana together with the distribution of natural resource endowments and to assess the extent to which these resources can be harnessed to reduce poverty.

Methodology

This study would use three major methodologies. Firstly, the multidimensional poverty analysis tool developed by Alkire and Foster (2011). The second method will involve a socio-economic survey and thirdly, geographic information systems (GIS) technique.

Results Achieved so far

Identified collaborators and funding agencies.

Way Forward

Literature is being reviewed while proposal is being revised. Additionally, searching for other potential funding agencies.

2.5 SCIENCE AND PEOPLE

COMPLETED RESEARCH PROJECTS

2.5.1 Information Sources and Needs among Mango (*Mangifera Indica L.*) Farmers in the Shai Osudoku District of the Eastern Region of Ghana

Principal Investigator: Folitse, B.Y.

Participating Scientists: Manteaw, S.A., Bekoe, S., Koranteng, M.I., Bancie, H.H.

Start Date: March 2016

Duration: 1 year 4 months

Location: CSIR-INSTI

Budget: GH₵1,600.00

Sponsors: GOG

Objectives

The general objective of the study was to find out the information sources and needs of mango farmers in the Shai Osudoku District in the Eastern Region which is a major mango growing area in Ghana. The specific objectives were to describe the characteristics of the mango farmers and to identify their sources of information, needs and challenges faced by the mango farmer in the study area. The intent is to provide empirical information on the type of information needs of the mango farmers in the business, which will inform information professionals, extension agents and policy decisions by government and stakeholders including farmers in their effort to promote sustainable mango production in Ghana.

Major Findings

The findings of the study revealed that the mango farmers in Shai Osudoku district need various types of information for mango farming, and they use a number of information sources for access to their required information. Although mango farmers source information from, radio, agricultural input dealers, leaflets, NGOs/CBOs and family/friends, mango farmers in the

study area have challenges in accessing agricultural information for their mango business. Besides, lack of information centres/Libraries, inadequate number of extension agents, lack of awareness of information sources and information not easily accessible have caused them problems in accessing agricultural information properly. There is a need for government and Directorate of Agricultural Extension Services (DAES) of the Ministry of Food and Agriculture (MoFA) to lay more emphasis on sustainable practices on information accessibility to mango farmers and also to disseminate information to them and address their information needs properly.

Publications from Project

A research paper has been developed and submitted to International Information & Library Review for consideration and publication.

2.5.2 Willingness to Pay for Agricultural Extension Services by Small-scale Pineapple Farmers in Ghana: A Case Study of Akuapem South District

Principal Investigator: Folitse, B.Y.

Participating Scientists: Akpotsu, B.W., Manteaw, S.A., Koranteng, M.I., Bancie, H.H.

Start Date: May 2017

Duration: 18 months

Location: CSIR-INSTI

Budget: GH₵1,600.00

Sponsors: GOG

Collaborating Institutions: Department of Agriculture, Nsawam Adoagyiri Municipal Assembly, Nsawam, Ghana

Objectives

- Describe the socio-economic characteristics of small-scale pineapple farmers
- Identify the sources of agricultural information available to small scale farmers

- Ascertain the wiling-to-pay for agricultural extension services by the small scale pineapple farmers
- Examine factors influencing small-scale pineapple farmers and willingness to pay for agricultural extension services.

Major Findings

Majority of the small scale pineapple farmers also indicated that they preferred information in the print format in the English language. Though the services were rated good, the small scale pineapple farmers in the study area were willing to pay for better extension services. This was confirmed by the results of the chi-square analysis. Nevertheless, there were some problems such as extension agents' lack of vehicles for transportation, inadequate funds for extension activities, large farmer: agricultural extension agents' ratio, poor conditions of service for extension agents were strongly agreed by the farmers in the study area as problems facing small scale pineapple farmers and extension service. It is therefore important that a workable fashion for the implementation of a policy be designed for the Pay for agricultural extension services by small- scale pineapple farmers in Ghana, this is expected to improve extension services and farmers' productivity.

Publications from Project

A research paper has been developed and submitted to The Journal of Development Studies for consideration and publication.

2.5.3 Assessing Farm Record Keeping Behaviour among Pineapple Farmers in the Akuapem South District, Ghana

Principal Investigator: Akpotsu, B.W.

Participating Scientists: Folitse, B.Y., Manteaw, S.A., Koranteng, M.I., Bancie, H.H.

Duration: 1year 6months

Location: CSIR-INSTI

Budget: GH₵1,500.00

Sponsors: GOG

Collaborating Institutions: Department of Agriculture, Nsawam Adoagyiri Municipal Assembly, Nsawam, Ghana

Objectives

The objectives of the study were to:

- Describe the demographic characteristics of pineapple farmers
- Determine the various types of farm records kept by pineapple farmers
- Define the benefits derived by pineapple farmers in keeping farm records
- Determine the factors affecting farm record keeping by the pineapple farmers
- Examine the challenges pineapple farmers faced keeping farm records

Major Findings

This study has shown that most small scale pineapple farmers in the study area are males with almost all the farmers having formal education and keep farm records. The records kept are mainly those pertaining to sales and production. Small-scale pineapple farmers in the study area preferred to keep their farm records daily and preferred manual storage. The socio economic factors affecting record keeping in the study area were educational level, years of experience and farm size. Small-scale pineapple farmers in the study area agreed that keeping of farm records will enable them to make productivity projections and also indicated that farm records will help manage change and improvements in the agribusiness. In the same way farmers designated that they had no formal training in record keeping and also indicated that, they are not able to keep farm records due to time constraints.

Publications from Project

A research paper has been developed and submitted to The Journal of Agricultural Education & Extension for consideration and publication.

ON-GOING RESEARCH PROJECTS

2.5.4 The Use of Mobile Phone Communication in Marketing of Agricultural Produce in Ghana: A Case Study of Agbogbloshie Market, Accra

Principal Investigator: Manteaw, S. A.

Participating Scientists: Folitse, B.Y., Dzandu, L.P., Koranteng, M.I., Bancie, H.H.

Start Date: August 2017

Duration: 18 months

Location: CSIR-INSTI

Budget: GH₵1500.00

Sponsors: GOG

Background Information & Justification

Agricultural produces marketing in Ghana is a seeming flurry of sounds, sights and odours. To an unacquainted visitor, the complete scenery can be overwhelming. The market consists of many small stalls where women are hawking different agricultural produce. Around the perimeter, there may be buildings with cloth stores, hardware stores and the like. Large trucks move in and out and bags of agricultural produce are loaded and unloaded while shoppers move about looking at the different offerings and making their purchases. In one stall there might be tomatoes and in another, plantains or cassava. On the edge of the market, there may be a small group of elderly women who are keeping a careful watch over the situation. Indeed, these women are often the central actors in the organization of these large-scale markets who are often referred to as market queens. While it may seem confused, there are well-entrenched procedures and ways of organizing the production, transportation and marketing of these agricultural produce (Djane and Ling 2015). There are flows of agricultural produce, information and duties that have been developed over time. In some cases, these are being changed by the adoption of mobile phone communication, but our work suggests that in other cases, this type of mediated interaction is not widely accepted and utilized for this purpose.

A central idea motivating this work is that improving information flow in the value chain supports development. If the information contained in this value chain is easily accessible by the actors, it will facilitate market logistics. Abraham (2006), also echoed in the work by Rashid and Elder (2009), suggests a strong link between mobile phone access and increased economic opportunities for farmers. Among other things, these authors note the increased ability on the part of the producers to follow price information, hence allowing them to better judge when to sell their crops. In this paper, the researchers will examine the role of mobile communication in marketing of agricultural produce in Ghana with the Agbogbloshie market as a case study. Assessment of mobile phone communication by market women in marketing agricultural produce will provide the necessary framework to identify its current strengths and weaknesses which will lead to recommendations that will increase its effectiveness.

The study will review terms of marketing agricultural produce. Following a discussion of the methods, the study will look at the role of mobile phone communication in the case of producers, large-scale wholesalers, transportation, smaller wholesalers, and retailers who find the mobile phone useful. In conclusion, we will offer some comments on the broad effect of mobile phone communication in the marketing of food in Ghana. Despite the recognition of the potential impact mobile phone communication can make in marketing agricultural produce, the adoption and use of the same has not been fully explored and therefore not well known among marketers of agricultural produce in Ghana. Therefore, this study was set to address the effectiveness of mobile phones in marketing agricultural produce among market women in Agbogbloshie market in Accra, Ghana.

The importance of mobile phone communication has been suggested in improving agricultural productivity in the rural areas. This is attributed to the benefits it offers such as facilitating communication between produce buyers, a short response time to farmers and other clients and farmers get personalized information (Mittal and Triphathi, 2009; Gelb et al, 2009). In market agricultural produce, mobile phone communication has been identified as a practice that can lead to increased market sales, increased incomes and improved livelihoods for the market women involved in the marketing of agricultural produce based on the benefits it offers (Maritz, 2011). The above mentioned studies only gave an insight into the benefits of mobile phone communication in the marketing of agricultural produce but did not evaluate its adoption in accessing market information among marketers. This study therefore attempted to contribute towards filling in the knowledge gap. The focus of Agbogbloshie market in Accra was justifiable owing to the fact that a great proportion of agricultural produce are offloaded in this market and the marketers in Accra relied on the produce as a source of

livelihood. Despite the agricultural production characteristics and associated returns from the enterprise, most market women still faced challenges in using mobile phones for communication.

Objectives

- To establish the extent to which mobile phone communication is used to market agricultural produce in Ghana
- To analyze the factors that influence adoption of mobile phone communication in marketing agricultural produce in Ghana
- To establish challenges faced in marketing agricultural produce using mobile phones

Methodology

The non-probabilistic, purposive sampling technique that will be adopted to recruit respondents for the study ensured only relevant respondents who are market women most likely to provide rich, quality and fruitful data in the context of examining causal relationship between the independent and dependent variables will be recruited. Also, this procedure was strategically have adopted with a view to ensuring there is a match between research questions and sample of respondents. The study will adopt elements of both quantitative and qualitative paradigm – mixed method strategy. One hundred and twenty participants who are marketing various agricultural produce and are currently subscribing to mobile phones will be involved in the research questionnaire and interviews. The interview will be for 10 to 20 minutes with different agricultural produce sellers.

Results Achieved So Far

Questionnaires have been developed for the study.

Way Forward

Data collection will start in March 2018.

Programmes and Activities

3.1 Electronics/Communications

This Division undertook several activities both internally and externally.

Technology Seminar

CSIR-INSTI held its first Technology Seminar on 23rd March 2017 with a guest speaker in the person of Dr. Ashitey Trebi-Ollennu from the National Aeronautics and Space Administration (NASA). The theme of the Seminar was "The Insight Mission – Instrument Deployment Robotics System". The seminar was attended by 50 participants from over 10 different CSIR Institutes. The expectations of exposing CSIR-INSTI/ECRI to both local and global stakeholders were achieved during the seminar. The seminar was followed by round table discussions with Dr. Ashitey Trebi-Ollennu and other stakeholders during which potential research areas of public interest and national development to aid a more tailored research agenda for INSTI and CSIR were identified.

Google Scholar

In accordance with a DMC decision, all Research Scientists of the Institute were signed up to Google Scholar. IDs were attached to respective publications to boost CSIR's global ranking.

E-mail Addressing System

In line with the division's action plan to support IT operations of CSIR-INSTI, institutional e-mail addresses were configured for all senior members. This fostered an efficient and more professional operating environment within and outside the Institute.

Open Source Human Resource Management Platform

An open source human resource management platform was installed and customized for the institute. For the pilot phase, a test data was fed into the platform and a training planned for administrators prior to the subsequent rollout of the platform for internal use. The target of this setup is to cut down on the use of papers within the institute and to enforce a digitized storage of management records.

Linux Server

A Linux server was installed in the server room to host future services. The server is expected to host a number of services that will be required both for internal and external transfer of data. Currently, a web and DNS services are running on the web server and will soon be hosting additional services as and when required.

Advanced Internet Search Techniques

The course manual for the proposed course on Advanced Internet Search Techniques has been developed and is currently under review. The course schedule, logistics planning, costing and marketing are all in progress. Invitations were sent out to 5-CSIR Accra-based Institutes for participation in the Boot Camp on 30th May 2017.

Connection to GOVNET

Remote site assessment was carried out and GPS coordinates have been retrieved for all CSIR Institutes and forwarded to NITA. On-site connection feasibility assessment has been carried out by the NITA Technical Team at the CSIR Head Office, CSIR-STEPRI, CSIR-WRI and CSIR-INSTI. Further study of sites would be carried out to confirm feasibility.

3.2 Information Technology

The IT Section carries out general maintenance of computer/ICT equipment in the Institute. This includes the installation and test of new software, ensuring that staff work with appropriate software, and ensuring that anti-virus software are installed and kept up to date. In the area of hardware, the staff carried out checks on and installed new computers. The Section provided IT backbone services for all workshops and seminars in the Institute.

3.3 Library and Documentation

The Library and Documentation Division is made up of three sections, the Collection Development, Cataloguing and Classification and User Services/ GAINS Sections. The sections work together to provide Library and Documentation Services for the CSIR and analogous institutions, learned professional associations and societies, industrial sector, students and the general public. Operational objectives of the Division are to:

- collect, process, store and repackage for dissemination S&T information embodying the results of indigenous S&T research activities as well as

those generated elsewhere for the benefit of planners in government, production and manufacturing concerns, etc.

- support the promotion of efficient R&D activities in the country through the provision of STI services using appropriate information processing and communication technologies.
- strengthen national STI and infrastructure through effective networking and collaborative activities at the National and International levels, and develop strategies to improve access to information in any format.

3.3.1 Collection Development Section

The Collection Development section is responsible for providing specific and general guidelines for the selection and acquisition of new materials through purchases, exchanges, soliciting or donation, legal deposit or through subscription and collaboration. It is also responsible for data collection to feed all the databases in the Library and Documentation Division.

During the period under review, the section continued to identify, select and receive some relevant scientific and technological (S&T) materials for the library. Periodicals such as journals, magazine and newspapers were received through exchanges, donations from collaborated institutes and agencies of the Library, and subscriptions.

Other materials acquired by the section include annual reports, monographs, and theses. Also, conferences and seminars on S&T activities advertised in the dailies were selected. The following were the major activities undertaken during the period under review:

Below is the summary of statistical report on materials received in the year 2017

Table 3.1: Summary of Statistical Report on materials received from January to December 2017

Type of Material	Number of Copies Received	Percentage
Theses	48	2.83
Journals/ Magazines	88	5.18
Books	28	1.65

Newspapers: Daily Graphic	657	38.67
Ghanaian Times	657	38.67
Spectator	99	5.83
Mirror	111	6.53
Annual Reports	11	0.65
Total	**1699**	**100.00**

Library Thing

The Library Thing is a social cataloging web application for storing and sharing book catalogs and various types of book metadata. It is used by authors, individuals, libraries and publishers. This online web application is being used by the Collection Development Section to record all materials received by the section. The Section has captured seven hundred (700) books in this database.

3.3.2 Cataloguing and Classification Section

The Cataloguing and Classification Section is responsible for the processing of the materials acquired for the library and making them ready for display and use by clients. This is done by way of the physical description of the materials and content description.

Library Materials Received and Processed

The section received 28 (9) titles from the Collection Development Section. The books have been catalogued and classified but yet to be entered into the Catalogue database.

Two hundred and twenty-seven (227) journals, were received by the section, those processed have been sent to the User Services Section for display and use by the library users.

Thirty-three (33) theses were received by the section from the Collection Development Section. The theses have been labeled and sent to User Services Section.

Forty-two (42) report titles made up of sixty-three copies were received by the section from the Collection Development Section. They have been appropriately labeled.

3.3.3 User Services Section

The identification and retrieval of information to satisfy the needs of clients is the main activity of the User Service section. These services are provided through books, periodicals, abstracts, newspapers, reference materials. Though the services are digitized, manual information retrieval for scientists, consultants, and students continued. This involved the use of tools such as the card catalogue, books and other reference materials.

Visits to the Library

Reading materials and the reading room were continually used by clients who visit the library. During the period under review, a total of three thousand, two hundred and sixty-seven (3,267) clients visited the library. Out of this number, 2,757 (84.4%) of the clients used the reading room on the ground floor whilst 510 (15.6%) used books and other facilities at the User Services section. Table 3.2 below illustrates the trends:

Table 3.2: Clients' visits to the Library

Section	Number	Percentage
Reading Room	2,757	84.4
User Service Section	510	15.6
Total	**3,267**	**100.0**

CSIR Open Access Training

A sensitization workshop for Scientists in the Southern Sector CSIR Institutes was organized on the use of Open Access from 1st to 10th November 2017. Messrs. Benjamin Yao Folitse, Simon K. Osei, Eric Acquaye and Mrs. Lucy Payne Dzandu were the facilitators. A description of attendance at the various institutes visited is listed in the table.

Table 3.3: Attendance of CSIR Institutes at Open Access Training Workshop

Date	Institutes	No. of Scientists
1st Nov 2017	Animal Research Institute	15
2nd Nov 2017	Institute of Industrial Research	11
3rd Nov 2017	Food Research Institute	14

7th Nov 2017	Science and Technology Policy Research Institute & Accra Soil Centre	6
8th Nov 2017	Water Research Institute	36
9th Nov 2017	Plant Genetic Resources Research Institute	11
10th Nov 2017	Oil Palm Research Institute	12
	TOTAL	**105**

3.4 Printing/CID

This Section provides 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. The section executed the following jobs:

Table 3.4: List of projects implemented by Printing/CID division

№	Organization	Description of Job
1	CARLIGH	Receipt Books
2	CSIR – CRI	Letterheads
3	CSIR – FRI	2015 Annual Report
		2016 Annual Report
		Plantain Fufu Flour Flyer
		Wheat Composite Flour Flyer
4	CSIR – Head Office	Letterheads
		A4 Branded Envelopes
		DL Sized Envelopes
		GJAS Vol. 51
5	CSIR – PGRRI	Letterheads
6	CSIR – SARI	2016 Annual Report
		Cowpea Production Guide (Brochure)

7	CSIR – STEPRI	Directors Business Card
		IRB Poster
		IRB Brochure
		Business Cards for Dr. George Owusu Essegbey
8	All CSIR Institutes	Wall Calendars
		Desk Calendars
		Diaries
		Season's Greetings Cards

3.5 Science Publishing

The Science Publishing Division is mandated to publish Ghana Journal of Agricultural Science and Ghana Journal of Science as well as other S & T literature emanating from the national and international scientific community. For the year under review, the Division undertook the following activities:

- Editing, typesetting and proofreading of manuscripts submitted by researchers for publication
- Writing reports, technical correspondence and distribution of print journals

Ghana Journal of Agricultural Science

The Ghana Journal of Agricultural Science published Vol. 51 (2017) [Ghana J. Agric. Sci. 51 (2017)] comprising of 9 articles.

Ghana Journal of Science

The Ghana Journal of Science published Vol. 57 (2017) [Ghana J. Sci. 57 (2017)] comprising of 6 articles. The 11th Meeting of the Editorial Board of Ghana Journal of Science was organized at CSIR-INSTI, Accra on 12th December 2017.

3.6 Thematic Mapping

This Division has the mandate to gather data and information to design and construct Thematic Maps that depict contemporary geographic knowledge on Ghana at the national, regional and municipal or district levels and also respond to the need of clients for special or customized maps.

Map showing Oil Palm Industry

The Division developed geospatial database for the Oil Palm industry in Ghana and produced maps. The following were done in order to achieve this task:

A

1. Update of road network in Oil Palm Belts in Kwaebibrim district and Western region. This was done using Google Earth. The available road network for the areas mentioned were converted from shapefiles to KML files which were then uploaded on Google earth and the existing gaps filled through on screen digitizing
2. Labeling of the rivers/streams in these belts with the help of Topo sheets
3. Currently updating road network in the Northern region. This is done using Google earth and on screen digitizing. The available road network for the region was converted from shapefile format to KML which was then uploaded on Google earth. The existing gaps are being filled through on screen digitizing.

B

1. Update of road network in Oil Palm Belt in the Central region. This was done using Google Earth. The available road network for the area mentioned was converted from shapefiles to KML files which was then uploaded on Google earth and the existing gaps filled through on screen digitizing
2. Labeling of the rivers/streams in this belt with the help of Topo sheets
3. Currently updating road network in the Upper West region. This is done using Google earth and on screen digitizing. The available road network for the region was converted from shapefile format to KML which was then uploaded on Google earth. The existing gaps are being filled through on screen digitizing.

The following draft maps have been shown to the client:

- Current Oil Palm Production Belt in Ghana
- Base map for Mpohor District
- Base map for Mpohor/Wassa East District
- Base map for Obuasi Municipal
- Base map for Twifo-Ati-Mokwa
- Upper Denkyira East District

Solar Panel at Ada-Foah

Coordinates for the installation of a solar panel at Ada-Foah were generated and a draft submitted to client for perusal.

Maps for Woeli Publishers

Four (4) draft maps for Woeli Publishers were digitized, constructed and composed. They are;

- Ada in 1945
- Ada Estuary
- Ada in 1931
- Ada today

Other Maps

In addition to the above, the following databases were also developed and maps produced upon request by clients:

- Agro-ecological zones of Ghana
- Lawra District base information
- Plotting of GPS readings
- Songor Lagoon, Ada-Sege

Road Network

Road Network in the Northern and Upper West Regions were updated via Google Earth. All the respective twenty-six (26) and eleven (11) MMDAs in the Northern and Upper West Region have been covered and their respective updated KML files have been saved according to MMDA name. Fourteen (14) MMDAs in the Brong Ahafo Region were also completed while thirteen (13) are still ongoing. The completed ones are;

- Tano North
- Sunyani Municipal
- Sunyani West
- Kintampo South
- Pru
- Sene West
- Techiman Municipal
- Atebubu Amantin
- Wenchi Municipal
- Kintampo North Municipal
- Nkoranza North
- Sene
- Techiman North
- Berekum Municipal

Two (2) MMDAs in the Upper East Region likewise have been completed while eleven (11) are still ongoing. The completed ones include;

- Kassena Nankana East
- Kassene Nankana West.

Action Plan

An action plan for 2017 under the Division "Geo-spatial and Information Service" was prepared.

Public Training

The Head of the GIS Section, Dr. Albert Allotey organized a training programme for the public on Geographic Information Systems on 8th September, 25th September and 2nd October 2017.

Administration and Financial Issues

4.1 Administration

The Administration Division provided administrative support services and created the enabling environment for staff of the institute to perform efficiently and effectively. The Division ensured the implementations of directives, policies, rules and regulations of the Council.

4.1.1 Management of INSTI

A thirteen-member (13) Internal Management Committee with Dr. Joel Sam as Chairman managed the Institute. No Management Board existed for the period.

4.1.2 Staff Strength

The staff strength of the Institute stood at 66. This was made up of 16 Core and 4 Non-core Senior Members totaling 20, 26 Senior Staff and 20 Junior Staff. The staff strength and gender distribution is shown below. A detailed list of staff is shown in Appendix III.

Table 4.1: Staff Strength: Gender Distribution

Gender	Senior Members	Senior Staff	Junior Staff	Total
Males	17	16	16	49
Females	3	10	4	17
Total	**20**	**26**	**20**	**66**

4.1.3 Junior and Senior Staff and Senior Members Promotions

The promotion of the following officers took effect from the 1st of January 2017.

Table 4.2: List of Staff Promotions

№	Name	Division	Previous Grade	Promotion Grade
1	Samuel Ankrah	Accounts	Accounting Ass.	Senior Accounting Ass.
2	Daniel Darke	Accounts	Principal Accounting Ass.	Chief Accounting Ass.
3	William Akpakli	Administration	Senior Security Officer	Principal Security Officer
4	Fuseini Inusah	Administration	Security Ass. Grade I	Senior Security Ass.
5	Enos Awusie	Administration	Driver Inspector	Traffic Supervisor
6	Jonathan Sotie	Administration	Driver Grade II	Driver Grade I
7	Matthew N. Amoatey	Administration	Driver Grade II	Driver Grade I
8	Usman Wahab	Administration	Senior Labourer	Senior Headman
9	Alex Mireku	Printing	Senior Technical Ass.	Work Superintendent
10	Stephen Ayim	Printing	Junior Foreman	Foreman
11	Seth Asare	Printing	Tradesman Grade I	Artisan

4.1.4 Upgrading

Mr. Collins Opoku Dwomoh was interviewed and upgraded to the position of Scientific Information Officer.

4.1.5 New Employment

As a result of retirements and resignations in the Institute, the following officers were employed to fill various vacant positions:

Table 4.3: Newly employed staff for 2017

№	Name	Grade	Division
1	Michael Wilson (Ing)	Chief Technologist	Electronics
2	Victor Gordon (Ing)	Chief Technologist	Electronics / Communications

3	Yaw Twum-Barimah (Ing)	Chief Technologist	Electronics
4	Abel Yeboah Ofori	Chief Technologist	Communications
5	Benjamin Yaw Peh	Principal Technologist	Electronics / Communications

4.1.6 Internal Training

Various training programmes in the form of workshops, seminars, etc. were held at the Institute to keep staff abreast with current trends in various research and academic platforms. Some programmes were led by members of staff whiles others had invited external resource persons.

Table 4.4: List of Internal Training Presentations

№	Date	Topic	Resource Person(s)
1	25th Jan	Module Training	Dr. Albert N.M. Allotey
2	6th Feb	Research Writing /Scientific Writing	Dr. Albert N.M. Allotey Mrs. Lucy P. Dzandu
3	7th March	Accessing e-resources	Mrs. Lucy P. Dzandu Mr. Simon Osei Mr. Benjamin Y. Folitse
4	6th-9th June	Scientific Writing and Author-ship Skills using TEEAL and Research 4 Life	Mrs. Lucy P. Dzandu Mr. Benjamin Y. Folitse Mr. Simon K. Osei Mrs. Grace Obeng-Koranteng
5	4th-7th July	Gender Mainstreaming in Ghana	Mrs. Lucy P. Dzandu Prof. Mary Obodai (FRI) Rev. Gilbert Nachim (H/O) Dr. Margaret Owusu Mrs. Grace Obeng- Koranteng
6	25th July	Filing Skills (for Registry Section)	Mrs.Gifty N.D. Aryee

7	7th-10th Aug	Research Writing: Training-of Trainer/ Trainer of Trainers Research Communication	Dr. Albert N..M. Allotey Mrs. Lucy P. Dzandu

The internal training programmes were held in collaboration with the following organizations:

- Electronics Information for Libraries (EIFL)
- International Network for the Availability of Scientific Publications (INASP)
- Information Training & Outreach Centre for Africa (ITOCA)
- The Ministry of Food and Agriculture (MOFA)
- All CSIR institutes

4.1.7 National Service Persons

Fifteen (15) National Service personnel were engaged during the year and assigned to various Divisions and Sections of the Institute to enable them acquire various skills on-the-job.

4.1.8 Study Leave Issues

As part of the Institute's policy on training, the following Members of Staff were granted study leave to continue their education at various Institutions.

Table 4.5: Staff on Fulltime/Partial Study Leave with Pay.

№	Name	Institution	Programme	Duration	Date of Start/ Expected Completion
1	M.A. Mahamadu	SouthWest Jiatong University, China	PhD Communication Engineering	3years full time study leave with pay	Sep 2011 - Aug 2014 (Extended to 2018)
2	L.P. Dzandu	Accra Institute of Technology, Ghana	PhD Information Technology	4years	Sep 2013 - Aug 2017

3	F.T. Kabutey	Harbin Institute of Technology, China	PhD Environmental Science and Engineering	3years full time study leave with pay	Sep 2015 - July 2018 (Extended to 2020)
4	S. Ankrah	University of Cape Coast (Accra Campus), Ghana	Bachelor of Commerce	3years partial study leave with pay	Aug 2015 - July 2017
5	E. Davidson	KAAF University College, Ghana	BSc Geomatic Engineering	4years partial study leave with pay	March 2014 - Feb 2018
6	A. Ampofo-Addo	Ghana Institute of Management in Public Administration, Ghana	MSc Information Management Systems	2years partial study leave with pay	Aug 2016 - Aug 2018
7	D. Kumiwa	University of Cape Coast (Tema Campus), Ghana	Diploma in Business Studies	3years partial study leave with pay	Aug 2015 - July 2018
8	Y.D. Azuma	University of Ghana	Diploma in Public Administration	2years partial study leave with pay	Sep 2017 - July 2019
9	E. Opoku	Central University College, Ghana	MBA Human Resource Management	2years partial study leave with pay	Sep 2017 - July 2019

4.1.9 Resignation

Three (3) members of staff resigned from service of the Council for various reasons.

Table 4.6: List of Staff who Resigned

№	Name	Grade	Date of Resignation
1	Eric Asante	Chief Technologist	20th January 2017
2	Collins Opoku Dwomah	Scientific Information Officer	21st October 2017
3	Abel Yeboah Ofori	Chief Technologist	31st October 2017

4.1.10 Retirement

Dr. Richard Kofie, the Deputy Director of the Institute, retired from service on 31st July 2017. He served the Council for over thirty-three (33) years after starting his career as an Assistant Research Officer and rising to the position of Principal Research Scientist.

Mr. A. Ayitey Armah, Senior Scientific Information Officer retired from the Council on 31st March 2017 serving for 13 years. He began work as a Scientific Information Officer.

4.1.11 Obituary

Mr. Francis Viduku, Principal Technical Officer passed away on 21st July 2017 at Abor in the Volta Region. He was laid to rest at Akatsi Xavior on 2nd September 2017.

Mrs. Susan S. Gyamfi, Chief Auditing Assistant passed away on 15th September 2017 at the Korle Bu Teaching Hospital. She was laid to rest at the Awudome Cemetery on 11th November 2017.

4.2 Accounts Division

The objectives of the Division among other things were to:

- 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 active role in setting the annual budget, monitor the budget and do variance analysis.

Financial Statement for 2017

Table 4.7: INSTI Statement of Revenue and Expenditure for the Year Ended December 31, 2017

REVENUE	**BUDGET**	**ACTUAL 2017**	**ACTUAL 2016**
	GH₵	GH₵	GH₵
Compensation	2,914,676.00	2,945,223.52	2,687,599.99
Goods and Services	84,003.00	-	28,075.31
Non-Financial Assets	-	-	-
IGF	226,983.00	293,670.38	302,789.22
Donor Grants	40,000.00	38,417.16	37,351.59
Other Income	-	-	-
TOTAL	3,265,662.00	**3,277,311.06**	**3,055,816.11**
EXPENDITURE			
Compensation	2,914,676.00	2,945,223.52	2,687,599.99
Goods and Services	84,003.00	242,970.76	199,308.51
Non-Financial Assets	-	-	-
Government Subsidies	-	-	-
Social Benefits	-	-	-
Other Expenses-IGF	96,467.78	95,620.64	158,439.32

Consumption of Fixed Assets	200,000.00	9,434.10	9,134.10
TOTAL	3,295,146.78	**3,293,249.02**	**3,054,481.92**
SURPLUS/(DEFICIT)	-	(15,937.96)	1,334.19

Table 4.8: Balance Sheet as at December 31, 2017

ASSETS	**2017**	**2016**
	GH₵	GH₵
CURRENT ASSETS		
Stocks	34,990.27	5,718.60
Sundry Debtors	25,865.40	25,865.40
Staff Debtors	9,589.10	8,904.56
Inter-Institute Debit Balances	16,532.44	18,837.84
Bank and Cash Balances	26,620.00	24,271.40
TOTAL CURRENT ASSEST	**113,597.21**	**83,597.80**
NON-CURRENT ASSETS	23,683.26	33,117.37
TOTAL ASSETS	**137,280.47**	**116,715.17**
LESS CURRENT LIABILITITES		
Inter-Institute Credit Balances	83,965.08	79,322.93
Provision and Accruals	13,590.00	13,590.00
Other Credit Balances	38,375.48	7,164.37
TOTAL LIABILITIES	135,390.56	100,077.30
NET ASSETS	1,349.91	19,637.87
CONTRIBUTED BY		
Accumulated Fund	1,349.91	19,637.87

APPENDIX I

Publications

Refereed Journal Papers

Folitse, B.Y., Osei, S., Dzandu, L.P., Obeng-Koranteng G. (2017) A study on the Agricultural Research Scientists' Knowledge in the use of Internet Resources. International Journal of Research Studies in Computing, Volume 6, Number 1, 9-23

Folitse, B.Y., Sam, J., Dzandu, L.P., Osei, S.K. (2017) Poultry Farmers' Information Needs and Sources in Selected Rural Communities in the Greater Accra Region, Ghana. International Information and Library Review 1-12. http://doi.org/10.1080/10572317.1351020

Folitse, B.Y., Obeng-Koranteng, G., Osei, S., Dzandu, L.P. (2017) The Present Status of Shallot (Allium ascalonicum L.) Farming Enterprise in Ghana: The Case of Keta Municipality. Agricultural Communications, 5(2): 8-16

Osei S., Folitse B.Y., Dzandu, L.P., Obeng-Koranteng, G. (2017) Sources of Information for Urban Vegetable Farmers in Accra, Ghana. Information Development, Volume 33, Issue 1, 72-79

Sam J., Osei S., Dzandu, L.P., Atengble, K. (2017) Evaluation of the Information Needs of Agricultural Extension Agents in Ghana. Information Development, Volume 33, Issue 5, 463-478

Bekoe, S., Ayoung, D. A., Boadu, P. & **Folitse, B.Y.** (2017) An Empirical Study on The Effects of Mobile Telephony Usage on Livelihoods in Brong Ahafo Region of Ghana. The Journal of Community Informatics, 13(3), 130—144.

Lettu, C. K., Kofie, R. Y. & Allotey, A. N. M. (2017) Tourism Information Packaging and Promotion, the GIS Approach--the Case of Jomoro District of Ghana. Journal of Tourism, Hospitality and Sports Vol. 27, 41-48

Fold, N., **Allotey, A.N.M.**, Kalvig, P. & Moeller-Jensen, L. (2017) Grounding Institutions Through Informal Practice: Credibility in Artisanal Mining of Aggregates, Ghana. Land Use Policy, (May), 0-1, https://doi.org/10.1016/j.landusepol.2017.06.022

Technical Report

Osei-Kofi, P.S., Aboagye, L.M., **Bekoe, S., Dzandu, L.** (2017) Publication pattern in CSIR- Plant Genetic Resources Research Institute (CSIR-INSTI/GISD/ERR/BS/2017/03)

APPENDIX II

External Training Workshop/ Conference/ Seminar

Allotey, A.N.M. attended;

An Introduction to Calls for DANIDA Research Proposals, Information Meetings for Applicants on 1st February 2017 at the Ghana Academy of Arts and Sciences, Accra.

A Faculty Lecture on the Effect of Land Use Dynamics on Habitat of Two Sympatric Primates in Boabeng-Fiema Monkey Sanctuary, Ghana on 24th February 2017 at the Presbyterian University College, Akropong.

A Closing Ceremony of a Pilot Research Project on Tomatoes Production in Ghana on 5th June 2017 at CSIR-STEPRI.

A Research in Germany (ADDA) Breakfast Meeting on 17th June 2017 at the Ibiss Styles Hotel, Airport, Accra.

A Panel Discussion on Ghana's Seed Sector on 20th June 2017 at CSIR-STEPRI.

The Pan African Chemistry Network Congress 2017 from 7th to 9th November 2019 at the International Conference Centre, Accra, and presented a poster.

Aryee, G. attended;

A Training Seminar for Institutes Local Persons themed "Packing for Promotions: The Role of Institutes Screening Committees" on 20th July 2017 at CSIR-STEPRI.

Awanyo, D. attended;

An Open-Day themed "Strengthening Research, Policy and Industry Linkage: An Agenda for Strategic National Development" on 22nd June 2017 CSIR-STEPRI.

A Training Seminar for Institutes Local Persons themed "Packing for Promotions: The Role of Institutes Screening Committees" on 20th July 2017 at CSIR-STEPRI.

A Career Development and Mentoring Training for Early Career Non-Research Staff on 24th November 2017 at CSIR-STEPRI.

Bekoe, S. attended;

An Open-Day themed "Strengthening Research, Policy and Industry Linkage: An Agenda for Strategic National Development" on 22nd June 2017 CSIR-STEPRI.

Dzandu, L. P. attended;

A Business Plans Launch on 10th February 2017 at CSIR-STEPRI

A Multi-Stakeholder Workshop For Knowledge Sharing on 23rd February 2017 at CSIR-STEPRI

A Multi-stakeholders workshop on Lessons Learned and Way Forward of Partnerships for Inclusive Development on 23rd February 2017 at CSIR-INSTI, Accra.

A 3-day Train the Trainers' workshop on Open Access, Open Research Data and Open Science from 27th-30th June 2017 at Ghion Hotel, Addis Ababa, Ethiopia, East Africa.

A 10-day training course titled "The CODATA-RDA Research Data Science Summer School" from 10th to 21st July 2017 at the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy.

A Closing Ceremony of a Pilot Research Project on Tomatoes Production in Ghana on 5th June 2017 at CSIR-STEPRI.

Folitse, B.Y. attended;

An ECOAGRIS workshop on 1st February 2017 at MOFA Resource Centre, Accra.

A Panel Discussion on Ghana's Seed Sector on 20th June 2017 at CSIR-STEPRI.

A Project Dissemination Workshop themed "Cashew Fruit: Adding Value for Food Security" on 22nd June 2017 at CSIRR-FRI.

A 3-day train the trainers' workshop on Open Access, Open Research Data and Open Science from 27th-30th June 2017 at Ghion Hotel, Addis Ababa, Ethiopia, East Africa.

A 2-week ECOAGRIS training on Web Portal and Data Uploading from 27th November to 8th December 2017 at MoFA Resource Centre, Accra.

A Closing Ceremony of a Pilot Research Project on Tomatoes Production in Ghana on 5th June 2017 at CSIR-STEPRI.

Gordon, V. attended;

A Seminar on Biofuels on 6th April 2017 at CSIR-IIR.

A 2-day Career Development and Mentoring Training for Early Career Research Scientists/Technologists from 17th -18th October 2017 at CSIR-STEPRI.

The Ghana Institution of Engineers Education Forum on 19th October, 2017 at the Ghana Institution of Engineers Centre.

Kofie, R.Y. attended;

An Orientation Programme for Deputy Directors of CSIR on 25th February Career Development and Mentoring Training for Early Career Non-Research Staff on 24th November 2017 at CSIR-STEPRI.

Lawal, R. attended;

A Career Development and Mentoring Training for Early Career Non-Research Staff on 24th November 2017 at CSIR-STEPRI.

Osei, S. attended;

An ECOAGRIS workshop on 1st February 2017 at MOFA Resource Centre, Accra.

A 3-day train the trainers' workshop on Open Access, Open Research Data and Open Science from 27th-30th June 2017 at Ghion Hotel, Addis Ababa, Ethiopia, East Africa.

A 4-day training workshop on Scientific Writing and Authorship skills from 6th to 9th June 2017 at CSIR-INSTI, Accra.

A Closing Ceremony of a Pilot Research Project on Tomatoes Production in Ghana on 5th June 2017 at CSIR-STEPRI.

Peh, B. attended;

An Open-Day themed "Strengthening Research, Policy and Industry Linkage: An Agenda for Strategic National Development" on 22nd June 2017 CSIR-STEPRI.

Sam, J. attended;

The 2nd AFLIA conference of the 64th Africa Library Summit from 14th to 20th May 2017 at Yaoundé, Cameroon.

An EIFL Stitching Management Board Meeting from 21st to 23rd July 2017 at the Royal Library, Hagua, Netherlands.

A 3-day EIFL General Assembly from 22nd to 24th September 2017 at Tbilisi, Georgia.

Twum-Barimah, Y. attended;

A Seminar on Biofuels on 6th April 2017 at CSIR-IIR.

A 2-day Career Development and Mentoring Training for Early Career Research Scientists/Technologists from 17th -18th October 2017 at CSIR-STEPRI.

Wilson, M. attended;

The Core of Excellence Launch Workshop on 13th July 2017 at CSIR-SARI.

A 2-day Career Development and Mentoring Training for Early Career Research Scientists/Technologists from 17th -18th October 2017 at CSIR-STEPRI.

APPENDIX III

List of Staff as at 31st December 2017

SENIOR MEMBERS

№	NAME	PRESENT DESIGNATION	QUALIFICATION
1	Dr. Joel Sam	Director/ Chief Librarian	PhD (Information Studies) MPhil (Library Studies) BA (Hons) Grad Dip (Library Studies)
2	Mrs. Lucy Payne Dzandu	Deputy Director/ Senior Librarian	MPhil (Library Studies); M.A. (Library Studies); PGDip (Education); BA (Hons) Sociology & Political Science
3	Dr. Seth Awuku Manteaw	Senior Scientific Information Officer	PhD (Agricultural Extension); MSc (Agronomy); PG Dip.(Communication-Studies); MA (Communication Studies)
4	Mr. Joseph A. Anyen	Senior Accountant	MBA (Finance) ; I.CA.; BSc.(Admin) Accounting Option
5	Dr. Albert N. M. Allotey	Senior Research Scientist	PhD (Geography & Resource Development); MPhil (Geography & Resource Development) BA (Hons) Geography & Resource Dev't
6	Mr. Joshua Addae-Boateng	Senior Public Relations Officer	M.A. (Adult Education); BA (Hons) Psychology/Religion

7	Mr. Benjamin Yao Folitse	Senior Librarian	MPhil (Agricultural Extension); M.A.(Library Studies); B.Ed. (Agric); Dip (Agric Ed.)
8	Mrs. Grace Obeng-Koranteng	Senior Librarian	M.A.(Library Studies); BA (Hons) Information Studies with History; Dip (Librarianship)
9	Mrs. Gifty N.D. Aryee	Senior Administrative Officer	MA (Industrial Sociology) BA (Management Studies) DBS (Secretarial)
10	Mrs. Dorothy Awanyo	Administrative Officer	MBA (Admin.); BA (Public Admin.); Dip. (Librarianship)
11	Dr. Stephen Bekoe	Scientific Information Officer	PhD (Informatics); MSc.(Information Studies); BA (Hons) Publishing Studies
12	Mr. Mahamuda A. Mahamadu	Scientific Information Officer	M.Sc. (Electrical Engineering); BSc.(Hons) Computer Science / Statistics)
13	Mr. Felix Tetteh Kabutey	Scientific Information Officer	MPhil (Botany); BSc.(Applied Biology with Environmental Sci.); Teacher's cert "A'; SSSCE; BECE
14	Mr. Simon Osei	Librarian	PG Dip (Library Studies) BA (Hons) Library Studies
15	Mr. Yaw Twum - Barimah	Chief Technologist	MSc. (Telecom); BSc. Elec. &Computer Engineering
16	Mr. Victor D. Gordon	Chief Technologist	MSc. (Telecom; & Internet Telecom.)

17	Mr. Michael Wilson	Chief Technologist	MPhil (Computer Engineering); PostGrad.(Wireless & Mobile Computing); CDAC ; BSc. Computer Eng.;
18	Mr. Christian K. Lettu	Chief Technologist	MPhil (Dev. Geography); BA (Hons) Geography & Resource Development
19	Mr. Jeffrey Yeboah	Principal Technologist	M.A. (Comm. Studies); BA (Info. Studies Archaeology)
20	Mr. Peh Benjamin Yaw	Principal Technologist	MSc. (MIS); BSc. (Computer Eng.)

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. Bernice Acorlor	Chief Administrative Assistant	HND (Secretariaship & Mgt)
4	Ms. Cordellia Akua Busumtwi	Chief Administrative Assistant	Cert. (Private Secretary)
5	Mrs. Gifty Yiborku	Chief Administrative Assistant	HND (Secretariaship & Management)
6	Ms. Linda Agbefe	Chief Auditing Assistant	BSC(Commerce)
7	Mrs. Margaret Ivy Koranteng	Chief Library Assistant	Diploma (Librarianship)
8	Ms. Doreen Appiah	Chief Library Assistant	BA (Info. Studies with Political Sci.); HND (Info. Systems)
9	Ms. Esther Opoku	Chief Library Assistant	BA (Information Studies and Sociology); Diploma (Librarianship)
10	Mr. Atta Ampofo Addo Snr.	Chief Library Assistant	CIM (Level 1); BA (Info. Studies & Sociology
11	Rev. Dennis N.D. Dodoo	Chief Purchasing Assistant	HND (Purchasing)
12	Mr. Emmanuel E. Davidson	Chief Technical Officer	Cert. Basic Cartography
13	Mr. Samuel Opare	Chief Technical Officer	BSc (Mgt & Computer Studies)
14	Ms. Sarah Mensah	Principal Accounting Assistant	Dip.(Public Finance and Accountancy)

15	Ms. Risikatu Lawal	Principal Accounting Assistant	BSc.(Accounting); DBS (Accounting); CIPS Cert. (Purch.& Supply)
16	Mr. Alex K. I. Ocansey	Principal Assistant Printer	Cert. (ITS) Snr.Sup/Mgt; N.V.T.I. Grade I Cert.
17	Mr. William K. Akpakli	Principal Security Officer	BA (Social Work with Psychology); SSSCE: BECE
18	Mr. James W.K. Sam	Senior Accounting Assistant	H.N.D.(Marketing); D.B.S. (Accounting)
19	Mr. Samuel Ankrah	Senior Accounting Assistant	Bachelor of Commerce; HND (Accountancy); SSSCE; BECE
20	Mr. Eric Sam	Senior Technical Officer	HND (Graphic Designing)
21	Mr. Robert Abomoi	Senior Security Officer	Security Trg. Module 3; M.S.L.C.
22	Mr. Roland A. Pappoe	Technical Officer	Cert (Linux Network Admin.); City & Guilds Grad. Dip. (Microtech) I & II
23	Mr. Eric K. Acquaye	Technical Officer	Advanced Certificate in Microsoft Certified Systems Eng. (GIMPA); SSSCE
24	Mr. Cephas Awusie	Security Officer	Security Training Module I; G .C. E.'O' Level
25	Mr. Abdul Rahaman Iddrisu	Security Officer	Security Training Module I; M.S.L.C.
26	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. Yvonne D. Azuma	Senior Clerk	SSSCE, DBS (Secretariaship); Nat. Banking Coll.
3	Ms. Doris Kumiwa	Senior Clerk	(Cert Cashier & Frontline Exec); SSSCE; BECE
4	Ms. Lucy Akyempon	Senior Clerk	"O" level, DBS
5	Mr. Simon Angabe	Senior Security Assistant	Security Training Module I; MSLC
6	Mr. Nathan K. Aborgeh	Senior Security Assistant	Security Training Module I; M.S.L.C.
7	Mr. Fuseini Inusah	Senior Security Assistant	SSSCE
8	Mr. Charles Kulley	Junior Library Assistant	SSSCE
9	Mr. Bancie Habila Hussein	Junior Library Assistant	SSSCE
10	Mr. Enos Awusie	Traffic Supervisor	Intercity STC (Def. Driving Course); MSLC

11	Mr. Joseph Lamptey	Traffic Supervisor	Intercity STC (Def. Driving Course); BECE
12	Mr. Seth Asare	Artisan	Special Junior Tech. Super. Mgt Course, ITS- Accra; MSLC
13	Mr. Jonathan Sotie	Driver Grade I	NVTI (Motor Vehicle Mechanic I); BECE
14	Mr. Mathew Narteh Amoatey	Driver Grade I	City & Guild (Mech. Eng. Craft Practice); BECE; Driv. Lic "C"
15	Mr. Razak Ayidana Akambase	Supervisor Grade I	B.E.C.E.
16	Mr. Kojo Asanaab	Supervisor Grade I	B.E.C.E.
17	Mr. Isaac G. Amponsah	Supervisor Grade I	NVTI GD II
18	Mr. Robert Achandi	Supervisor Grade II	M.S.L.C.
19	Mr. Francis Ayarik	Supervisor Grade II	Nil
20	Mr. Abdul Wahab Usman	Senior Headman	Nil