



**CSIR-FORESTRY RESEARCH INSTITUTE OF GHANA**

# Annual Report 2012 & 2013





# CSIR-FORESTRY RESEARCH INSTITUTE OF GHANA

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# Executive Summary

As one of the Institutes of the Council for Scientific and Industrial Research, the Forestry Research Institute of Ghana continues to work towards satisfying its mandate to undertake forestry and forest product research to ensure sustainable management and utilisation of Ghana's forest resources.

In line with this directive, the Institute undertook twenty projects of which five were financed from Internally Generated Funds. The projects primarily focused on biodiversity conservation, processing and utilisation of timber and other lesser-known species and climate change and its related issues.

Forestry and Wildlife Unit conducted a study on Biodiversity in a Semi-Deciduous Forest Zone comparing diversity in a Natural, Cleared Forest and Teak Plantation. The outcome showed that though primary forests are more species rich and diverse, their diversity was not different between natural and degraded forests.

The increasing use of herbicides in the country necessitated a research on Plant and Soil Microbial Response to Herbicides in Plantations. Preliminary results revealed that herbicides used had effect on morphological and structural features of some plantation trees.

Studies by the Forest Products and Trade Unit focused on Characterisation and Utilisation of emerging wood fuel species for charcoal production. From the study, it was evident that many producers have resorted to lesser-known species for charcoal production.

The Environment and Biodiversity Unit assessed biodiversity and ecosystem services from sacred groves in Ghana specifically the Tano Sacred Grove. One of the major findings was that communities overlooked the important functions of sacred groves such as pest control, fire safeguard, pollinator source and protection of the Tano River.

Financial analysis for the period showed that there was a significant decline in funds for research in 2013, in comparison to the previous year.

Some publications during the period include a Book, thirty-one (31) Journal Articles and over forty (40) Conference Papers.

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# Composition of CSIR-FORIG Management Board

1.	Mr. Edward O. Nsenkyire Chairman, Forestry Commission Board	Chairman
2.	Dr. (Mrs.) Rose M. Entsua-Mensah Deputy Director-General, CSIR	Member
3.	Dr. Lawrence M. Aboagye Director, CSIR-PGRI	Member
4.	Mr. S. Afari Dartey Chief Executive, Forestry Commission	Member
5.	Mr. O.K. Boateng Poku President, Ghana Timber Association	Member
6.	Nana Dwomoh Sarpong President, Ghana Timber Millers Organisation	Member
7.	Dr. V.K. Agyeman Director, CSIR-FORIG	Member
8.	Mr. Francis Osei Amofah Administrative Officer, CSIR-FORIG	Secretary

# 1.0 INTRODUCTION

As one of the Institute's under the Council for Scientific and Industrial Research, the Forestry Research Institute of Ghana (CSIR-FORIG) has diversified and rebranded its research to meet the challenges of the century. One of the goals of the Institute is to use institutional leverage to influence government policy in the forestry sector. The strategic direction of FORIG is to focus on these issues:

1. Capacity development to engage in emerging research areas such as climate change and MDGs.
2. Increase investment and external promotion of quality results for commercialization and application by stakeholders.
3. Develop long term collaborative programmes and partnerships with diverse stakeholders for capacity building.
4. Diversify sources of research funding to maintain long-term funding prospects.
5. Increase capacity to advise government policy and align research with national priorities.

Research by the Institute is organized under three main programmes (Forestry and Wildlife; Environment, Biodiversity and Land-Use and Forest Products and Trade) with different thematic areas.

The Forestry and Wildlife Programme focuses on:

- Policy, legislation and institutional framework for natural resources management;
- Pluralism and governance of natural resources;
- Rural livelihoods, benefit sharing and poverty reduction;
- Resource assessment, timber harvesting and wildlife management;
- Landscape restoration, wildfire management, silvicultural systems and plantation development.
- Modeling of growth of forest

The work by Scientists in the Environment, Biodiversity and Land-Use Unit addresses issues related to the following:

- Biodiversity conservation and management;
- Rehabilitation and restoration of degraded landscapes;
- Mechanisms for harnessing environmental services and carbon sequestration and CDM;
- Ecosystem health and vitality;
- Declining trend in stream flow and soil productivity.

The thematic areas that drive research by the Forest Products and Trade Unit include:

- Processing and utilization of timber, wood residues and promotion of lesser utilised species, plantation timber and small diameter logs;
- Forest sector investment (in forest products development and processing), fiscal regimes and forest taxation;
- Sustainable trade in forest resources (through VPA, market development, industry audit, certification etc.);
- Sustainable development and marketing of NTFPs (bamboo and rattan, medicinal plants and herbal medicines, natural insecticides and dyes, essential oils and fats);
- Bio-energy: including development of traditional sources of energy and its efficient utilization.

In recognition of the fact that research continues to remain as its central focus, CSIR-FORIG ensures efficient management of research projects and activities, to achieve desired results that fulfils the needs and aspirations of Ghana, other stakeholders and donors.

## 2.0 Research Projects

### 2.1 Biodiversity in Dry Semi-Deciduous Forest Zone: Comparison between Natural Forest, Cleared Forest and Teak Plantations in Ghana

<b>Project Team:</b>	Kankam, B.O., Opuni-Frimpong, E., Ofori-Boateng, C.A., Duah-Gyamfi, A. and Mensah, J.K.
<b>Start Date:</b>	June 2012
<b>Expected Completion Date:</b>	2014

#### Introduction

The continuous loss of forest cover over the years and its consequent devastating effect on global environmental conditions necessitated the use of planted forests worldwide. In 2007, it was estimated that 121,127 hectares of plantations mainly from exotic species such as teak, cedrela, *Gmelina*, pines and eucalyptus had already been established in Ghana. However, the extent to which these plantations support biodiversity is unknown. Plantation may affect biodiversity either positively or negatively yet, we do not know how different wildlife may respond to different plantation types (specifically teak as pursued in this research). Given that many forest organisms depend on old-growth microhabitats, there is *a priori* reason to expect differences in relative abundance and diversity of species (e.g. amphibians, butterflies, macrofungi) in natural forests and plantations. The study makes preliminary inferences about the biodiversity changes associated with plantation establishment (in this case in the dry semi-deciduous forest zone) in Ghana which may also identify the species most vulnerable to fragmentation. The objectives are as follows:

1. To examine and compare the amphibian and butterfly communities in a natural forest, cleared forest and teak plantations.
2. To examine and compare the diversity and abundance of macrofungi.
3. To assess and compare the diversity and abundance of seedlings and saplings.

#### Methodology

The following survey methods were used:

*Amphibian:* Following a stratified random design, we established six square plots (~100x200 m); two in each habitat type (primary forest, degraded forest and teak plantation). Each plot was surveyed thrice with an equal sampling intensity of 210 man-hours per plot (7 people searched for frogs for 30 minutes per plot/visit). Captured frogs were identified in the field and released at the site of capture.

*Butterflies:* We trapped fruit-feeding butterflies using cylindrical traps. The traps were baited with mashed banana that has fermented for 2 days. At least 10 traps were placed in the under storey of each site (natural forest, cleared forest and teak plantations). The traps were suspended from canopy branches at ~25 m height with the baited trays 50 cm above the forest floor and spaced  $\geq 100$  m apart along each transect.

*Macrofungi:* Five 50 x 20m plots were randomly laid in each of the 5 and 20year old teak plantation, and the natural forest to survey at least 5% (range: 10–20%) of the study area. Within each demarcated plot, the macrofungi encountered were photographed in-situ before picking, labeled and described properly (shape, size, colour, smell and nature of substrate or foothold). The collected macrofungi were identified based on macroscopic and microscopic features using field monograph of coloured mushrooms book.

*Seedling and sapling:* A modified-Whittaker plot was employed in the assessment of plant diversity in a 5 –year old and 25-year old teak plantations surveyed for this study at Asemaneye. The modified-Whittaker plot of dimensions 20 m x 50 m and was placed in three randomly selected positions in each of the plantations visited. Vegetation surveys to assess understorey regeneration in plantations were carried out in ten 0.5 m x 2 m (1-m<sup>2</sup>) subplots systematically spaced along the inside border of the main plot, while for trees  $\geq 10$  cm dbh the entire plot was assessed. The team surveyed at least 5% (range: 10–20%) of each site.

## Results

### *Amphibian*

Six species of leaf litter frogs comprising 97 individuals were recorded. Richness estimators predicts up to 8 species to occur in the study site. The most abundant species recorded was *Arthroleptis* of the family Arthroleptidae.



2.1: *Leptopelis occidentalis*



2.2: *Conraua derooi*

### *Butterflies*

A total of seven butterfly species belonging to three genera were recorded. Seven species were recorded in the natural forest, six in the 5-year old teak and 3 in the 25-year old teak plantation. *Bicyclus funebris* was the commonest and most abundant species.

*Macrofungi*

A total of 19 macrofungal species belonging to 11 genera were recorded. The natural forest however, recorded the highest number (14 species) of fungal species, followed by the 25-year-old teak plantation (13 species) and then the 5-year-old teak plantation (8 species).

*Under storey floristic composition, abundance and diversity*

A total of 46 species were recorded in the under storey plots of the plantations surveyed. Overall, the 25-year-old teak plantation had 25 species, while 21 species were recorded in the 5-year-old stand. There were no significant differences between plantations in total species richness.

## Conclusion

With regard to the amphibian population, the primary forest was the most species rich and diverse. However, the floristic composition, abundance and diversity were the same for the different plantation sites.

## 2.2 Plants and Soil Microbial response to Herbicides during Plantation establishment in Ghana

<b>Project Team:</b>	Apetorgbor, M.M., Peprah, T., Mensah, J.K., Duah-Gyamfi, A. and Darko-Obiri, B.
<b>Start Date:</b>	February 2012
<b>Expected Completion Date:</b>	2014

## Introduction

Several hectares of plantations are being established in Ghana to reforest degraded forest lands for the past two decades. During the initial establishments of these plantations, different herbicides are used by farmers to selectively remove or kill non-economic plant species, which often compete with the tree saplings for light, water, space and nutrients.

The continual use of these herbicides depletes populations of ecologically important soil micro-organisms and causes loss of soil fertility. The herbicides also alter soil properties, such as pH, which in turn inhibits essential microbial activity. Other studies have shown that sprayed chemicals and non-fluid herbicides not only killed off vegetation at the time of treatment, but the chemicals persist in the soil or vegetation for between one and two years or longer in the treated environment. These non-biodegradable chemicals often enter the food chain and result in biomagnifications.

The study therefore seeks to identify and evaluate the usage and effect of herbicides on the survival and growth performance of planted seedlings. Additionally, it assesses the effects of herbicides on soil micro-organisms and plant diversity under established plantations.

## Methodology

The study was carried out in plantations established in Mankrang and Afram Headwaters Forest Reserves. Six plots, with dimension of 50m x 50m were surveyed at each site. Within each plot, the number and nature of plant species as well as macro and microorganisms in the soil was recorded. Water was also collected from all water bodies close to farms for analysis of chemical composition.

## Results

A total of eighty three (83) species from forty five (45) families were identified in the 16 plots surveyed at both the Mankrang and Afram Headwaters Forest Reserves. At Mankrang, forty seven (47) plant species from twenty six (26) families were recorded while at Afram Headwaters, fifty eight (58) plant species belonging to thirty three (33) families were identified. The family Asteraceae was the most dominant family at both sites. The survey revealed that some leaves on a number of plant species had curled edges.

The population of earthworms belonging to the family *Oligochaeta*, was extraordinarily high on some plots and absent in others at Mankrang Forest Reserve. At the Afram Headwaters Reserve, earthworms were encountered on all the plots. The percentage occurrence of soil microflora did not follow any trend in all the plots.

## Conclusion

The number of tree species and families in the Afram Headwaters Forest Reserve significantly outnumbered those of Mankrang indicating the effect of relatively heavy usage of herbicides at Mankrang. The Herbicides had effect on the morphological and structural features of some plantation trees. The leaves of many teak saplings on plots at Mankrang Forest Reserve were curled at the edges. However, saplings of teak were not affected by herbicides on plots in the Afram Headwaters Forest Reserve. Population of soil macro and microorganisms, water chemical composition and other aspects of the study are still ongoing to holistically determine the effect of herbicides on the environment.

## 2.3 Characterization and Efficient Utilization of emerging Wood Fuel Species for Charcoal Production in the Savanna Transition Zone of Ghana

<b>Project Team:</b>	Sparkler, B.S., Obiri, B.D., Derkyi, N.S.A., Dabo, J. and Adjei, R.
<b>Start Date:</b>	January 2012
<b>Expected Completion Date:</b>	December 2012

### Introduction

Ninety percent (90%) of wood fuel supply in Ghana is derived directly from the natural forest. Over exploitation of traditional hard wood species such as *Anogeissus leiocarpus* (Kane), *Milicia excelsa* (Odum) and *Khaya senegalensis* (Mahogany) has resulted in scarcity of these species. This has led to charcoal producers switching to new soft wood species, which produce loads of charcoal dust, burns quickly, and generates charcoal of poor quality. In spite of this shift in tree species used for charcoal production, there is virtually no empirical information on the emerging wood fuel species that are used for charcoal production. Currently, there is no information on the energy characteristics of the emerging wood fuel species used for charcoal production. Moreover, the trend and magnitude of extraction of emerging species are not known thus the implications on sustainability of the resource cannot be determined. This study is designed mainly to identify and characterize these wood fuel species and assess their availability, extent of extraction and utilization in the forest savanna transition zone of Ghana. The ultimate aim is to assist in suggesting further research and development interventions for ensuring sustainable utilization and management of wood fuel resources.

### Methodology

The study area was Kintampo North municipality in the forest savanna transition ecological zone. This area is the the hub for wood fuel production for consumers in Ghana and for export to other neighbouring wood-deficient countries. The team conducted a socio-economic and ethno-ecological survey plus laboratory studies to analyse the energy characteristics of all the species identified.

### Results

Charcoal producers listed twenty five tree species used for producing charcoal. This comprises of soft and hardwood species. However, hardwood species are usually preferred because charcoal produced from such species had higher energy content, burns slowly over a long period with less ash residue and dust. All producers interviewed use the traditional earth mound method in producing charcoal. This involved piling wood in a dug-out pit covered with leaves, sand, and other combustible materials to help convert the wood into charcoal. The process is closely monitored day and night for about 8-10 days, depending on the size and moisture content of the wood during carbonization. The producers noted



that due to scarcity, lesser known species such as *Erythrophyllum suaveolens* with poor energy characteristics are increasingly carbonised as charcoal.



2.3: Samples of air dried wood species

### Way forward

Some samples of major wood fuel species in use were extracted for laboratory analysis to determine their energy characteristics and appropriateness for charcoal production.

## 2.4 Biodiversity and Ecosystem Services from Remnant Forest/ Sacred Groves: The Case of Tano Sacred Grove

<b>Project Team:</b>	Bosu, P.P., Djagbletey, G., Ametsitsi, G., Addo-Danso, S., Foli, E.G. and Cobbinah, J.R.
<b>Start Date:</b>	January 2012
<b>Expected Completion Date:</b>	January 2013

### Introduction

Sacred groves are small areas of intact or slightly degraded primary forests reserved for religious and traditional rites. These forest islands remain among the most valuable biodiversity hotspots for which much could be obtained for the conservation and sustainable management of forests for the future. The focal objectives of the study were to:

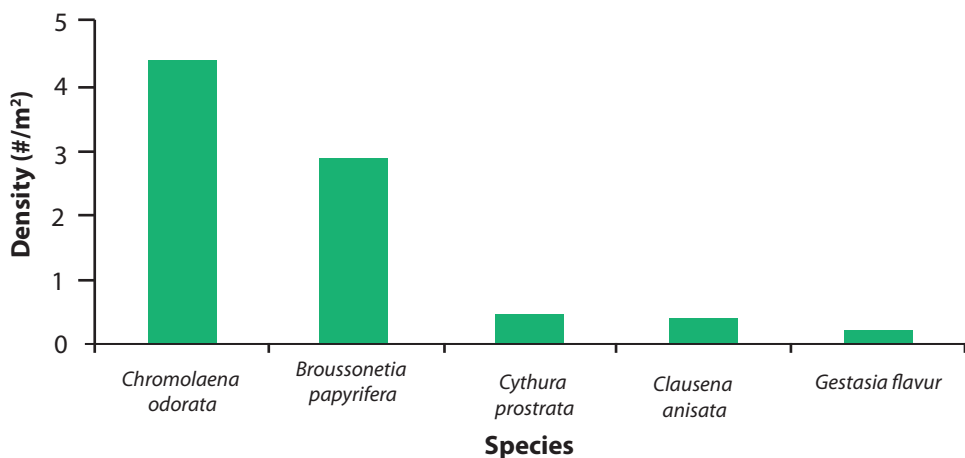
1. Assess the potential of the Tano Sacred Grove (TSG) to provide the ecosystem service of pollination to the surrounding agricultural landscape.
2. Determine soil nutrients and carbon stocks in the TSG and the various land-use types.

## Methodology

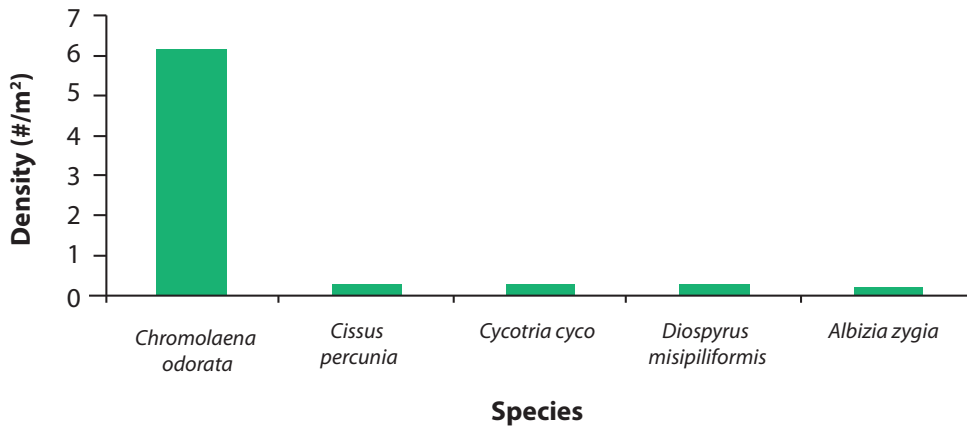
Two keystone pollinator species, namely honey bees (*Apis mellifera*) and carpenter bees (*Xylocopa* spp), were chosen for the assessment. Honey bees and carpenter bees were sampled from inside and outside of the TSG in February and March 2012, respectively. The experimental set up was replicated in three other locations just outside the sacred grove in a mango, cashew and avocado plantation. Inventory was also carried out on both flora and fauna to assess their diversity. Sampling was carried out at monthly intervals. Carbon stocks of the vegetation and soil, within the sacred grove were assessed to determine their potential to provide REDD benefits to local communities in future. Soil samples were collected at 0-10cm and 10-20cm soil depth for soil chemical analysis.

## Results

The five most dominant under storey species in the remnant forest and *Broussonetia* infested plot are shown in the following figures. In the *Broussonetia* infested plot, an invasive species, *B. papyrifera* and an invasive herb, *Chromolaena odorata* (Figure 2.4), were the dominant species that accounted for 76.8% of the total species in the under storey layer. *Broussonetia papyrifera* was absent in the under storey layer of the remnant forest however *C. odorata* (Figure 2.5) was the predominant species accounting for 61.4% of the total species in the under storey layer of the remnant forest.



2.4: Dominant species in the under storey layer of the *Broussonetia* invaded site



### 2.5: Dominant species in the under storey layer of the remnant forest

For faunal diversity, the diversity of insect pollinators in the sacred grove was compared with the other land use types outside the grove. The goal was to evaluate the sacred grove's ability to provide the ecosystem service of pollination to the surrounding agricultural landscape. Results showed that stingless bees were far more abundant in the traps than carpenter and honey bees in the three land use sites.

An evaluation of the current and potential benefits from sacred groves to fringing communities revealed that game was the most important ecosystem service due mainly to the presence of a bat colony which increased the activities of hunters. Another important benefit from the grove was ecotourism and it was mentioned as the second most important ecosystem service to the community because of efforts made in the past to develop the Tano Sacred Grove (TSG) as an ecotourism destination. However, other important roles of the sacred grove such as pest control, fire protection and pollinator source to the surrounding agricultural fields were hardly mentioned. Most importantly, its role in relation to the protection of the Tano River was never mentioned.

### Way forward

An assessment of the understorey vegetation and tree diversity would determine the current status of vegetation diversity. The results will facilitate projections on the biodiversity trajectory of TSG, providing recommendations to conservationists and resource managers on how to conserve the grove. Education on ecosystem services provided by the sacred grove would enable the community to appreciate its importance.

## 2.5 Utilization of Sawmill Residues in Ghana: Production of Panel Products from Sawdust

<b>Project Team:</b>	Owusu, F.W., Appiah, J.K., Appiah-Kubi, E., Tekpetey, S.L., Damnyag, L., Essien, C., Sekyere, D. and Ofori, J.
<b>Start Date:</b>	April 2012
<b>Expected Completion Date:</b>	2014

### Introduction

For years, Australia and other countries have used a mixture of sawdust, sand and cement for making wall panels. This material has thermal insulating properties, is lightweight with an adequate carrying capacity, porous and very durable. It does not rot or decay. It is vermin, termite and insect proof and does not support fungal growth. It is widely accepted as an environmentally friendly material and does not contain or emit any toxic elements.

Although many outlets are available for the utilization of wood fines in Ghana, economical disposal of sawdust (Figure 2.6), shavings and waste chips remains a problem of growing concern to the wood industry and enormous quantities of these waste materials are produced annually by sawmills.



2.6: Heaps of sawdust and wood shavings at sawmill in Kumasi

Throughout the world, particularly in developing countries, a great demand is placed on raw materials for the building and construction industry especially in the last decade. This is due to an increasing population which causes a chronic shortage of affordable houses. Researchers have therefore been challenged to convert industrial wastes into useful building and construction materials.

The aim of this project therefore is to add value to sawdust in Ghana through the development and production of building panel products from sawdust.

### Specific Objectives

- To determine the appropriate design mix proportions and techniques for producing sawdust panel products;

- To determine some technological properties of sawdust panel products and promote their utilization.

## Methodology

Information was first compiled on sawdust availability and sources. Different kinds of designs of pressing machines, their capacities, pressure, loading systems and installation mechanisms were reviewed to enable the study team gather information for the design of the pressing machine. Metal scraps were used for the fabrication of the machine at Suame magazine in Kumasi. Sawdust was subsequently used in combination with sand and a binding medium to form building panels.

## Results

Three categories of wood processing firms namely: small, medium and large scale firms were identified in the Ashanti Region. An assessment showed that sawdust was readily available throughout the year. The wood species available in the sawdust appeared in three classes; light, medium and high density species.

Experts from Mechanical Engineering Department of KNUST and DY Frimpong Engineering at Suame magazine in Kumasi jointly fabricated a pressing machine that was subsequently assembled and electrically installed at FIDD workshop (Figure 2.7).

## Way Forward



2.7: Fabricated pressing machine

The project is timely and relevant to the mandate of CSIR-FORIG and Ghana's development as a whole. Completion of the last two phases namely; testing of the durability of the product and developing prototypes could mark the beginning of sawdust panel production in Ghana.

## 3.0 Donor Funded Projects

### 3.1 Propagation of *Allanblackia parviflora* in Ghana

**Project Team:** Peprah, T., Asomaning, J.M., Apetorgbor, M.M. and Ofori, E.

**Start Date:** January 2012

**Expected Completion Date:** January 2013

Biodiversity conservation in agricultural landscapes of Ghana has been a major challenge for the nation. Some farmers are very reluctant to maintain indigenous forest trees on their farm lands because they are not aware of the benefits that could be derived from the tree. *Allanblackia* species (Family Clusiaceae) is a high value multipurpose indigenous fruit tree found in the rainforest regions of West, East and Central Africa. Benefits derived from the tree include shade, timber, medicine and seed oil, and is therefore explored by farmers in agro forestry systems for both environmental and economic benefits. The seed oil is of prime importance because of its export value. In many African countries notably Ghana, Nigeria, Cameroon and Tanzania the species is being developed as part of a rural-based enterprise. A socio-economic study has shown that farmers are willing to adopt *Allanblackia* for integration into agro forestry systems provided there is a market, an attractive price, early bearing varieties and known methods for propagation. The aim of this project is to improve the propagation techniques of the species using seeds and cuttings to produce high quality planting materials. The result of a marcoting experiment showed that the rooting of marcotts were significantly different in the seeds and cuttings. The roots from the cuttings are shown below:



3.1: Roots emerging from the polybags



3.2: Rooted marcotts with fibrous roots

Seed and seed sections were germinated for 91 days and showed the following results depicted in figures 3.1 and 3.4



**3.3:** Proximal sections of the seed showing emerging shoots



**3.4:** Distal sections showing primary roots

Trial plots were set up at three different sites, namely; New Edubiase (dry semi-deciduous zone), Kamaso (moist semi-deciduous zone) and Benso (moist evergreen zone) to transplant the propagules. The design adopted was two trees plot per propagule type, replicated 15 times in a completely randomized design plot. An assessment for survival, growth, flowering and fruiting was then scheduled at one year intervals.

After a year, a survey of the propagule sites showed that the seedlings performed better than the other propagules (cuttings and grafts) in all the sites. The mortality rate was almost 100 per cent for all the cuttings and some of the grafts.

## 3.2 Wildlife Survey, Capture and Translocation of Key Wildlife Species (Forest Clearance Phase) Akyem Gold Mining Project at Ajenjua Bepo Forest

<b>Project Team:</b>	Kankam, B.O., Ofori-Boateng, C. and Agyeman, V.
<b>Start Date:</b>	May 2012
<b>Expected Completion Date:</b>	May 2013

Mining operations destroy forest habitats and negatively impact on wildlife. Newmont Golden Ridge Limited (NGRL) conducted a wildlife survey to mitigate the effect of mining operations of the company on wildlife on a proposed mining site at Ajenjua Bepo Forest Reserve (ABFR), to identify, capture and translocate critical animal species (species of global conservation concern) within the proposed mine site prior to forest clearing operations.

Wildlife species that were captured were temporarily kept in a housing facility and examined for ill health or injuries (if they occur) by veterinary officers from the Wildlife Division prior to their release into selected sites. Post release wildlife monitoring was conducted for signs of mortality within a kilometer radius from the point of release for eight weeks. Birds that were captured using mist nets were released on the spot shortly after identification.

Animals captured include 16 amphibian species, 17 reptile species (i.e. 9 lizards, 6 snakes and 2 tortoises), 70 bird species and 14 mammal species. Three species of global concern were recorded, namely: the hooded vulture (*Necrosyrtes monachus*: endangered), the tree pangolin (*Phataginus tricuspis*: near-threatened) and a tortoise (*Kinixys erosa*: data deficient). Other wildlife captured and translocated are: 6 lizards, 6 snakes and 4 tortoises. More than 400 individual frogs of least concern according to IUCN conservation status were also relocated.

At the end of the project, it was apparent that although the reserve had a low biodiversity value yet there was a strong indication that the species list had not been exhausted.

### 3.3 Comparative Studies on yield of *Volvariella volvacea*, *Pleurotus tuber-regium* and *Auricularia auricula-judae* using Root and Tuber Wastes for Improved Livelihood of Six Rural Communities in the Tano North District of the Brong Ahafo Region of Ghana

**Project Team Leader:** Apetorgbor, M.M.

**Start Date:** May 2011

**Expected Completion Date:** May 2012

The emergence of small scale mushroom farms in several tropical and subtropical countries is aimed at widening the production base of non-traditional export crops and promoting the economic welfare of rural communities. Ghana is endowed with enormous quantities of agricultural and forestry wastes and there is the need to utilise these wastes especially root and tuber wastes, to improve yield of edible and medicinal local mushrooms.

Oil palm mushroom (*Volvariella volvacea*) was cultivated on low beds using dry composted cassava, yam and potato peels (Figure 3.5) while *P. tuber-regium* was cultivated in heat resistant polypropylene bags. Peels were used singly, as mixtures and then variously mixed with dry leucaena, plantain and cassava leaves as supplements. Yam peels supplemented with plantain leaves gave the best yield with pinheads appearing in 14 days followed by potato peels supplemented with plantain and yam peels supplemented with leucaena leaves. Potato peels supplemented with plantain leaves induced early formation of pinheads (11 days) followed by yam and cassava peels and a mixture of yam and potato peels. A mixture of yam and potato peels gave better yield than when supplemented with leucaena leaves. The best composting period of the substrates for optimum growth and yield of mushroom was ten days. Protein and ash contents were higher in the fruit body of *V. volvacea* when cultivated on potato peels than on cassava peels. Variety of cassava peels used in cultivation of the oil palm mushroom also had an effect on its yield. Mycelia growth of *P. tuber-regium* (Figure 3.6) started well for 14 days on all the substrates after which only four continued to support growth of the mycelia and produce substantial fruit bodies.





**3.5:** Fruit bodies of *V. volvacea* growing on a mixture from bagged yam peels supplemented with plantain leaves



**3.6:** Fruit bodies of *P. tuber-regium* developing of yam peels and plantain leaves

At the end of the project, a training manual was produced and training sessions were held in collaboration with staff from the Ministry of Food and Agriculture (MoFA) in the district. The project was sponsored by the West Africa Agricultural Productivity Programme (WAAPP).

## 3.4 Capacity building for CDM Forestry in the Framework of SFM emphasizing Community Forests and Poverty Alleviation in Ghana

<b>Project Team:</b>	Opuni-Frimpong, E., Agyemang, V.K., Darko-Obiri, B., Opoku Mensah, E., Nyarko Duah, N.Y., Beniako, K.N. and Yeboah, D.
<b>Start Date:</b>	2011
<b>Expected Completion Date:</b>	2014

The potential of forestry-related Clean Development Mechanism (CDM) in Ghana is very significant as large areas of Ghana's forests have been degraded via over-aggressive, non-sustainable logging practices, slash-and-burn agricultural practices, and conversion of forests to alternative crops such as cocoa.

This project intends to develop the capacity for CDM-Forestry in Ghana through community rehabilitation of Ghana's degraded forests targeted at poverty alleviation in conjunction with sustainable forest management (SFM). Activities undertaken in the second year of the project to enhance the attainment of project objectives include; demarcation and compartmentalization of plantations for complete assessment and tree inventory and canopy cover determination. Others are: felling and collection of wood samples, crushing and milling of wood and analysis of wood carbon content. Selection of the degraded Pamu-Berekum Forest reserve by CDM definition was done and the Oda-Kotoamso Community Agroforestry Project (OCAP) model was duplicated. Planting of indigenous and exotic species began in the demarcated plots within the Pamu Berekum forest reserve. An analysis of carbon sequestration was also conducted in the

stands together with a socio-economic and an environmental survey in participating communities. The implementation of this phase of the project was successful with capacity building programs for students and farmers within the target communities which has attracted more participants from other communities.

### 3.5 Towards Sustainable Indigenous Mahogany Timber Production in Ghana: Phase II, Refining the Silvicultural “Tool Kit” and Practical Training for Industrial-Foresters and Community Farmers

<b>Project Team:</b>	Opuni-Frimpong, E., Darko-Obiri, B., Tekpetey, S.L., Appiah Kubi, E., Essien, C., Mensah Opoku, S. and Opoku-Mensah, E.
<b>Start Date:</b>	2010
<b>Expected Completion Date:</b>	2014

Sustainable supply and conservation of mahogany is threatened by over exploitation of natural mahogany forests. Exacerbating the situation is the inability to establish mahogany plantations in their native range as a result of the incidence of mahogany shoot borer (*Hypsipyla robusta*). The borer kills the main stem of the young trees, causing excessive forking and branching and contributing to tree mortality. As a consequence of the destructive activities of *Hypsipyla*, some entomologists have classified it as the most important pest in tropical forestry. This project, sponsored by ITTO, focuses on the development of an integrated pest management strategy for *Hypsipyla* via plantation culture that could contribute to restoration and conservation of African mahogany. The development objective is to improve the sustainability of indigenous mahogany in Ghana by developing superior mahoganies that are ecologically adapted and insect tolerant and to expand collaboration with industry and community tree farmers. The specific objective seeks to refine the silvicultural “tool kit” to improve the ability to produce economically viable indigenous mahogany in mixed plantations and to transfer this technology to Ghana’s key industrial partners and community tree growers via a practical “how to” cultivate indigenous mahoganies manual.

During the year under review, vigorous research activities were carried out to achieve the objectives of the project. These include: development of superior mahogany seedling production centers at Mesewam and the establishment of a hedge garden. Vegetative propagation methods of producing progenies from *Hypsipyla* tolerant genotypes were conducted at FORIG nursery site in addition to a study to assess the effects of rooting media on vegetative propagation of *Khaya ivorensis* and *Khaya grandifoliola*. Mahogany seed orchards with diverse genetic sources of *Khaya* and *Entandrophragma* have been established in participating community nurseries.

Wood quality and lumber properties from mature plantation-grown mahoganies were determined by extracting samples from 40-year old *Khaya* species to determine their sawing characteristics. Anatomical properties were compared and mechanical and strength

properties determined. Studies were also conducted to examine the variations in selected anatomical characteristics of plantation grown *Khaya grandifoliola* wood from different vegetation zones in Ghana. Another study was conducted to assess the mechanical properties of plantation grown *Khaya grandifoliola* wood from Moist Semi-Deciduous (MSD) and Wet Evergreen (WE) zones of Ghana.

### 3.6 Democratic Representation in Ghana's REDD+ Process

**Project Team Leader:** Marfo, E.

**Start Date:** 2012

**Expected Completion Date:** 2013

Stakeholder participation and consultation at the national and sub-national levels is an important pillar for the development of REDD+. Ghana claims to have developed its REDD Readiness Plan through a highly participatory and consultative process using the notion of stakeholder representation in designing the institutional architecture for participation. The rhetoric of democratic representation is highly visible in Ghana's constitution and forest policy statements but to what extent was the espoused democratic principles regarding representation implemented by intervening authorities who designed and implemented the REDD Readiness strategy consultative process. The study explores the politics of institutional choice for democratic representation of REDD+ actors, by examining espoused visions of democracy against actual commitments in practice.

The study argues that representation is an illusory and highly symbolic feature of the REDD+ participatory process in Ghana. Democratic representation remains a highly conceptual notion compared to the practice of participation. Institutional choices for stakeholder representation were instrumental in the sense of getting various stakeholders listed as having participated in the process than representation of substantive interests. In effect, current understanding of representation under institutional choices for stakeholder participation approaches is very far from the desired democracy outcomes of responsiveness and accountability.

### 3.7 Rehabilitation of Degraded Forests for Sustainable Wood Fuel Production and Climate Change Mitigation in the Forest-Savanna Transition Zone of Ghana

<b>Project Team:</b>	Darko-Obiri, B., Obeng, E.A., Oduro, K.A., Peprah, T., Damnyag, L., Derkyi, N.S.A., Opuni-Frimpong, E., Nutakor, E. and Adjei, R.
<b>Start Date:</b>	May 2013
<b>Expected Completion Date:</b>	May 2015

An important product derived from forests and woodland is wood fuel, which accounts for over 85% of the total energy consumption of West African countries and provides for the energy needs of most households. The Intergovernmental Panel on Climate Change' (IPCC) fourth assessment report on mitigation of climate change puts wood fuel as the only source of fuel for one third of the world's population with this demand expected to double in the next 50 years. The IPCC report continues to estimate the world wide harvesting of wood as 60% industrial round wood and the remaining 40% as wood fuel, primarily charcoal and firewood. Though wood fuel is the most common form of biomass, it is currently not easily accessible because of the fast rate of degradation of the natural forest. In Ghana, wood fuel consumption increased from about 18.4 million m<sup>3</sup> in 1990 to about 33 million m<sup>3</sup> in 2006, largely in response to population growth. The Energy Commission of Ghana estimates that wood fuel consumption in Ghana is twice as large as other energy sources, including electricity and petroleum and over 90% of rural households depend on wood fuel for cooking. The use of LPG in Ghana on the other hand accounts for only 4–6% of the residential sector's energy needs and is only concentrated in the urban areas, mostly among the middle and higher income groups in society.

A recent study on forest dependency in the transition zone of Ghana also indicates that the most exploited product from natural forest is woody biomass mainly for charcoal production and firewood. Commercial charcoal production in the transition zone is a major livelihood activity that supplies charcoal to urban areas and for export to Europe. The over reliance on woody biomass as household and industrial energy, has contributed significantly to the accelerating rate of natural forest depletion particularly in the forest-savanna transition zone.

The government of Ghana has become increasingly concerned about the need to preserve the country's wood and forest resources. It is anticipated that, better management of wood fuel supply particularly from the natural forest or through woodlots and plantation establishment would contribute extensively to natural forest conservation and carbon sequestration. Moreover, the current technologies used in charcoal production coupled with the limited range of suitable known species for wood fuel has compounded the problem of over harvesting of traditional species such as *Anogeissus leiocarpus*, *Milicia excelsa*, *Nesogordonia papaverifera*, *Piptadeniastrum africanum* and *Khaya spp.* that are also prime economic hardwood timber species. These species are preferred for charcoal because of their slow burning properties. However, there are other fast growing species

with high calorific values that could easily be planted in short rotation systems to produce appreciable woody biomass for charcoal and firewood that have not been experimented.

Sponsorship of this project is by ITTO with the goal to contribute to the sustained socio-economic development of forest dependent communities and reduction in forest degradation in the forest savanna transition zone of Ghana through the promotion of smallholder and commercial tree plantations that could ensure sustainability of the resource base.

Baseline surveys have been completed with the identification of six communities where test plots for planting wood fuel would be sited. Some species both indigenous and exotic have also been selected for planting on the plots. The project team enjoyed good co-operation from the communities and FSD field staff who facilitated quantitative and qualitative information gathering.

### 3.8 Determination of the Technological Properties of Bamboo Species for Housing in Ghana

**Project Team:** Owusu, F.W., Appiah, J.K., Tekpetey, S.L., Appiah-Kubi, E., Damnyag, L., Essien, C., Sekyere, D. and Ofori, J.

**Start Date:** June 2012

**Expected Completion Date:** June 2013

Bamboos provide numerous services and products for human survival in many countries. Despite this potential, bamboo processing and utilization in Ghana is almost non-existent compared to its utilization in many countries in South East Asia. In Ghana, though some work has been done on the anatomical, physical and chemical properties, very little is known about machining properties like planing and sawing, as well as mechanical properties such as bending, compressive and tensile strength. This study, forms part of the Ministry of Environment Science, Technology and Innovation' (MESTI) strategic plan to introduce at least 60 per cent alternative indigenous raw materials into the building and construction industry in Ghana by 2015.

The main objective of the project is to determine some technological properties of some bamboo species in order to enhance their processing and efficient utilization for housing in Ghana.

The specific objectives of the study are to:

- Determine the physical, machining and mechanical properties of some bamboo species from two ecological zones in Ghana;
- Determine the glue bonding characteristics of some bamboo species in Ghana;
- Produce prototype products from bamboo species in Ghana.

The CSIR-FORIG research team conducted feasibility studies on bamboo growing areas and bamboo plantations at Bobiri forest reserve in the moist semi-deciduous forest zone,

Subri Industrial Plantation Limited (SIPL) in Daboase and Oil Palm Research Institute, Kade to assess availability, types of bamboo species and condition of the stands.

Bamboo culms from both natural and plantation forest stands were extracted from Daboase for the determination of the physical and mechanical properties. The bamboo species selected include the following: *Dendrocalamus latiflorus*, *Bambusa vulgaris*, *Guadua chacoensis*, *Bambusa bambos* and *Guadua angustifolia*. For each species, five bamboo culms from different clumps of the selected bamboo species were harvested at Daboase (Figure 3.7), treated and further processed.



3.7: Harvesting and macroscopic measurement of bamboo at Daboase

Internodes from the lower part of each bamboo culm was obtained for all the selected species. Test samples of dimension 25 mm by 25 mm by culm wall thickness were prepared for moisture content and basic density determination according to International Standards for Testing Bamboo (ISO 22157-1:2000E). The green moisture content, basic density and shrinkage characteristics were determined.

For the mechanical properties, an Instron Machine at FORIG was used to verify the bending, compression, tensile, hardness and shear strength of the bamboo samples.



3.8: Measurement of culm wall thickness



3.9: Bamboo samples for shrinkage determination



**3.10:** Fabricated parts of the bending test apparatus



**3.11:** Test samples for physical and mechanical properties

Bamboo species from Daboase had mean basic density values within a range of 490 to 580kg/m<sup>3</sup>. In comparison with values for some bamboo species from Asia like *Phyllostachys pubescence*, which has a recorded basic density value range of 400 to 900kgm<sup>-3</sup>.

Naturally grown bamboo species especially *Bambusa vulgaris* has been reported to have a mean basic density range from 466.10 kg/m<sup>3</sup> to 761.5 kg/m<sup>3</sup> from three different sites in Ghana. This study revealed that the bamboo species selected showed superior characteristics as constructional materials in terms of their morphological and physical properties. It is believed that the ongoing work on the mechanical and machining properties will elucidate characteristics that are suitable for the utilisation of bamboo for housing in Ghana.

### 3.9 Generating and Disseminating Scientific Information on REDDES in Africa

**Project Team:** Foli, E., Cobbinah, J.R., Agyeman, V.K., Marfo, E., Darko Obiri, B., Acquah, S.B., Damnyag, L., Addo-Danso, S. and Obeng, E.

**Collaborators:** International Union of Forest Research Organisations (IUFRO), Vienna; Forestry Research Institute of Nigeria (FRIN); Institute of Agricultural Research for Development (IRAD), Cameroon; Forestry Development Authority (FDA), Liberia

**Start Date:** January 2012

**Expected Completion Date:** July 2014

The key elements central to the on-going global debates on climate change constitute the focus of ITTO's Thematic Programme on Reducing Emissions from Deforestation and Forest Degradation and Enhancing Ecosystem Services (REDDES). Deforestation and forest degradation are directly driven by a multitude of factors from inside and outside the forest sector. Within the forest sector, these factors are directly related to forest governance,

and include: commercial harvesting of timber, illegal timber harvesting, firewood collection, uncontrolled forest fires, etc. Outside the forest sector, the causative factors are: population growth, expansion of agricultural lands for food, bio-fuels and poverty.

This present project seeks to address these identified problems by working with the forest science community in selected pilot sites in Africa through an integrative, international, policy-relevant and multi-disciplinary approach. The development objective is to improve forest dependent livelihoods through sustainable management and restoration of tropical forests, with the following specific objectives:

1. To strengthen the capacity for scientific analysis of REDDES implementation pilot projects in Cameroon, Ghana, Liberia and Nigeria.
2. To disseminate scientific information to policy makers, forest managers, and local communities, that will enhance strategies to successfully implement REDDES on the ground.
3. To promote regional networking and exposure through the organisation of a regional Congress, with participation of forest scientists and practitioners from all over Sub-Saharan Africa and overseas.

To address the objectives, the strategy adopted was to employ community-level stakeholder engagement in discussing issues related to the causes of deforestation and forest degradation, and strategies for addressing these. This was achieved through workshops, focus group discussions, and the administration of semi-structured questionnaires to randomly-selected respondents from the different stakeholder groups. Three workshops were held in the Offinso pilot site in Ghana. Through the above engagements, the strategies for REDDES were developed and discussed at another Strategy Workshop held at Offinso on 27 November, 2013 with similar workshops in Cameroon, Nigeria and Liberia.

The last output was achieved through the organisation of the First IUFRO-FORNESSA Regional Congress on “Forests and Trees: Serving the People of Africa and the World” and ITTO/AFF Forest Policy Day which took place on 25 – 29 June 2012 at ICRAF Headquarters, Nairobi, Kenya.

The implementation of the project has been quite successful, and all the field activities have been completed in Cameroon, Ghana and Nigeria.



**3.12:** Some participants arriving at the World Agroforestry Centre (ICRAF)



### 3.10 Development and implementation of a species identification and timber tracking system in Africa with DNA fingerprints and Stable Isotopes

<b>Project Team:</b>	Opuni-Frimpong, E., Mensah, J., Bandoh, W., Opoku Mensah, E., Govina, J. and Ofori, E.
<b>Start Date:</b>	2012
<b>Expected Completion Date:</b>	2015

Illegal logging and trade in illegal timber and wood products are the cause of many economic and ecological problems in both producer and consumer countries. Although instruments have been established against illegal logging and trade, at both national and regional levels, practicable control mechanisms to identify the origin of timber and wood products are lacking. Such methods of identifying types of wood and timber origins are fundamental prerequisites for efficient import controls or corresponding origin testing by the timber industry. Existing timber tracking systems use paper-based records of timber origin at all levels of the documentation process. The tests presently used, for example in the scope of the CITES international species protection convention, meet their limits in many tropical tree species. New methods that are on the threshold of usability are DNA fingerprints and stable isotopes. The innovative character of these new methods stem from the fact that characteristics inherent to the timber are used instead of externally applied marks. This eliminates the possibility of falsifying accompanying chain-of-custody-documents and marks and reduces the possibility of laundering timber from illegal harvest. It allows for independent controls at any point of the complex timber trade network. The combination of both methods, DNA-fingerprints and stable isotopes, has the advantage that a higher cost efficiency, and spatial resolution and stronger statistical power for the control system can be expected. First results of pilot-studies with Mahogany (*Swietenia macrophylla*) in Latin-America and Iroko (*Milicia excelsa*) and Sapele (*Entandrophragma cylindricum*) in Cameroon support this assumption.

The lead country for this project is Germany and other timber producing partner countries include; Ghana, Cameroon, Central African Republic, Democratic Republic of Congo, Gabon and Kenya.

The objective is to develop and implement a species identification and timber tracking system with DNA fingerprints and stable isotopes for important timber tree species in Africa.

At a project implementation team meeting in Cameroon, three species were targeted for the study namely; *Milicia excelsa* (Odum/Iroko), *Triplochiton scleroxylon* (Wawa/Ayou) and *Entandrophragma cylindricum* (Sapele). However, Ghana was given more funds to do more sampling of *Khaya* species which was not on the list of common species from Yoyo Forest Reserve.

The outcome of this project would ensure better enforcement of forest laws and regulations by improved verification and monitoring procedures and transfer of knowhow and capacity building in producer countries.

### 3.11 Advancing REDD+ in Ghana: Preparation of REDD+ Pilot Schemes in Off-Reserve Forests and Agroforests

**Project Team:** Oduro, K.A., Agyeman, V.K., Foli, E. & Damnyag, L.

**Start Date:** April 2013

**Estimated Duration:** March 2014

This project is preparing a major support component to Ghana's Readiness Preparation Proposal (RPP) and aims at strengthening Ghana's capacities to prevent and reduce deforestation and forest degradation and enhance carbon stocks (REDD+). It lays out the ground work for the development or enhancement of off-reserve production systems under REDD+ schemes, in line with effort to reduce GHG emissions in forests.

The present REDDES project is a preparatory step for an additional support component for the implementation of Ghana's R-PP and is mainly concerned with developing a number of analytical works and the definition of REDD+ pilots in off-reserve areas. The project is also aimed at developing a framework to guide the implementation of REDD+ from the national to the local level. This shall allow Ghana to take stock of existing initiatives that have the potential to be considered under REDD+, as well as to concretely analyze promising REDD+ activities, which will be an integral part of the RPP.

The objective is to provide Ghana with proposals for the enhancement of sustainable off-reserve production systems under REDD+ schemes with a focus on local livelihood improvement. Some of the outputs of this project include a draft guide on the implementation of REDD+ in Ghana: criteria and modalities for developing a REDD+ project together with a policy brief defining the Governance Structure of Carbon Assets in Ghana.

### 3.12 Allanblackia: Standard Setting and Sustainable Supply Chain Management (Phase II)

**Project Team:** Anglaaere, L.C.N., Blay, D., Damnyag, L., Dabo, J., Owusu, S. and Manu, E.

**Project Start Date:** January 2010

**Project Completion Date:** December 2012

This project, which is sponsored by the Swiss Economic Cooperation Organization (SECO), is a continuation of a first phase that focused on establishing biological baselines for Allanblackia (AB) within five communities in the Western Region. It involved an

assessment of phenology of species (flowering, fruiting, fruit size and number of seeds per pod), regeneration and growth rates of the Allanblackia tree on farms and in the forest.

Following a successful completion of this phase, a proposal was made for a second phase to move the AB programme forward and to, among other things, increase population of AB within the landscape. The project was consequently up-scaled to cover 8 communities in the Western Region.

The Development Objective (DO) of the project is that “Allanblackia improves livelihoods and landscapes in Allanblackia endemic communities of Ghana”. The Specific Objective (SO) of the project is that “Allanblackia farmers have improved access to markets for sustainably produced Allanblackia, improving their livelihoods and landscapes”.

To achieve these objectives FORIG undertook the following tasks:

- Preparation and implementation of Allanblackia related Forest Landscape Restoration (FLR) plans;
- Preparation of Allanblackia FLR monitoring and evaluation framework and training of field team to collect and analyze data.
- Creation/establishment of demonstration plots on sustainable Allanblackia (Figures 3.13 & 3.14), using standard/guidelines and the principles of FLR.
- Assessment of needs of community nurseries and support of AB related nursery activities.



**3.13:** *Inter planting AB into food crop farms (modeled)*



**3.14:** *Planting in open patches within matured cocoa farms*

Some of the major achievements are as follows:

- A total of seven hundred and nineteen (719) community members were sensitized on community tree nurseries in 71 community meetings.
- Two hundred and forty one (241) farmers and community members (121 women and 120 men) from 8 project sites were trained in tree nursery as a business.
- Three (3) AB project communities (Nkrankrom, Kamaso and Wassa Berekum) were assisted by the project to develop community nurseries through the supply of nursery tools and materials and capacity development.

- Fifteen (15) people from these communities were given intensive training in nursery management by FORIG and FORM International staff.



**3.15:** *Training of community members in AB seed processing and nursing*

The expected benefits of the project include poverty reduction in target communities through new income generation activities and an increase in export earnings.

### 3.13 Development of Building Blocks made of Stabilized Laterite and Agricultural Residues as an environmentally friendly alternative to Cement Blocks in Ghana

**Project Team:** Appiah-Kubi, E., Strautmann, J., Owusu, F.W., Appiah, J.K., Tekpetey, S.L., Damnyag, L., Essien, C., Sekyere, D. and Ofori, J.

**Start Date:** January 2012

**Expected Completion Date:** December 2012

Housing continues to be a major problem in many African countries. In Ghana, the cost of building materials is high and many poor families live in congested and overcrowded cities. Laterite is a readily available building material which has been used for many years by local people in villages who cannot afford cement for building construction. Agricultural residues such as corn and rice husks and sawdust from processing industries that are potential raw materials for building are mostly, burnt in the open causing air pollution.

This project is in collaboration with Bern University of Applied Sciences, Architecture Wood & Civil Engineering, Switzerland and CSIR-BRRI, and is in two main phases. The first project phase is concerned with the collection and analysis of readily available raw materials such as sawdust, corn stalk with the husk, rice husk and palm fibres (Figures 3.16 & 3.17).



**3.16:** *Heap of rice husks at a rice processing factory at Ejura*



**3.17:** *Heap of oil palm fruit fibers and empty palm fruit bunches*

Laterite soil was collected from selected sites in three regions of Ghana (Ashanti, Brong Ahafo and Eastern) where they naturally occur in large quantities. The soils were analysed to ascertain their chemical composition and physical properties such as moisture content and binding properties with selected additives. Atterberg limit test was conducted to determine the plasticity index of the various laterite soils. In addition, sieve analysis and hydrometer tests were used to determine particle size distribution.

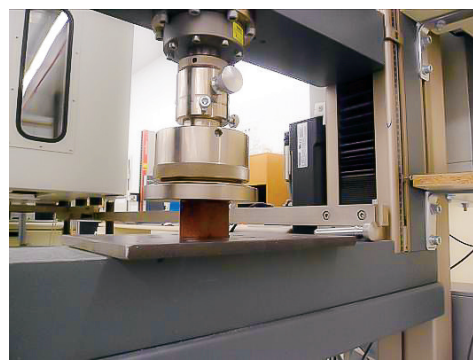
Fresh agricultural residues were collected from selected farms, sawmills and beverage factories and then analysed with regard to plant type, fibre content, chemical extracts, moisture content etc.

The second project phase involved numerous trials to produce building blocks using the researched laterite sources and agricultural residues.

Several tests were conducted to obtain an optimum mix for the bricks using laterite and residues in a geopolymerization process. The curing method and influence of time on strength of the bricks were investigated. It was found that the best condition for curing was to allow the bricks to dry under ambient conditions with time.



**3.18:** *Sample of the bricks*



**3.19:** *Compressive test apparatus and set up*

The optimal amount of residue per 100g of laterite mix was also investigated. It was found that, equal volume of laterite and residue was the optimum quantity needed in the case of rice husk. Mix of bricks with rice husk beyond this volume was not workable. Sawdust and corn stalk were workable at 25% more of the laterite volume. Palm fibre was workable at

25% more with difficulty in moulding bricks. It was also too wet with 25% less volume and is recommended that equal volume of laterite is used in their mixes.

To effectively use the bricks in construction, the right size and the appropriate mix of laterite and agric residues should be further investigated to obtain the best brick for building in Ghana.

### 3.14 Does shifting Carbon Use Efficiency determine the Growth Rates of intact and disturbed Tropical Forests? Gathering new evidence from African forests

<b>Project Team:</b>	Adu-Bredu, S., Owusu-Afriyie, K., Duah-Gyamfi, A., Addo-Danso, S.D., Djagbletey, G.D., Amponsah Manu, E. and Adu-Opoku, A.
<b>Collaborators:</b>	School of Geography and the Environment, Environmental Change Institute, University of Oxford
<b>Start Date:</b>	2011
<b>Expected completion Data:</b>	2015

#### Introduction

Tropical forests play a major role in the global carbon cycle, by storing a substantial amount of carbon in biomass and soil, and by regulating transfer of this stored carbon into the atmosphere as greenhouse gas carbon dioxide (CO<sub>2</sub>). Tropical forests in Amazonia and Africa appear to be increasing in biomass, absorbing around 12±3 % of current anthropogenic CO<sub>2</sub> emissions (and the rate of rise of atmospheric CO<sub>2</sub> would be about 17% higher without this tropical sink), but the continuity of this biomass carbon sink is uncertain. Improved understanding of productivity, carbon cycling and carbon use efficiency (*the ratio of net primary production to gross primary production*), and their controlling factors is essential to improve attempts to accurately model tropical forest carbon cycling, and their potential responses to future environmental changes.

The project therefore seeks to address the relative importance of photosynthesis and autotrophic respiration in determining forest function in intact and disturbed tropical African forests. To achieve this comprehensive carbon cycle assessment plots have been established and replicated across two contrasting countries in Africa namely, Ghana (West Africa) and Gabon (Central Africa). In Ghana, the project is implemented in different ecological zones namely: the Bobiri Forest Reserve (moist semi-deciduous zone), Ankasa Forest Reserve (wet evergreen zone) and the Kogyae Strict Nature Reserve (dry semi-deciduous zone).

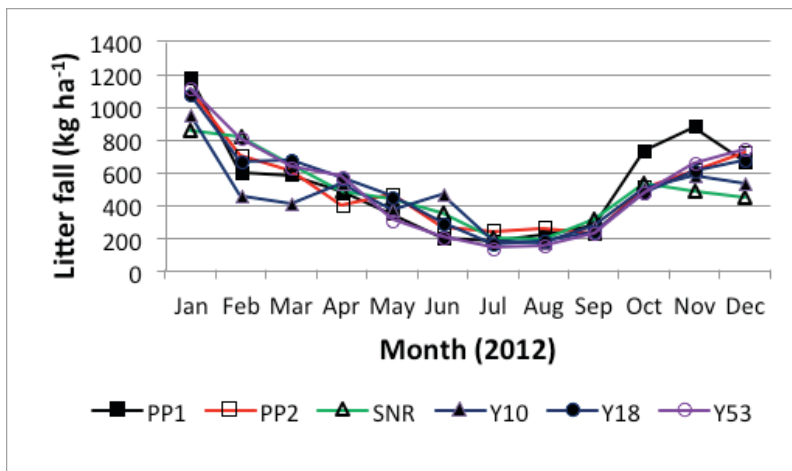
The underlying hypotheses are as follows: (i) there is no significant site-to-site variation in the Gross Primary Production (GPP) (forests within Ghana in comparison to Gabon),

despite variation in soil properties, climate and tree species composition; (ii) there is substantial site-to-site variation in Net Primary Productivity (NPP), and this is mainly driven by shifts in carbon use efficiency (CUE, the proportion of photosynthetic carbon converted to biomass), and (iii) forest CUE increases substantially after disturbance (logging and fire) and subsequently declines over time.

## Preliminary results

### *Litter fall production*

One hectare plots were established in various post-logged year compartments in the Bobiri Forest Reserve for the study. The post-logged year sites are 10 – ( $Y_{10}$ ), 18 – ( $Y_{18}$ ), 30 – ( $PP1$  and  $PP2$ ), 53-year ( $Y_{53}$ ) post-logged sites, as well as a Strict Nature Reserve (SNR) site, which has never undergone logging. Generally, litterfall was highest during the dry season, and exhibited similar patterns among the plots. This trend is comparable to litterfall production recorded in tropical forests in other regions. The litter fall production decreased from January, reaching a minimum value in July and August, and thereafter increased towards December (Figure 3.20). The annual litter fall rate ranged between 5.46 and 6.40 Mg d.w.  $ha^{-1} year^{-1}$ , with the least recorded by the 10-years post-logged site ( $Y_{10}$ ) and the highest by  $PP1$ .



3.20: Litter fall production in different (post-logged and unlogged) plots at Bobiri Forest Reserve

## Conclusion

The preliminary results showed that the relatively young post-logged site had the least litter fall an indication that removal of bigger trees reduced significantly the amount of litter fall produced.



3.21: Litter in traps

### 3.15 Savanna Forest Boundary Transition in West Africa – Coupling the Energy Balance and Hydrology and Carbon Cycles across the Biome zot

<b>Project Team:</b>	Adu-Bredu, S. and Ametsitsi, G.K.D.
<b>Collaborators:</b>	Nature Conservation and Plant Ecology Group, Wageningen University
<b>Start Date:</b>	October 2011
<b>Expected Completion Date:</b>	September 2015

GEOCARBON is an European FP7 project with a global perspective, with the ultimate aim to lay the foundations for an operational Global Carbon Observing and Analysis System in support to both science and policy.

The loss of most transitional forest over a distance of 150 km nationwide (“savanisation”) particularly in the zone of transition (ZOT) in Ghana has been dramatic. It has been a source of livelihood for fringe communities and supplies ecosystem services such as charcoal, grazing and medicinal herbs, in addition the ZOT has a unique biodiversity conservation value. The adjacent forest and savanna systems in the ZOT are uniquely defined by space and time scale and interactions, which support a mix of these vegetation types under the same climatic conditions. In this project, the aim is to study vegetation interaction with soil, climate and edaphic factors in a forest savanna-ecotone in West Africa, to elucidate the dynamics of vegetation change in the light of fire mediated feedbacks and alternate states of forest and savanna.

The study is being conducted in the Kogyae Strict Nature Reserve in Ghana. The study has four components which would determine the following: (i) how edaphic properties (e.g. nutrients and soil depth) affect vegetation structure and phenology (ii) effects of canopy closure on fire dynamics (iii) effects of edaphic properties on physiological activity in trees (e.g. sap flow) and (iv) the resulting seasonal variation of exchange of CO<sub>2</sub> and latent and sensible heat in this ecotone. Soil physical and chemical properties, fire characteristic measurements and land atmosphere feedbacks will be analysed over a two year period. The research outputs will include a PhD thesis, scientific publications and presentations both locally and internationally at workshops and seminars.

This project adapts the state of the art technology to measure land atmosphere feedbacks and energy balance. A sustainable 36 m lattice tower (Figure 3.22) above canopy equipped with eddy covariance gadgets has been built and running, measuring energy fluxes and carbon dioxide exchange.

This is the first of its kind in the transition zone of Ghana. In addition, 35 permanent plots have been established in the forest, forest-savanna (mixed) and savanna sites within the reserve. Studies on fire dynamics has been conducted for two years, while data on soil depth variation and moisture distribution was collected. The phenology of trees, sapflow rate and resistance to fire is being studied.





**3.22:** *Lattice tower at Kogyae*

The project has been sustained by high level of commitment by collaborative partners which created opportunity for training of MSc and PhD Students. The management of the project seeks to establish a permanent research site in the transition zone and a paradigm shift in FORIG's research scope and dimension. Project management has established a mechanism to address known and unforeseen challenges in view of the highly technical nature of some components.

## 4.0 Commercialisation and Information Division

The Commercialization and Information Division comprises of the library, computer and marketing sections. The activities undertaken by these sections during the period under review are reported in the ensuing paragraphs. The Division is also responsible for coordinating all commercial activities of the Institute. These are:

1. Sale of seeds and seedlings
2. Sale of spawns
3. Sale of wood
4. Consultancy services
5. Training in alternative livelihood programmes such as mushroom and snail farming.
6. Production of honey and prekese syrup for sale.

### Sale of Seeds and Seedlings

Over the years, CSIR-FORIG collects various species of tree seeds for sale to prospective plantation developers in the country. Major clients are the Forestry Services Division and private developers. The seeds supplied are usually based on requests. Various species collected during the period include Ofram, Emire, Cedrela, Teak and Mahogany. A major challenge with this activity is the unavailability of seed trees and so within the next few decades, the Institute intends to avert this by establishing seed orchards throughout all the ecological zones.

Seedling production is another source of income for the Institute. During the period under review, the Institute continued with the production of quality seedlings from tested and treated seeds. The most popular species patronised by clients were Ofram, Cedrella, Teak and Emire.

### Sale of Wood

FORIG sold thinnings from its research plots at Pra-Anum, Amantia and Afram Headwaters at Abofour as a research by-product.

### Contract Research

The Institute undertakes consultancy services and contract research as a commercial activity. However, in 2012 and 2013, very few consultancies and contract research activities were undertaken.

## Training Workshops Organised

A four-day mushroom training course for improved livelihood (Oyster and Oil Palm Mushrooms) was organized for participants with Dr. (Mrs.) Mary Apetorgbor as the main resource person.

## 4.1 Library Section

The library provides essential information services to support research activities at the Institute and to cater for the general information needs of the entire forestry sector. The library has a book stock of approximately 6,500 books and it does not subscribe to any journal due to lack of funds. Subscriptions to online databases provide a valuable source of full-text articles. The library also has in stock an extensive collection of bulletins, reports and annual reports.

In this era of advanced information storage and retrieval, it has become necessary for the library to facilitate access to information technology and provide the means and techniques by which researchers and other clientele could acquire advanced skills for literature searches. The library is equipped with desktop computers, which provide access to a number of databases including PROSPECT, WOODS of the WORLD, FOREST COMPENDIUM and FOREST SCIENCE.

An internet connection is available to provide access to online databases such as AGORA, EBSCOHOST and JSTOR. The Library continues to provide proactive services such as Selective Dissemination of Information (SDI). During the period under review, about 100 internet and CD-ROM searches were conducted.

## 4.2 Computer Section

The computer section manages CSIR-FORIG's computer network and helps scientists to analyse their data. With respect to the Management of Local Area Network, a new Internet Service Provider was contracted in September 2012, to provide the Institute with a 2MB dedicated Broadband Internet Service. The monthly charge for this service is US\$1,419 and the Institute has planned to purchase a new server and to install more user-friendly mailing software.

## 4.3 Marketing Section

This section coordinates all marketing activities of the Institute. This includes preparation of Marketing Plans which outline key marketing strategies to intensify public awareness of the Institute through radio programmes, publications etc and to increase CSIR-FORIG's Internally Generated Fund. Specific activities undertaken include the following: organization of radio talk shows and a publication of one Volume of the Institute' Journal and three Issues of CSIR-FORIG newsletter.

## 5.0 Administration Division

The objectives of the Division are to:

1. Provide support services and create an enabling environment to facilitate effective and efficient performance of work by all Divisions.
2. Ensure implementation of policies, procedures, rules and regulations of the Council at the Institute level and undertake human resource management and development activities.

### 5.1 Staff Strength

The total staff strength of the Institute as at January 2013 was 174. This number is made up of 53 Senior Members, 80 Senior Staff and 41 Junior Staff.

### 5.2 Upgrading and Promotions

Four Senior Members were promoted during the period under review to Chief, Principal, Senior and Research Scientist respectively.

With regard to Senior and Junior Staff, a total of twenty-eight (28) members were promoted during the year 2011. Their promotions took effect from 1<sup>st</sup> January, 2012.

### 5.3 Training

The breakdown of the number of officers who completed or are undergoing training programmes at the Institute is presented in Table 5.1.

**Table 5.1:** Number of officers in training

LEVEL	COMPLETED	ON-GOING
PhD	1	7
Mphil/MSc/MA	-	8
BSc/BA	2	5
Diploma	-	1
Short courses (Drivers)	5	-
Short courses (Security) Modules I & II	4	-
<b>TOTAL</b>	<b>12</b>	<b>21</b>

## 5.4 Graduate School

The CSIR Graduate School programme took off in September 2012. The programme, which is currently targeted at professionals in Ghana, aims to become a postgraduate centre of learning for Bio-economy and Natural Resources Management in the West African sub-region in future.

ECORES is a tailor-made post graduate programme for training middle level professionals in Bio-Economy and Natural Resources Management. The 2-year programme comprises four modules leading to the award of a dual Masters' degree. The school is jointly managed with the University of Eastern Finland (UEF).

## 5.5 New Appointments

The following persons were recruited during the period under review;

- Dorothy Asare-Akoto, Principal Technical Officer
- Michael Ampah, Senior Administrative Assistant
- Samuel Apraku Yeboah, Senior Technical Officer
- Haruna Seidu, Senior Technical Officer
- Gifty Wiafe Tenkorang, Senior Accounting Assistant
- Kwasi Owusu Bempah, Senior Accounting Assistant
- Diana Afua Tanoah, Clerk Grade I
- A total of ten (10) persons were also recruited as labourers for the Institute.

### Appointment of Deputy Director

Council approved the appointment of Dr. Stephen Adu-Bredu, a Principal Research Scientist, as the new Deputy Director with effect from January 2013.

## 5.6 Awards

Dr. Joseph Rexford Cobbinah (Chief Research Scientist and former Director of CSIR-FORIG) is the first African to receive the International Union of Forestry Research Organizations' (IUFRO) distinguished Service Award since its establishment in 1896.

## 5.7 Redesignation/Reassignment of positions

Management approved the re-designation/re-assignment of two senior members as follows:

- Mrs. Sarah Pentsil, the Scientific Secretary, was re-assigned to the position of Research Scientist and attached to Forest Products Trade and Marketing Division, effective 1<sup>st</sup> June, 2012.
- Mrs. Stella B. Acquah, a Computer Programmer, was re-designated as a Research Scientist (Biometrics), effective 1<sup>st</sup> June, 2012.

There was in addition, an inter-Institute transfer from CSIR-SARI to CSIR-FORIG Savanna Research Centre in Bolga.

## 5.8 Retirements

Eight (8) members of staff (One senior member, one senior staff and six junior staff) retired from the service of the Council in the year 2012. They were rewarded for their invaluable contributions to the Council during an Annual-Get-Together Ceremony in December, 2012.

## 5.9 Bereavement

The Institute lost three members of staff during the period under review. They are:

1. Dr. Ebenezer Owusu Sekyere, Principal Research Scientist
2. Mr. Kennedy Kwasi Asamoah, Librarian
3. Ms. Patience Nsiah-Nimoh, Senior Technical Assistant

## 5.10 Human Resource

One major asset of CSIR-FORIG is the number of highly qualified staff in all the Divisions. The names of Senior Members and Senior Staff in each of the nine (9) Divisions are as follows:

### 5.10.1 List of Senior Members

Administration Division	
Victor K. Agyeman	B.Sc. Nat. Res. Mgt., MPhil Silviculture, PhD Forest Ecology, LLB, QC (BL), <i>Chief Research Scientist, Director</i>
F. Osei-Amofah	B.A. Secretaryship, Dip. Ed., Postgraduate Dip. Mgt. Studies, <i>Administrative Officer, Head of Administration Div.</i>
Comfort Konto (Ms.)	Dip. Education, B.A. (Hons) Economics, MBA Strat. & Consultancy Mgt., <i>Administrative Officer</i>
Georgia Coffie (Mrs.)	B. Ed. Secretarial & Mgt., MSc E-Comm. & Marketing, <i>Administrative Officer</i>
Forests, Livelihoods and Governance Division	
Emmanuel Marfo	BSc. Nat. Res. Mgt., MSc. Tropical Forestry, PhD Environmental Science, <i>Senior Research Scientist, Head of Division</i>
Dominic Blay Jr.**	BSc. Botany, MSc. Forest Resources Mgt. , PhD Forest Ecology, <i>Principal Research Scientist</i>
Eric E. Nutakor	B.A. Social Science, MPhil. Silv. & Forest Mgt., <i>Research Scientist</i>
Elizabeth Obeng (Mrs.)	BSc. Agric, MSc. Sustainable Res. Mgt., <i>Research Scientist</i>
William Dumenu	BSc. Nat. Res. Mgt., MSc. Forest Ecol. and Mgt., <i>Research Scientist</i>
Forests and Wildlife Management Division	
Theresa Peprah (Mrs.)	BSc. Nat. Res. Mgt., MPhil. Tree Improvement, <i>Senior Research Scientist</i> <b>Head of Division</b>
Stephen Adu-Bredu	BSc. Nat. Res. Mgt., MSc. Silv. Mgt., PhD Silv. Mgt./Ecophysiology, <i>Principal Research Scientist</i> <b>Deputy Director</b>
Mary M. Apetorgbor (Mrs.)	BSc. (Hons) Botany, PhD Plant Pathology/ Mycology, <i>Principal Research Scientist</i>
Emmanuel Opuni-Frimpong	BSc. Nat. Res. Mgt., MPhil. Silv. Mgt., PhD Forest Entomology, <i>Senior Research Scientist</i>

Bright O. Kankam	BSc. Nat. Res. Mgt., MPhil. Wildlife and Range Mgt., PhD Primatology, <i>Research Scientist</i>
Kwame Antwi Oduro <sup>△△</sup>	BSc. (Hons) Nat. Res. Mgt., MSc. Forestry and its relation to Land Use, <i>Research Scientist</i>
Akwasi Duah Gyamfi <sup>△△</sup>	BSc. Nat. Res. Mgt., MPhil. Ecology & Mgt., <i>Research Scientist</i>
John K. Mensah	BSc. Botany, MSc. Plant Pathology, <i>Research Scientist</i>
Caleb Ofori Boateng	B.Sc. Nat. Res. Mgt., PhD Wildlife & Range Management, <i>Research Scientist</i>
<b>Forest Industry Development Division</b>	
Francis W. Owusu	BSc. Agric Engineering, MPhil. Wood Technology, <i>Research Scientist</i> , <b>Head of Division</b>
Joseph Ofori <sup>**</sup>	BSc. Chemical Tech., MSc & DIC Timber Tech., PhD Wood Technology, <i>Chief Research Scientist</i>
Daniel Sekyere <sup>**</sup>	BSc. Chemistry, MSc. Chemistry, PhD Pulp & Paper Tech., <i>Principal Research Scientist</i>
Charles Essien	BSc. Nat. Res. Mgt., MPhil Wood Technology, <i>Research Scientist</i>
Stephen Tekpetey Lartey	BSc. Nat. Res. Mgt, PhD Wood Science, <i>Research Scientist</i> , <b>Head of Division</b>
Emmanuel Appiah-Kubi	BSc. Civil Engineering, MPhil. Civil Engineering, <i>Research Scientist</i>
<b>Forest Products Trade and Marketing Division</b>	
Lawrence Damnyag	BA. Economics, MPhil. Economics, PhD Forest Economics, <i>Senior Research Scientist</i> , <b>Head of Division</b>
Andrew Oteng Amoako <sup>**</sup>	BSc. Wood Technology, MSc. Wood Science, PhD Wood Products & Eng., <i>Chief Research Scientist</i>
Emmanuel Ebanyenle	BSc. Nat. Res. Mgt., MPhil. Wood Science, PhD Forest Science, <i>Senior Research Scientist</i>
Beatrice Darko-Obiri (Mrs.)	BSc. Agric, MSc. Agroforestry, PhD Agroforestry, <i>Senior Research Scientist</i>



Sarah Pentsil (Mrs.)	BSc. (Hons) Nat. Res. Mgt., MSc. Dev. Policy & Planning, <i>Research Scientist</i> <b>Transferred to Forest Product Trade &amp; Marketing</b>
Samar B. Sparkler <sup>△△</sup>	BA. Arts (Econs. & Geog.), MA. Geog. & Rural Dev., <i>Research Scientist</i>
<b>Ecosystem Services and Climate Change Division</b>	
Ernest G. Foli	BSc. Nat. Res. Mgt., MPhil Forest Men./ Inventory, PhD Silv. & Mgt., <i>Senior Research Scientist</i> , <b>Head of Division</b>
Paul P. Bosu	BSc. Biological Science, MPhil. Biological Science, PhD Forest Entomology, <i>Senior Research Scientist</i>
Joseph Cobbinah <sup>**</sup>	BSc. Biological Science, PhD Forest Entomology, <i>Chief Research Scientist</i>
Stephen E. Akpalu	BSc. Agric, MPhil. Env. Science, <i>Research Scientist</i>
Gloria D. Djagbletey (Mrs.) <sup>△△</sup>	BSc. Nat. Res. Mgt., MPhil Silv. & Forest Mgt., <i>Research Scientist</i>
George K. Ametsitsi <sup>△△</sup>	BSc. Nat. Res. Mgt., MSc. Env. Res. Mgt., <i>Research Scientist</i>
Daniel Shalom Addo-Danso <sup>△△</sup>	BSc. Nat. Res. Mgt., MSc Forest Ecol. and Mgt., <i>Research Scientist</i>
Gloria Kukuriye Adeyiga	B.Sc. Natural Policy & Legislation, M.Sc. GIS & Remote Sensing, M.Phil. Tree Physiology <i>Research Scientist</i>
<b>Biodiversity and Land-Use Division</b>	
Luke C.N. Anglaaere	BSc. Nat. Res. Mgt., MSc. Silv. & Forest Biology, PhD Agroforestry, <i>Senior Research Scientist</i> <b>Head of Division</b>
Daniel A. Ofori <sup>*</sup>	BSc. Agric, MPhil. Tree Improvement, PhD Molecular Biology, <i>Chief Research Scientist</i>
Joseph Asomaning	BSc. Agric, MSc. Seed Technology, PhD Seed Science and Technology, <i>Senior Research Scientist</i>
K. Owusu-Afriyie	BSc. Nat. Res. Mgt., MSc. Forest Mgt., PhD Plant Science, <i>Research Scientist</i>
Lucy Amissah (Mrs.) <sup>△△</sup>	BSc. Nat. Res. Mgt., MPhil. Silv. & Forest Mgt., <i>Research Scientist</i>

Francis Dwomoh <sup>△△</sup>	BSc. Nat. Res. Mgt., MSc. GIS & Earth Obs. <i>Research Scientist</i>
William K. N. Bandoh <sup>△</sup>	BSc. Nat. Res. Mgt., <i>Asst. Research Scientist</i>
<b>Commercialization and Information Division</b>	
Margaret Sraku-Lartey (Mrs.) <sup>△△</sup>	BA. Social Science, Post. Grad. Dip. Lib. Studies, MA. Industrial Mgt., <i>Principal Librarian</i> <b>Head of Division</b>
Stella Britwum Acquah (Mrs.) <sup>△</sup>	BSc. Computer Science, MBA. Mgt. Info. <i>Systems Research Scientist</i>
Darimani Bukari	BA. Publishing, Studies, MPhil. Art and Culture, <i>Information Officer</i>
Naomi Appiah (Mrs.)	BA. Publishing Studies, MBA Marketing, <i>Marketing Officer</i>
<b>Finance Division</b>	
Francis Kumah	BA. (Hons) Accounting & Econs., <i>Asst.</i> <i>Accountant</i> <b>Head of Division</b>
Osei Yaw Agyei	BSc., MBA, ACCA <i>Accountant</i>
K. Agyeman Prempeh	ICA, <i>Accountant</i>

\*Sabbatical Leave

\*\*Post Retirement Contract

△△PhD Student

△MSc/MPhil Student

### 5.10.2 List of Senior Staff

Name	Rank
Emmanuel Zagblenku	Chief Technical Officer
John Agbozo	Chief Technical Officer
Bridgette Brentuo	Chief Technical Officer
Leticia Asamoah	Chief Technical Officer
Michael Mensah	Chief Technical Officer
Prempeh Bandoh	Chief Technical Officer
Godson K. Zorve	Chief Technical Officer
Paul Kankam	Chief Technical Officer
Maud M. Prempeh	Chief Technical Officer
Samuel A. Kyei	Chief Technical Officer

Name	Rank
Asiamah Yeboah Konadu	Chief Administrative Assistant
C.C. Acheampong	Chief Accounting Assistant
J.J. Mensah	Chief Accounting Assistant
Mavis Serwah Kwarteng	Chief Accounting Assistant
Evelyn Owusu Agyeman	Chief Accounting Assistant
John Sackey	Chief Works Superintendent
Paul Adusei	Chief Works Superintendent (Traffic)
Samuel Appiah	Chief Works Superintendent (Traffic)
Albert Nyeha	Principal Technical Officer
Peter L. Arthur	Principal Technical Officer
Philip T. Boampong	Principal Technical Officer
Sarfo Kwame Bonsu	Principal Technical Officer
Jacqueline Twintoh	Principal Technical Officer
Frank Baffour Asuming	Principal Technical Officer
Elizabeth Ampah	Principal Technical Officer
Richard Adjei	Principal Technical Officer
Emmanuel Sarpong	Library Assistant
Awurama Andoh	Principal Administrative Assistant
Anastasia Duah-Gyamfi	Principal Administrative Assistant
Margaret Adugbire	Principal Administrative Assistant
Ernest Osei Boakye	Principal Technical Officer
Eric Frimpong	Principal Technical Officer
Kwaku Asumadu	Principal Technical Officer
Jemima Owusu	Principal Technical Officer
Daniel Debrah	Principal Technical Officer
Osei Tutu Boateng	Principal Technical Officer
Dorothy Asare Akoto	Principal Technical Officer
Akwasi Baah Acheamfour	Principal Technical Officer
Govina J. Kudjo	Principal Technical Officer
Samuel Atusong	Principal Accounting Assistant
Isaac Boahen	Principal Accounting Assistant
Francis Asare Abetia	Principal Administrative Assistant

Name	Rank
Jane Nketiah	Principal Administrative Assistant
Ebenezer Frans Mensah	Senior Technical Officer
Michael Ampah	Senior Technical Officer
Daniel Peprah	Senior Technical Officer
Jonathan Dabo	Senior Technical Officer
Emmanuel Manu	Senior Technical Officer
Sandra Owusu	Senior Technical Officer
Ezuame Constant	Senior Technical Officer
Samuel Larbi	Senior Administrative Assistant
Rebecca Okyere Drako	Senior Stores Superintendent
Wendy O. Amankwa	Senior Accounting Assistant
Elvis Nkrumah	Senior Technical Officer
George K. Nyantakyi	Senior Security Officer
Osei Boateng	Senior Security Officer
Anthony Boateng	Senior Asst. Transport Officer
Gabriel Lumor	Technical Officer
Mark Debrah Marfo	Technical Officer
Sylvester Kuudaar	Technical Officer
Daniel Damte	Draughtsman
Isaac Donkor	Administrative Assistant
Kester Mensah	Administrative Assistant
Joseph Sebuka Kwaku	Administrative Assistant
Akwasi Bempah Owusu	Accounting Assistant
Michael Atitsugbui	Security Officer
Agnes Mantey	Superintendent Telephonist
Mohammed Awal Issa	Assistant Transport Officer
Jackson Nti	Assistant Transport Officer
Thomas Avarison	Assistant Transport Officer
Sampson Adonteng	Assistant Transport Officer

## 6.0 FINANCE DIVISION

Objectives of the Division are to:

1. Provide suitable financial information to management for the daily management of the Units of the Institute;
2. Assist in short and long-term planning;
3. Help establish internal control measures to safeguard assets of the Institute and ensure the completeness, accuracy and reliability of financial records.

**Table 6.1:** Financial summary for 2012

<b>Government of Ghana</b>	<b>Inflows (GH¢)</b>	<b>Outflows (GH¢)</b>	<b>Variance (GH¢)</b>
Personnel Emoluments (Note 1)	5,847,042	5,102,610	744,432
Administrative Expenditure (Note 2)	184,078	5,882,773	(5,698,695)
Service Expenditure (Note 3)	–	71,963	(71,963)
Internally Generated Funds	183,780	142,950	40,829
Guest Houses	67,597	20,508	47,089
Production Unit	22,796	35,256	(12,460)
<b>Total</b>	<b>6,305,293</b>	<b>11,256,060</b>	<b>(4,950,767)</b>
Donor (Note 4)	3,249,446	2,426,570	822,876

Note 1: Personnel emoluments figure (GH¢1,090,268) includes all grants that were supposed to have been received in 2012. It also includes 18% salary adjustment which was expected in 2012.

Note 2: Administrative grant which accrued was paid by the government in 2013.

Note 3: Service expenditure was financed from IGF and accumulated resources.

Note 4: Donor funds were received in Dollars, Euros, Pounds and Ghana Cedi. The following average exchange rates were used; USD/GH¢=1.7960, £/GH¢=2.9279 and € /GH¢=2.5670.

**Table 6.2:** Financial summary for 2013

<b>Government of Ghana</b>	<b>Inflows (GH¢)</b>	<b>Outflows (GH¢)</b>	<b>Variance (GH¢)</b>
Personnel Emoluments Note 1	1,139,326	1,879,815	(740,489)
Administrative Expenditure Note 2	9,932	495,448	(485,516)
Service Expenditure (Note 3)	–	84,156	(84,156)
Internally Generated Funds	183,925	136,590	47,335
Guest Houses	67,923	76,027	(8,104)
Production Unit	41,540	38,661	2,879
<b>Total</b>	<b>1,442,646</b>	<b>2,710,697</b>	<b>(1,268,051)</b>
Donor (Note 4)	1,905,020	1,714,518	190,502

Note 1: Personnel emoluments include releases for the month of January and February 2013 only, because all salaries were subsequently paid by the Central Government to individual accounts through Controller and Accountant General's Department.

Note 2: The administrative grant which accrued was received in 2014.

Note 3: Service expenditure was financed from IGF and accumulated resources.

Note 4: Donor funds were received in Dollars, Euros, Pounds and Ghana Cedi. The following average exchange rates were used: USD/GH¢=2.0110 and €/GH¢=2.6815.

Note 5: Financial summary for 2013 is a draft document, pending final comments from External Auditors.

## 7.0 APPENDICES

### Appendix 1

#### Books

Hawthorne, W.D., Marshall, C.A.M., Abu Juam, M. and Agyeman, V.K. 2012. The Impact of Logging Damage on Tropical Rainforests, their Recovery and Regeneration: An Annotated Bibliography. *FRP, DFID, ITTO and CSIR Publication*. 123pp.

#### Handbooks

Acquah, S.B., Pentsil, S., Appiah, N., Dumenu, W.K. and Darimani, B. 2013. *Technologies for Forest Management, Utilization and Development*. CSIR-Forestry Research Institute of Ghana, Kumasi, Ghana, ISBN 9988-7943-6-3, xi + 34pp.

Oduro, K.A., Duah-Gyamfi, A., Acquah, S.B. and Agyeman, V.K. 2012. Ghana Forest and Wildlife Handbook. Ghana Forest and Wildlife Resources 2012. A compendium of information about forest and wildlife resources, forestry-related issues and wood processing in Ghana. *Forestry Commission (FC) Publication*. 88pp.

#### Book Chapters

Apetorgbor, M.M., Apetorgbor, A.K. and Obodai, M. 2012. Mushrooms and their nutritional and medicinal values. In: K. Bruce (ed.). *Farm Magazine*. Maiden Edition, Accra, Ghana. Pp 5-6.

Dumenu, K.W., Obeng, E.A., Samar, S.B., Owusu-Sekyere, E. and Asiedu-Opoku, E. 2013. Understanding the Dynamics of Climate Change Impacts on Forest-Dependent Livelihoods in Rural Ghana: Implications for Climate Change Resilient Policy. In: W. Leal Filho (editor). *Climate Change and Disaster Risk Management* pp 411-424. DOI: 10.1007/978-3-642-31110-9\_27. © Springer-Verlag Berlin Heidelberg.

#### Journal Papers

Adum, G.B., Eichhorn, M., Oduro, W., Ofori-Boateng, C. and Rödel, M.O. 2012. Two-stage recovery of amphibian assemblages following selective logging of tropical forest. *Conservation biology* DOI: 10.1111/cobi.12006

Adusei-Poku, K., Oduro, W., Opong, S.K., Ofori-Boateng, C., Larsen, T. and Molleman, F. 2012. Spatial and temporal variation in butterfly biodiversity in a West-African Forest; Lessons for establishing Efficient Rapid Monitoring Programmes. *African Journal of Ecology* 50: 326–334.

Appiah, N., Agyapong, A. and Asamoah, K. 2012. Effect of commercialisation policy on the performance of CSIR-Forestry Research Institute of Ghana. *Ghana Journal of Forestry* 28(1): 51–63.

- Appiah-Kubi, E., Kankam, C.K. and Adom-Asamoah, M.** 2012. Bending and Modulus of Elasticity properties of ten lesser used Ghanaian timber species using structural size dimensions. *Ghana Journal of Forestry*. Vol. 28 (1), 2012. pp 15-28.
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- Appiah-Kubi, E. and Tekpetey, S.L.** 2013. The contribution of Wood and Wood Industries to sustainable development in Ghana. Book of Abstracts. World Wood Day Symposium. Organized by the International Wood Culture Society (IWCS) and the Government of Tanzania. 17 – 23 March 2013. Dar es Salaam, Tanzania. pp. 16
- Appiah-Kubi, E., Tekpetey, S.L, Owusu, F.W. and Appiah, J.K.** 2012. Timber trade in Ghana: Export trends and barriers to local patronage of lumber from sawmills. Paper accepted for oral presentation at the IUFRO-FORNESSA Conference, Nairobi, Kenya. June 2012.
- Appiah-Kubi, E., Adom-Asamoah, M. and Brunner, M.** 2012. The bending strength properties of ten lesser used timber species in Ghana. Paper accepted for oral presentation at the 66<sup>th</sup> Forest Products Society Convention.
- Apetorgbor, M.M. and Apetorgbor, A.K.** 2013. Diversity of macrofungi and plant species in two different ecological zones in Ghana. 3<sup>rd</sup> International Congress on Fungal Conservation, Book of Abstracts. 11-15 November, 2013, Mugla, Turkey.
- Apetorgbor, M.M., Bosu, P.P., Nkrumah, E. and Roux, J.** 2013. Plantation forestry diseases in Ghana: Causes and management strategies. Biosecurity, Food Safety and Plant Pathology. Acta Phytopathologia Sinica 43 No 2013 Supplement. 10<sup>th</sup> International Congress of Plant Pathology, ICPP 2013. Book of Abstracts. August 25-30, Beijing China.
- Asomaning, J.M., Peprah, T. and Ofori, D.A.** 2012. Accelerated Ageing Test to Compare Vigour of seed harvested from thirty-two plus trees of *Nauclea diderichii* (de Wild.) Merr in Ghana. FORNESSA-IUFRO conference held at ICRAF, Nairobi, Kenya. 25-30<sup>th</sup> June 2012.
- Britwum-Acquah, S. and Cobbinah, J.R.** 2012. Fostering the research agenda on Plant Resources of Tropical Africa, First IUFRO-FORNESSA Regional Congress, 25-29 June 2012 Nairobi, Kenya
- Bosu P.P., Obiri, D.B., Cobbinah, J.R., Stephens, S.S. and Wagner, M.R.** 2012. Alternative mixed plantations for sustainable production of native timber species and conservation of biodiversity in the humid tropics of Africa. Paper presented at IUFRO-FORNESSA Congress, 25-29<sup>th</sup> June 2012 Nairobi, Kenya

- Bosu, P.P. and Apetorgbor, M.M.** 2012. Invasion of paper mulberry (*Broussonetia papyrifera*): Its distribution, impact and potential control strategies. IUFRO-FORNESSA Regional Congress, 25-29 June 2012, Nairobi, Kenya. Page 64.
- Cobbinah, J.R. and Acquah, S.B.** 2012. Knowledge Synthesis: Unlocking the Potentials of Tropical Africa Plants. In: *Book of abstracts, Forest and Trees: Serving the People of Africa and the World*, IUFRO-FORNESSA Regional Congress & ITTO/AFF Forest Policy Day, 25–29 June 2012, Nairobi, Kenya, p.233
- Djagbletey, G.D., Adu-Bredu, S. and Amponsah-Manu, E.** 2012. Vegetation Carbon Stock Recovery after Selective Logging in a Moist Semi-Deciduous Forest in Ghana. *IUFRO-FORNESSA CONGRESS – June, 2012*, Nairobi-Kenya.
- Djagbletey, G.D., Bosu, P.P., Foli, E.G., Ametsitsi, G.K., Addo-Danso, S., Cobbinah, J.R., Bandoh, P. and Nkrumah, E.** 2012. Assessment of coping and adaptation strategies to the effects of climate change in Offinso North and South Districts of Ashanti, Ghana. IUFRO-FORNESSA Regional Congress, 25-29 June 2012, Nairobi, Kenya. Page 54.
- Dumenu, W.K.** 2012. Rethinking Benefit Sharing for Sustainability of Ghana's off-reserve timber resources. IUFRO/FORNESSA Conference: Forest and Trees: Serving the People of Africa. 25-29 June, 2012. Nairobi, Kenya.
- Djagbletey, G.D., Bosu, P.P., Addo-Danso, S., Ametsitsi, G.K., Foli, E.G., Duah-Gyamfi, K., Nkrumah, E., Bandoh, P., Amponsah-Manu, E., Dabo, J. and Cobbinah, J.R.** 2012. Biodiversity and ecosystem services from the Tano Sacred Grove in Ghana. Paper presented at the 11<sup>th</sup> CTWF International Workshop on "Terrestrial Ecosystems under the changing climate". Beijing, China. 02 – 05 September, 2012.
- Ebanyenle, E.** 2012. Ghana's tropical forest. Oral presentation for Fall 2012 Forest ecology students, School of forest resources and environmental science (SFRES), Michigan Technological University, Houghton, MI. 11 – 13<sup>th</sup> December, 2012 (invited).
- Ebanyenle, E., Burton A.J., Storer, A.J. and Yeboah, D.** 2012. Effects of elevated CO<sub>2</sub> and O<sub>3</sub> on wood density and decomposition of aspen clones and paper birch. Poster and published abstract, 8th Annual ESC/BRC Student Research Forum, SFRES, Michigan Technological University, Houghton, MI, 30/3/12.
- Foli, E.G. and Addo-Danso, S.D.** 2012. Enhancing adaptation of forests and people in Africa to climate change: Development of a pilot case for a selected forest ecosystem in Ghana. Presented at the 1<sup>st</sup> IUFRO-FORNESSA Regional Congress. ICRAF Headquarters, Nairobi, Kenya. 25 – 30 June 2012.
- Foli, E.G. and Addo-Danso, S.D.** 2012. Capacity needs assessment and development of a capacity building plan for REDD+ implementation in Ghana. Invited paper presented at the FCPF REDD+ Readiness Preparation Launch Workshop. Alisa Hotel, Accra. 26 April 2012.
- Nyarko-Duah, N.Y., Opuni-Frimpong, E., Belford, E.J.D. and Storer, A.J.** 2012. The effect of mixed-tree species stands on *Hypsipyla robusta* attacks and growth of African mahogany in a wet forest. IUFRO – FORNESSA Regional congress. Nairobi – Kenya, 25<sup>th</sup> – 29<sup>th</sup> June, 2012. Book of Abstracts. Pp 34.



- Nyarko-Duah, N.Y., Opuni-Frimpong E., Belford E.J.D. and Storer, A.J.** 2012. The presence of weaver ants (*Oecophylla longinoda*) in mixed-tree species stands on *Hypsipyla robusta* attack and growth of African mahogany. IUFRO – FORNESSA Regional congress. Nairobi – Kenya, 25th – 29th June, 2012. Book of Abstracts. Pp 14.
- Opuni-Frimpong, E. and Kwarkye, G.A.** 2012. Variation in growth and response to *Hypsipyla* of 19 families of *Khaya grandifoliola* in 3 ecological zones of Ghana. IUFRO – FORNESSA Regional congress. Nairobi – Kenya, 25th – 29th June, 2012. Book of Abstracts. Pp 9
- Opuni-Frimpong, E., Opoku, S.M. and Storer, A.J.** 2012. Growth and Productivity of *Khaya grandifoliola* in the Dry Semideciduous forest of Ghana: A comparison in pure stands and in mixed stands. IUFRO – FORNESSA Regional congress. Nairobi – Kenya, 25th – 29th June, 2012. Book of Abstracts. Pp 197
- Ofori-Boateng, C., Oduro, W. & Rödel, M.O.** 2012. “Differential response of amphibian communities logging effects in three forest types of Ghana”.World Herpetology Congress. West road concert hall, University of British Columbia, Canada, 10<sup>th</sup> November 2012 Oral presentation.
- Obiri, D.B., Yeboah, E. and Mcdonagh, J.** 2012. Biochar for improved livelihoods and climate change mitigation: Farmer perceptions and experiences from the Interior Savanna Zone of Ghana. Paper presented at PISCES JOINT IMPLEMENTATION GROUP and IFPRI BIOCHAR WORKSHOP. 12-14 November 2012. Golden Tulip, Kumasi.
- Opuni-Frimpong, E., Nyarko-Duah, N.Y., Kwarkye, G.A. and Storer, A.J.** 2012. Incidence of *Hypsipyla robusta* (Moore) on native mahogany trees: a challenge for sustainable supply and conservation of mahogany resources. IUFRO – FORNESSA Regional congress. Nairobi – Kenya, 25th – 29th June, 2012. Book of Abstracts. Pp 206
- Obiri, D.B.** 2012. Building forest assets for income and ecosystem sustainability: Experiences from ITTO community/smallholder forestry projects in Ghana. A paper prepared for FAO/ITTO/RECOFTC meeting 26-28 March 2012. FAO, ROME
- Obiri, D.B., E. Marfo, E. Nutakor, J. Cobbinah and Treue, T.** 2012. Tenure and Forest Reliance in Ghana. Paper presented at IUFRO-FORNESSA Congress, Nairobi, Kenya 25-29<sup>th</sup> June 2012 Nairobi, Kenya
- Owusu, F.W., Tekpetey, S.L., Essien, C., Appiah-Kubi, E. and Appiah, J.K.** 2012. Technological properties of bamboo species for housing in Ghana. Research results presented at a Stakeholders workshop on the implementation of the action plan on the use of local raw materials in the building and construction industry in Ghana. Workshop held at Volta Hotel, Akosombo organized by MEST from 28<sup>th</sup> to 30<sup>th</sup> November 2012.
- Owusu, F.W., Tekpetey, S.L., Essien, C., Appiah-Kubi, E. and Appiah, J.K.** 2012. Technological properties of bamboo species for housing in Ghana. Research results presented at a Stakeholders workshop on the implementation of the action plan on the use of local raw materials in the building and construction industry in Ghana. Workshop held at Volta Hotel, Akosombo organized by MEST from 28<sup>th</sup> to 30<sup>th</sup> November 2012.

- Peprah, T., Ofori, D.A., Agyeman, V.K., Jamnadass, R. and Simons, A.J.** 2012. Status of *Allanblackia parviflora* Domestication in Ghana. Paper presented at AB National Forum on 15<sup>th</sup> November 2012. Coconut Grove, Accra
- Tekpetey, S.L., Opuni-Frimpong, E., Appiah-Kubi, E. and Essien, C.** 2013. Plantation Grown Mahogany in Ghana: Are they inferior to naturally grown ones? Book of abstracts of the 67<sup>th</sup> Forest Product Society international Convention and Society of Wood Science and Technology 56<sup>th</sup> International Convention. June 9-11, 2013, Austin Texas, USA.
- Tekpetey, S.L., Owusu, F.W. and Appiah-Kubi, E.** 2012. The recovery rate and lumber quality of two lesser-utilized timber species (LUS) in Ghana: Essential Technical Measures to promote LUS. A paper presented at IUFRO Congress 2012 in IUFRO DIVISION 5 – FOREST PRODUCTS”. Portugal.
- Tekpetey, S.L. and Appiah-Kubi, E.** 2012. The role of Wood in Ghanaian Economy: Past and Present Performance. Division 5 – forest products” Lisbon, Portugal
- Tekpetey, S.L. and Frimpong-Mensah, K.** 2012. Innovative Processing and Utilization of Bamboo Resources in Ghana in a Climatic Threatened Environment: The Technical Issues. IUFRO-FORNESSA, Nairobi, Kenya
- Sraku-Lartey, M.** Bridging the gap between unemployment and self employment while applying common business planning ethics. Paper presented at the conference ‘Stepping out: the 21<sup>st</sup> century graduate’ held at the Presbyterian University College, 15-03 – 2013.

### Policy Brief

- Beeko, C., Oduro, K.A. and Obeng, E.A.** 2012. The impact of development assistance. Policy Brief. Growing Forest Partnership.
- Foli, E.G., Dumenu, W.K. and Damnyag, L.** 2012. Developing Equitable and Effective Benefit Sharing Mechanisms for REDD-Plus Implementation in Ghana: A Brief for Policy and Decision Makers. IUCN.

### Brochure

- Sools, R., Tollenaar, M. and Anglaere, L.C.N.** 2012. Best Practice for Planting *Allanblackia*. A Brochure produced for community AB planting.

### Fellowship

- Apetorgbor, M.M.** 2013-2014: Selected by the Steering Committee of the African Women in Agricultural Research and Development (AWARD) for a two-year AWARD Fellowship to strengthen Leadership and Science skills. World Agroforestry Centre, Nairobi, Kenya

### Posters

- Apetorgbor, M.M., Mensah, J.K. and Dabo, J.** 2012. Diversity of mycorrhizal associations in a protected forest: A case study of the Bobiri forest reserve of Ghana. Forest and

trees: Serving the people of the world. IUFRO-FORNESSA Regional Congress and ITTO/AFF Forest Policy Day. Book of Abstracts. Poster. Nairobi, Kenya. 25<sup>th</sup>-29<sup>th</sup> June, 2012. p291

**Apetorgbor, M.M. and Apetorgbor, A.K.** 2012. Growing oil palm mushrooms (Domo) on roots and tuber wastes. West Africa Agricultural Productivity Programme (WAAPP)-Ghana. Regional Root and Tuber Crops Workshop. CSIR-Crops Research Institute, Fumesua, Kumasi. 19<sup>th</sup> to 23<sup>rd</sup> November, 2012. Poster.

**Apetorgbor, M.M., Mensah, J. and Dabo, J.** 2012. Diversity of mycorrhizal associations in the Bobiri Forest Reserve of Ghana. Forest and trees: Serving the people of the world. IUFRO-FORNESSA Regional Congress and ITTO/AFF Forest Policy Day. Book of Abstracts. Poster. Nairobi, Kenya. 25<sup>th</sup>-29<sup>th</sup> June, 2012. p291.

**Foli, E.G., Makungwa, S., Addo-Danso, S.D. and Kleine, M.** 2012. Development of strategies for the adaptation of people to climate change: Case studies in selected forest ecosystems in Ghana and Malawi. Poster presented at the 2012 International Conference on Climate Adaptation, Tucson, Arizona, USA. 29 – 31 May 2012.

**Owusu, F.W., Appiah, J.K., Essien, C., Brentuo, B. and Foli, E.G.** 2012. Wood Machining properties of some timber species from Afram Arm of the Volta Lake. A poster presentation made at the 17<sup>th</sup> Colloquium of Faculty of Science, University of Ghana. Theme: “Reaching for Greater Heights in Science and Technology for National Development”. Held at Legon, Accra from 21<sup>st</sup> – 23<sup>rd</sup> March 2012.

**Tekpetey, S.L., Adu, S., Campbell, F.O. and Adu, G.** 2013. Mechanical Strength properties of *Bambusa vulgaris* and *Bambusa vulgaris var. vittata* for enhanced Utilization. Poster presentation at the 67<sup>th</sup> Forest Product Society international Convention and Society of Wood Science and Technology 56<sup>th</sup> International Convention. June 9-11, 2013, Austin Texas, USA.

## Consultancy and Technical Reports

**Acheampong, E., Marfo, E. and Antwi-Danso, S.** 2013. Climate change mitigation activities as alternative livelihood for chainsaw dependent communities in Ghana: Preferences of chainsaw milling operatives.

**Adu-Bredu, S. and Foli, E.G.** 2013. Report on Mapping of Forest Cover and Carbon Stock in Ghana (Mapping Consultant's Services, the Forest Preservation Programme, Under a Japanese Grant Aid to the Republic of Ghana). Executed by PASCO CORPORATION, Japan in Collaboration with FC-RMSC, CSIR-FORIG and CSIR-SRI, Ghana. (Crown Agents' Reference No.: GHF09/11498/01) Pp 221. (Role; Adu-Bredu, S. and Foli, E. G.: Forest inventory methodology, supervision of inventory survey, tree destructive sampling, physical analysis of samples and allometric modeling

**Alder, D. and Foli, E.G.** 2012. Re-forestation in the Afram Plains: Species Selection, Timber Yields and Carbon Sequestration. A Consultancy report prepared under contract for Forest Trends, Washington, DC, in collaboration with Denis Alder Consulting, Ltd. Oxford, UK. February 2012. 36 pp.

**Anglaaere, L.C.N., Blay, D., Damnyag, L., Dabo, J., Owusu, S. and Manu, E.A.** 2012. Allanblackia: Standard setting and sustainable supply chain management – Phase II.

End of Year 2 Technical Report submitted to IUCN and SECO (Swiss Cooperation for International Development), January 2012.

**Appiah, N.** 2012 Commercial/Marketing Plan for CSIR-Forestry Research Institute of Ghana (2012).

**Apetorgbor, M.M. and Apetorgbor, A.K.** 2012. Comparative studies on yield of *Volvariella volvacea*, *Pleurotus tuber-regium* and *Auricularia auricula-judae* using root and tuber wastes for improved livelihood of rural communities in the Tano North District of the Brong Ahafo Region of Ghana. Final Progress Report submitted to CSIR/WAAP NCRG 009. May, 2010-May, 2012.

**Bosu, P., Appiah, N. and Marfo, E.** 2013. Assessment of baseline indicators: addressing illegal chainsaw milling through multi-stakeholder dialogue process in Ghana.

**Bosu, P.P., Appiah, N. and Marfo, E.** 2013. Developing Alternatives for Illegal Chainsaw Lumbering through Multi-Stakeholder Dialogue in Ghana and Guyana: Assessment of Baseline Indicators. Report Submitted to Tropenbos International. Eu-Chainsaw Project. 38 Pages.

**Darko-Obiri, B., Marfo, E., Agyemang, V.K., Owusu, F.W., Obeng, E., Britwum, A.S., Atta, A., Amankwah, G., Coleman, H., Zormelo, P., Haziell, K. and Frimpong-Mensah, K.** 2012. Ghana timber industry value-added processing study. A report submitted to FC-TIDD on the project Commissioned under the National Resource and Governance Programme, Forestry Commission and undertaken by FC-TIDD and CSIR-FORIG, April 2012. Consultancy services to Forestry Commission. 130pp.

**Isaac, M.E. and Anglaaere, L.C.N.** 2012. The effects of environmental change and migration on the socio-spatial dynamics of agrarian information networks in Ghana. A paper presented at a Conference for the International Network for Social Network Analysis, Sunbelt, Los Angeles, USA, March, 2012.

**Isaac, M.E. and Anglaaere, L.C.N.** 2012. Agrarian resilience in a changing climate. A Report submitted to the Canada-Africa Research Exchange Programme (CAREG) of the International Development Research Centre (IDRC) of Canada. March 2012.

**Kankam, B.O., Boateng, C.O. and Agyeman, V.** 2012. Akyem Gold Mining project at Ajenjua Bepo Forest Reserve: Wildlife Survey, Capture and Translocation of Key Wildlife Species (*prior to Forest Clearance phase*). Submitted to Newmont Golden Mining Company-Akyem, Ghana.

**Kankam, B.O., Boateng, C.O. and Agyeman, V.** 2012. Akyem Gold Mining project at Ajenjua Bepo Forest Reserve: Wildlife Survey, Capture and Translocation of Key Wildlife Species (*Forest Clearance phase*). Submitted to Newmont Golden Mining Company-Akyem, Ghana.

**Kankam, B.O., Boateng, C.O. and Agyeman, V.** 2012. Akyem Gold Mining project at Ajenjua Bepo Forest Reserve: Wildlife Monitoring Plan. Submitted to Newmont Golden Mining Company-Akyem, Ghana.

**Kankam, B.O., Boateng, C.O. and Agyeman, V.** 2012. Akyem Gold Mining project at Ajenjua Bepo Forest Reserve: Wildlife Management Guideline. Submitted to Newmont Golden Mining Company-Akyem, Ghana.

- Kathuku, A., Muriuki, J. Bosu, P., Dulla, H. and Mowo, J.** 2012. The extent of adoption of conservation agriculture with trees (CAWT) by smallholder farmers in Ghana. ICRAF Project report submitted to SIDA, Sweden. 24 pages.
- Marfo, E., Danso, E. and Nketiah, S.K.** 2013. Analysis of linkages and opportunities for synergies between FLEGT, REDD and national forest programme in Ghana. Wageningen, the Netherlands: Tropenbos International Ghana.
- Nutakor, E., Samar, B.S., Marfo, E. & Oduro, K.** 2013. Barriers to sustainability of alternative livelihood interventions.
- Owusu, F.W., Tekpetey, S.L., Essien, C., Appiah-Kubi, E. and Appiah, J.K.** 2012. Technological properties of some selected bamboo species grown in Ghana for housing. Draft technical report for submission to MESTI.
- Owusu-Afriyie, K., E.G. Foli, V.K. Agyeman, G.K.D. Ametsitsi, A. Duah-Gyamfi, S. Addo-Danso, E. Nutakor, B. Darko-Obiri, S. Adu-Bredu, S.B. Acquah, S. Akpalu, G.D. Djabbletey, J.K Mensah, E.A. Obeng, C.D. Konto & Pentsil, S.** 2012. Independent Technical Assessment Of The National Forest Plantation Development Programme: Final Report For The Brong Ahafo, Northern, Upper West and Upper East Regions, Submitted To The Ministry Of Lands And Natural Resources (MLNR). May, 2012.
- Ofori, D.A., Manjuga, M., Jamnadass, R., Asaah, E., Tsoberg, E., Tchoundjeu, Z., Peprah, T., Asomaning, J.M., Ofori, E., Kijazi, M. and Sesiwa, H.** Domestication of *Allanblackia* species. End of year report, 2012. 27pp.
- Obeng E.A., Marfo, E., Owusu, N. and Boateng Nantwi, G.** 2013. Developing Alternatives For Illegal Chainsaw Lumbering Through Multi-Stakeholder Dialogue: A Study Into The Effectiveness Of The Participatory Process
- Oduro, K.A.** 2012. Policy and institutional frameworks on conservation agriculture with trees in Ghana. Final Report submitted to ICRAF, May 2012. 46pp.
- Obiri, D.B., Nunoo, I., Obeng, E., Owusu, F.W. and Marfo, E.** 2013. Understanding the Charcoal Industry in Ghana and its Implication as an Alternative Livelihood Option for Displaced Illegal Chainsaw Lumber Producers.
- Owusu, F.W., Damnyag, L. and Marfo, E.** 2013. Supply of chainsaw lumber to the domestic market: A validation study report.
- Obiri, D.B., Yeboah, E., Dugan, E., Peprah, T., Obeng, E., Nutakor, E., Amevenku, F., Sarpong, D. and Acquah, B.S.** 2013. Sustainable Soil and Water Conservation and Environmental Friendly Agriculture in the Lake Bosomtwi Basin. Final Report-Phase I (FORIG/SRI/WRI/FORAW) Prepared for UNESCO – Accra Office)
- Obiri, B.D., Nunoo, I., Obeng, E.A., Owusu, F.W. and Marfo, E.** 2013. Understanding the Charcoal Industry in Ghana and its Implication as an Alternative Livelihood Option for Displaced Illegal Chainsaw Lumber Producers. Research Report. EU/TROPENBOS/FORIG/FC CHAIN SAW PROJECT
- Obeng, E.A., Owusu, N., Nantwi, G.B. and Marfo, E.** 2013. Developing alternatives for illegal chainsaw lumbering through multi-stakeholder dialogue: a study into the

effectiveness of the participatory process. Study Report. EU/TROPENBOS/FORIG/FC CHAIN SAW PROJECT

- Obiri, D.B., Yeboah, E., Peprah, T., Obeng, E.A., Nutakor, E. Acquah, S.B., Amevenku, F. and Dugan, E.** 2013. Agro socio-ecological and economic survey report. FORIG-UNESCO Sustainable soil and water conservation and environmental friendly agriculture Project. CSIR-FORIG/SRI/WRI. 35pp.
- Obiri, D.B., Dugan, E., Yeboah, E., Peprah, T., Obeng, E.A., Nutakor, E. Acquah, S.B., Amevenku, F. and Sarpong, N.D.** 2013. Sustainable soil and water conservation and environmental friendly agriculture in the Lake Bosomtwe basin. Project Final Report-Phase I. UNESCO, Ghana. (CSIR-FORIG/TR/BDO; EY;TP;EAO;ED;EN;FA;SBA/2013/71) 35pp.
- Obiri, D.B., Nunoo, I., Obeng, E.A., Owusu, F.W. and Marfo, E.** 2013. Understanding the Charcoal Industry in Ghana and its Implication as an Alternative Livelihood Option for Displaced Illegal Chainsaw Lumber Producers. Research Report. EU/TROPENBOS/FORIG/FC CHAIN SAW PROJECT. 94pp.
- Peprah, T., Asomaning-Mireku, J., Apetorgbor, M. and Ofori, E.** 2012. Propagation of *Allanblackia parviflora* in Ghana Report submitted to ICRAF
- Tekpetey, S.L. and Appiah-Kubi, E.** 2013. Bamboo as a sustainable material for the Construction Industry in Ghana. Paper presented at the 67<sup>th</sup> Forest Product Society International Convention and Society of Wood Science and Technology 56<sup>th</sup> International Convention. June 9-11, 2013, Austin Texas, USA.
- Sraku-Lartey, M., Ofori, J., Kumah, F., Angalaare, L., Kankam, B. Mireku, J. and Amofah, F.** Business Plan for FORIG 2013.
- Sraku-Lartey, M., Djabbletey, G., Pentsil, S. and Abetia, F.** 2012. Information Policy of CSIR-FORIG. CSIR-FORIG, Kumasi.

### Training Workshops Attended

- Appiah-Kubi, E.** Internship on a pre-project: “Development of building blocks made of stabilized laterite and agricultural residues as an environmentally friendly alternative to cement blocks in Ghana”. Held the Bern University of Applied Sciences (BFH-AHB), Wood and Materials Laboratory, Biel, Switzerland from July 21, 2012 – October 20, 2012
- Darimani, B.** Training Workshop for Librarians on New Cataloguing Code “Resource Description and Access” (RDA) And Related Concepts held at CSIR-INSTI, July 4-5. 2013
- Darimani, B.** Trainer-of Trainers Workshop on TEEAL/AGORA Databases, 29<sup>th</sup>-31<sup>st</sup> October, 2013, KNUST, Kumasi
- Dumenu, W.K.** Training workshop on quantification of cost of environmental degradation in Ghana. 02-10 June, 2012, Kofi Annan ICT Centre, Accra.
- Dumenu, W.K.** Information Literacy Training Workshop. INSTI, 23-30 March, 2012, Accra.
- Dumenu, W.K.** Resource Learning, INSTI, 17-18 April, 2012, Accra

- Dumenu, W.K.** Short course on Improving Forest Governance. Centre for International Development and Training, 09 June to 21 July, 2012, University of Wolverhampton, United Kingdom.
- Mensah, J.K.** Training Workshop on 'Analysis of molecular data in African timber species'. Institut De Recherche en Ecologie Tropicale, Libreville, Gabon, 25-27<sup>TH</sup> November, 2013.
- Mensah, J.K.** Training workshop for young scientists on 'proposal writing, scientific writing, report writing, project management and intellectual property'. CSIR-Crops Research Institute, Fumesua – Kumasi: 28<sup>th</sup> October-1<sup>st</sup> November, 2013.
- Mensah, J.K.** Training workshop for young scientists on 'proposal writing, scientific writing, report writing, project management and intellectual property'. CSIR-Crops Research Institute, Fumesua – Kumasi: 28<sup>th</sup> October-1<sup>st</sup> November, 2013.
- Mensah, J.K.** Training Workshop on 'Application of molecular genetic markers for timber tracking in Africa'. Kenya Forestry Research Institute, Nairobi, 11<sup>th</sup> – 17<sup>th</sup> March, 2013.
- Ofori-Boateng, C.** Zoological Society of London's EDGE Fellows Training Workshop in Applied ecology, GIS, and Data Analysis, 2<sup>nd</sup>-22<sup>nd</sup> November 2012, Mombasa, Kenya.
- Obeng, E.** Training workshop on proposal writing and research project management for selected researchers from CSIR Institutes, 28<sup>th</sup> – 1<sup>st</sup> November 2013.
- Ofori-Boateng, C.** ICCB Training workshop on open standards for project management. 18-20<sup>th</sup> July 2013. Renaissance Hotel, Inner Harbor, Baltimore, US.
- Ofori-Boateng, C.** JRS Biodiversity Informatics Training on Data Analysis. 29 July – 2 August 2013 at Kirstenbosch, Cape Town, South Africa.
- Opuni-Frimpong, E.** Training Workshop on 'Application of molecular genetic markers for timber tracking in Africa'. Kenya Forestry Research Institute, Nairobi, 11<sup>th</sup> – 17<sup>th</sup> March, 2013
- Oduro, K.A.** Basic statistics course. Wageningen University, the Netherlands. June 19 – 27 2012
- Obiri, D.B.** Certificate: Professional training in Bio-energy and climate change. Institute of Energy Systems, University of Edinburgh, Scotland, UK. September 9-October 12, 2013
- Pentsil, S.** 2012. Training programme on Innovation and Technology Management, India-Africa Technology Partnership Programme, New Delhi, India. 26-31 July 2012
- Peprah, T.** Electronic library resources train-the trainer workshop on TEEAL and AGORA Programmes for Ghana. KNUST, Ghana. 29-31<sup>st</sup> October 2013.

### Workshops/Conferences Attended

- Acquah, S.B.** *Serving the People of Africa and the World*, First IUFRO-FORNESSA Regional Congress & ITTO/AFF Forest Policy Day, 25–29 June 2012, Nairobi, Kenya. 20<sup>th</sup> July 2012

- Appiah, N.** Preparatory Workshop on “Developing Alternatives for Illegal Chainsaw Lumbering through Multi-Stakeholder Dialogue in Ghana and Guyana”. EU Chainsaw Project, Bobiri Research Centre.
- Appiah, N.** Corporate Commercialisation and Information Division (CCID) Mid-Year Review Session for all CSIR Institutes, 24 – 25 July 2012, Kasoa
- Appiah, N.** Corporate Commercialisation and Information Division (CCID) 2012 Planning Session for all CSIR Institutes, 21 – 22 November 2012, CSIR-Soil Research Institute, Kumasi
- Appiah, N.** Bobiri Butterfly Sanctuary Preparatory Workshop on “Developing Alternatives for Illegal Chainsaw Lumbering through Multi-Stakeholder Dialogue in Ghana and Guyana”. EU Chainsaw Project. 20<sup>th</sup> July 2012.
- Apetorgbor, M.M.** Launching of the Ghana Space Science and Technology Centre. GAEC-School for Nuclear and Allied Sciences. GAEC. 2<sup>nd</sup> May, 2012
- Apetorgbor, M.M.** Meeting to review Progress Reports and Work plans at Cocoa Research Institute of Ghana. 30<sup>th</sup> May to 1<sup>st</sup> June, 2012, CRIG, New Tafo-Akim
- Apetorgbor, M.M.** Ghana Science Association, 13<sup>th</sup> Biennial Workshop. ‘Towards the sustainability of Agriculture in the light of the oil find in Ghana: The way forward’ 1<sup>st</sup> August, 2012. CRIG, New Tafo-Akim
- Apetorgbor, M.M.** Launch of 2012 Greening Ghana. ‘Our Forests, Our Future’. St Monica’s Senior High School Park, Ashanti Mampong. 4<sup>th</sup> September, 2012.
- Apetorgbor, M.M.** West Africa Agricultural Productivity Programme (WAAPP) Ghana. Regional Root and Tuber Crops Workshop. CSIR-Crops Research Institute, Fumesua, Kumasi. 19<sup>th</sup> to 23<sup>rd</sup> November, 2012
- Apetorgbor, M.M.** 7<sup>th</sup> Pan-African Access and Benefit Sharing Workshop in Phalaborwa, South Africa. 25<sup>th</sup> February to 1<sup>st</sup> March, 2013.
- Apetorgbor, M.M.** AWARD Proposal Writing Skills Course in Speke Resort, Kampala, Uganda. June 26-July 02, 2013.
- Apetorgbor, M.M.** 10th International Congress of Plant Pathology, ICPP 2013, August 25-30, Beijing China.
- Apetorgbor, M.M.** AWARD Mentoring Orientation Workshop in Speke Resort & Conference Centre, Munyonyo, Kampala, Uganda. March 25-28, 2013
- Apetorgbor, M.M.** 7<sup>th</sup> Pan-African Access and Benefit Sharing Workshop in Phalaborwa, South Africa. 25<sup>th</sup> February to 1<sup>st</sup> March, 2013.
- Apetorgbor, M.M.** Validation Workshop on the AU Guidelines for the Coordinated Implementation of the Nagoya Protocol on Access and Benefit Sharing of Genetic Resources. Addis Ababa, Ethiopia. 28<sup>th</sup> to 30<sup>th</sup> October, 2013.
- Apetorgbor, M.M.** Project Technical Committee Meeting: ITTO Women’s Project PD 534-08 Rev. 1 (F) – PITRIS Consult. 7<sup>th</sup> November, 2012
- Apetorgbor, M.M.** Validation Workshop on the AU Guidelines for the Coordinated Implementation of the Nagoya Protocol on Access and Benefit Sharing of Genetic Resources. Addis Ababa, Ethiopia. 28<sup>th</sup> to 30<sup>th</sup> October, 2013



- Apetorgbor, M.M.** 3<sup>rd</sup> International Congress on Fungal Conservation, 11-15 November, 2013, Mugla, Turkey.
- Bosu, P.P.** Workshop on “Problem Formulation in Biosafety Risk Analysis”. Organized by The International Centre for Genetic Engineering and Biotechnology (ICGEB). Mensvic Hotel, Accra, Ghana. 30<sup>th</sup> September – 4<sup>th</sup> October, 2013.
- Bosu, P.P.** Workshop on Collaboration and Interdisciplinary Research. College of Physicians and Surgeons, Accra, Ghana. 15-19th July, 2013. (Organized by the International Foundation for Science as Side Event at the 6th FARA Science Week)
- Bosu, P.P.** Sixth Africa Agriculture Science Week and FARA General Assembly. Accra International Conference Centre, Accra, Ghana. 15-20 July 2013.
- Bosu, P.P.** Technical Advisory Committee to review applications for Confined Field Trials. Coconut Grove Hotel, Accra. 24-25<sup>th</sup> August, 2012.
- Bosu, P.P.** International Union of Forest Research Organizations (IUFRO) and Forest Research Network for Sub-saharan Africa (FORNESSA) 1<sup>st</sup> Regional Congress in Africa. 25-29th June 2012, Nairobi Kenya.
- Bosu, P.P.** Technical Advisory Committee (TAC) meeting, of the National Biosafety Committee. Alisa Hotel, Accra – Ghana. 29-30<sup>th</sup> April 2013.
- Bosu, P.P.** Workshop on Phytosanitary Measures in Africa. Organized by the Forest Invasive Species Network for Africa (FISNA) and Food and Agriculture Organization (FAO). Kampala, Uganda. 2 – 7 February 2012
- Bosu, P.P.** West African Science Service Center on Climate and Adaptive Land use (WASCAL). WASCAL Graduate Research Programs’ Advisory Boards Meeting, Elmina, 1-2 February, 2012.
- Bosu, P.P.** National Biosafety Commission and African Biosafety Network (ABNE) Training Workshop on Strengthening Regulatory Capacity for Application Review, Decision-making and Compliance on Biosafety Issues. Golden Tulip City Hotel, Kumasi. January 18 – 20, 2012.
- Damnyag, L.** Forests and trees: serving the people of Africa and the world; IUFRO-FORNESSA regional congress and ITTO/AFF forest policy data 25-29 June 2012, Nairobi, Kenya.
- Damnyag, L.** Biennial meeting of the Scandinavian Society of Forest Economics (SSFE), May 2012, Hyytiala, Finland.
- Dumenu, W.K.** IUFRO/FORNESSA on “Forests and Trees. Serving the People of Africa and the World”. Nairobi, Kenya. 25-29 June, 2012
- Foli, E.G.** African Geospatial Forum 7<sup>th</sup> Annual Conference and Exhibition on Geospatial Information, Technology & Applications. 03 – 04 October 2012. Mövenpick Ambassador Hotel, Accra.
- Foli, E.G.** MEST Workshop on In-Country Level Implementation Strategy of Rio+20 Outcomes. 27 September 2012. Alisa Hotel, Accra.

- Foli, E.G.** CIESIN/NASA (SEDAC) Workshop on Data Gaps for Research and Action on Climate Change Vulnerability, Impacts and Adaptation. 01 June 2012. Tucson Marriot University Park, Tucson, Arizona, USA.
- Foli, E.G.** First IUFRO-FORNESSA Regional Congress on “Forests and Trees: Serving the People of Africa and the World” and ITTO/AFF Forest Policy Day. 25 – 29 June 2012. ICRAF Headquarters, Nairobi, Kenya.
- Foli, E.G.** Second International Climate Adaptation Conference 2012. 29 – 31 May 2012. University of Arizona, Tucson. USA.
- Foli, E.G.** FCPF-funded REDD+ Readiness Preparation Workshop. 26 April 2012. Alisa Hotel, Accra.
- Foli, E.G.** IDRC/RIPS Second Climate Change Colloquium. Noguchi Memorial Institute for Medical Research Conference Hall. 09 February 2012. University of Ghana, Legon, Accra.
- Foli, E.G.** National Biosafety Commission and African Biosafety Network (ABNE) Training Workshop on Strengthening Regulatory Capacity for Application Review, Decision-making and Compliance on Biosafety Issues. Golden Tulip City Hotel, Kumasi. January 18 – 20, 2012.
- Foli, E.G.** West African Science Service Center on Climate and Adaptive Land use (WASCAL). WASCAL Graduate Research Programs’ Advisory Board Meeting, Elmina, 1-2 February 2012.
- Foli, E.G.** Workshop on Phytosanitary Measures in Africa. Organized by the Forest Invasive Species Network for Africa. Kampala, Uganda. 2 – 7 February 2012.
- Foli, E.G.** CSIR-FORIG/Oxford University Carbon Use Efficiency (CUE) Training Workshop. 28 – 31 May, 2012. Forestry Research Institute of Ghana (CSIR-FORIG), Kumasi.
- Foli, E.G.** A Campaign for Female Education (Camfed) Programme: Science, Technology and Mathematics, Education Camp for girls from Northern, Upper East, Upper West and Central Region of Ghana. Camfed Camp 2012. August 2012.
- Marfo, E.** REDD+ and FLEGT-VPA processes in Ghana, 28-29 November 2013, Paramaribo, Suriname
- Marfo, E.** Strengthening of institutional review board and capacity building of scientists on research ethics, 22<sup>nd</sup> January 2013, CRI, Kumasi
- Marfo, E.** Workshop for legal working group on European Union Timber Regulations. Organized by Client Earth, 12-13<sup>th</sup> March 2013, Accra
- Marfo, E.** Regional conference of the International Association for the Study of Commons and writing workshop of the Responsive Forest Governance Initiative, 9-24<sup>th</sup> April 2013, Cape Town, South Africa
- Marfo, E.** Overview of the legislation and the regulatory provisions governing the forest and wildlife sector and the possible role of civil society. Client Earth, 6-8 November 2013, Accra

- Marfo, E.** The international project coordination committee meeting of the EU-Chainsaw project, 24-26 November, 2013, Georgetown, Guyana
- Marfo, E.** Seminar on emerging legality requirements in the timber sector of Suriname, 28-29 November, Paramaribo, Suriname
- Marfo, E.** REDD+ and FLEGT-VPA processes in Ghana, 28-29 November 2013, Paramaribo, Suriname
- Marfo, E.** Strengthening of institutional review board and capacity building of scientists on research ethics, 22<sup>nd</sup> January 2013, CRI, Kumasi
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- Marfo, E.** Seminar on emerging legality requirements in the timber sector of Suriname, 28-29 November, Paramaribo, Suriname
- Owusu, F.W.** National Technical Committee on Standardization of Wood and Wood Products: Finalization of five Standards (FDGS 23, FDGS 1028, FDGS 1029, FDGS 1030 and FDGS 1031) development and drafting of Standards on lumber for local/ domestic market. Held at Ghana Standards Authority (GSA) conference room from 18<sup>th</sup>-20<sup>th</sup> Dec 2012.
- Ofori-Boateng, C.** "Innovative Conservation Awareness program increases stakeholder participation for the protection of a critically endangered West African frog". International Conference on Conservation Biology International Conference Centre, Baltimore, US, IN 21st August 2013 oral presentation.
- Opuni-Frimpong, E.** Forty-ninth Session of the International Tropical Timber Council and Associated Sessions of Committees. Libreville, Gabon 25-30 November 2013.
- Opuni-Frimpong, E.** JICA/ ITTO Side Event at UN Climate Change Conference and Nineteenth Session of the Conference of Parties (COP19), Warsaw, Poland, 11-22 November, 2013.
- Opuni-Frimpong, E.** Timber Tracking System in Ghana and establishment of genetic reference lab for Sustainable Forest Management. Presentation at the Side Event of the 49<sup>th</sup> International Tropical Timber Council and Associated Committees 25-30 November, Libreville, Gabon.
- Owusu, F.W.** Stakeholders' workshop on the implementation of the action plan on the use of local raw materials in the building and construction industry in Ghana. Workshop held at Volta Hotel, Akosombo by MEST from 28<sup>th</sup> to 30<sup>th</sup> November 2012.

- Obiri, D.B.** Forests and trees: serving the people of Africa and the world; IUFRO-FORNESSA regional congress and ITTO/AFF forest policy data 25-29 June 2012, Nairobi, Kenya
- Obiri, D.B.** Pisces Joint Implementation Group and IFPRI Biochar Workshop 12-14 November 2012. Golden Tulip, Kumasi, Ghana
- Obiri, D.B.** FAO/ITTO/RECOFTC meeting, 26-28 March 2012. FAO, ROME
- Oduro, K.A.** Capacity Building Workshop on FLEGT/VPA & EU TIMBER REGULATION (EU TR). June 12, 2012
- Obeng, E.** International Conference on Forest for Food Security and Nutrition in FAO, Rome, Italy 13<sup>th</sup> – 15<sup>th</sup> May 2013 .
- Owusu, F.W.** A training workshop organized at Goaso and Obogu to train Artisans from Goaso and its environs and Obogu in the use of portable timber milling machines (6<sup>th</sup>-7<sup>th</sup> Sept and 14<sup>th</sup>-15<sup>th</sup> September 2012). Organized by Tropenbos International, Ghana Programme
- Owusu, F.W.** Public review seminar to solicit the views of stakeholders on five draft Ghana standards on wood and wood products held at Miklin Hotel, Kumasi and organized by TIDD-FC and Ghana Standards Authority on 27<sup>th</sup> & 28<sup>th</sup> September 2012
- Owusu, F.W.** Validation of Artisanal milling concept and models of the Tropenbos International Ghana, ACP/FAO Pilot Project. Organized by Tropenbos International Ghana at Wood Industries Training Centre, Akyawkrom, Ejisu. Held on 25<sup>th</sup> September 2012.
- Owusu, F.W.** Workshop to promote three National Standards (GS198:2011, GS ISO 12466-1: 2007 and GS ISO 2074: 2007) for the plywood industry held at Miklin Hotel, Kumasi and organized by TIDD-FC and Ghana Standards Authority on 4<sup>th</sup> July 2012
- Pentsil, S.** 3<sup>rd</sup> National Policy Fair, Accra International Conference Centre, Accra, Ghana 16-21 April 2012
- Peprah, T.** Scientific Planning Meeting of the CGIAR Research Program (CRP) on Dryland Systems (CRP1.1) for West African Sahel and Dry Savanna. Noda hotel, Kumasi. 1 – 2<sup>nd</sup> August 2013.
- Peprah, T.** Workshop on tools for monitoring and evaluation of adaptation project activities, “Harvesting outcomes of climate change, agriculture, food security Program in West Africa: Burkina Faso, Ghana, Mali, Niger and Senegal”. Tiegber Hotel Wa. 29 – 31<sup>st</sup> August 2013.
- Peprah, T.** Component 2 Outcome Mapping Workshop, Bio-versity, Rome, Italy. 4<sup>th</sup> – 8<sup>th</sup> February 2013.
- Peprah, T.** Developing community-based climate smart agriculture through participatory action research in five benchmark sites in West Africa. Regional workshop in Bamako, Mali. 15 to 16 February 2012.
- Peprah, T.** AB National Forum on 15<sup>th</sup> November 2012. Coconut Grove, Accra
- Peprah, T.** Expert Group Meeting to Review Draft National Forest Plantation Strategy Document. 21-23 November 2012. Excelsa Lodge, Fumesua.

- Straku-Lartey, M. and Owusu, F.W.** Handicraft stakeholders forum. Theme: “Promoting Handicrafts as an alternative to unemployment problems and an area of entrepreneurship and wealth creation” held at the International Conference Centre, Accra on Tuesday 28<sup>th</sup> February 2012
- Samar, B.S.** PhD Research Proposal Writing Workshop organised by Tropenbos International Ghana and University of Amsterdam/Amsterdam Institute of Social Science Research (AISSR)/Governance and Inclusive Development Programme Group, on 23-26 July 2012 at Noda hotel, Kumasi, Ghana
- Samar, B.S.** Scaling up for Food Security in Africa; Champions for Change Leadership Training Workshop 27<sup>th</sup> March to 1<sup>st</sup> April, 2012 Accra-Ghana
- Tekpetey, S.L.** Biovision, Alexandria 2012, Alexandria, Egypt. February 2012
- Tekpetey, S.L.** IUFRO-FORNESSA International Conference, Nairobi, Kenya, 2012
- Tekpetey, S.L.** Society of wood science and Technology International visiting scientist program to SUNY-ESF, Syracuse and School of Forestry Yale University, USA, April 7 – May 30<sup>th</sup> 2013
- Tekpetey, S.L.** The 67<sup>th</sup> Forest Product Society International Convention and Society of Wood Science and Technology 56<sup>th</sup> International Convention. Austin Texas, USA, June 9-11-2013
- Tekpetey, S.L.** CSIR-WAAP Proposal Writing Workshop, Crop Research Institute of Ghana, 28<sup>th</sup> October to 1<sup>st</sup> November, 2013
- Tekpetey, S.L.** WWF WAFPO ITTO TFL-SPD-028/12 Empowering civil society and other non state actors to effectively contribute to forest law compliance in Ghana. Royal Lamerta Hotel, Kumasi, 30<sup>th</sup> October to 1<sup>st</sup> November, 2013
- Straku-Lartey, M.** Corporate Commercialisation and Information Division (CCID) 2012 Planning Session for all CSIR Institutes, 21 – 22 November 2012, CSIR-Soil Research Institute, Kumasi
- Straku-Lartey, M.** Research infrastructures for Africa-Europe cooperation, third caast-net stakeholders’ conference on africa-europe s&t cooperation in cooperation with paerip, 3<sup>rd</sup> – 4<sup>th</sup> December 2012, Accra, Ghana, La Palm Royal Beach Hotel
- Straku-Lartey, M.** Workshop on Marketing and Commercialisation, STEPRI, 22<sup>nd</sup> – 23<sup>rd</sup> August 2012.
- Straku-Lartey, M.** Ideal Conference ‘Stepping out: the 21<sup>st</sup> century graduate’ held at the Presbyterian University College, 15<sup>th</sup> March, 2013
- Straku-Lartey, M.** XIV IAALD World Congress, Cornell University, Ithaca, USA, 21-25<sup>th</sup> July 2013
- Straku-Lartey, M.** Climate Change & Agriculture in Horizon 2012, MPLaza Hotel, 4<sup>th</sup> to 6<sup>th</sup> November 2013
- Straku-Lartey, M.** Corporate Commercialization and Information Division (CCID) 2013 Planning Session for all CSIR Institutes, 20-22 November 2013, CUA Training Centre, Kasoa.

