# CSIR-Forestry Research Institute of Ghana




# Annual Report 2011

# CSIR-FORESTRY RESEARCH INSTITUTE OF GHANA

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For more information please contact:
The Director
CSIR-Forestry Research Institute of Ghana
U.P.O Box 63
Kumasi, Ghana.

**Telephone**
Director: +233-3220-60122
Offices: +233-3220-60123/60373
Fax: +233-3220-60121

Website: www.csir-forig.org.gh
E-mail: *director@csir-forig.org.gh*

Prepared by: *Mrs. Sarah Pentsil*

## Acknowledgements

Special thanks to Dr. Ernest Foli, Mrs. Margaret Sraku-Lartey, Mr. Kwame Oduro and Mrs. Naomi Appiah whose contributions and comments have helped to reshape this report.

# Executive Summary

In 2011, CSIR-FORIG continued pursuing her vision to be a centre of excellence through comprehensive research in forestry and related issues. Research was largely funded through internally-generated funds (IGF) and some donor support. Six research projects were funded from IGF and six by donors. This report highlights these research activities, their current status and the way forward. Some other activities in the Institute during the year under review have been highlighted.

One of the six IGF-funded projects was on the 'Floristic composition of Bobiri Forest Reserve with special reference to medicinal, mycorrhizal plants and macrofungi of economic importance'. The objective was to assess the abundance and diversity of medicinal, ectomycorrhizal tree species and macrofungi of economic importance and to evaluate their relationship with the flora of the reserve. The key finding of this research was that there is high endomycorrhizal association with timber species in Bobiri forest.

The second project funded by IGF titled 'Rehabilitation of fragmented areas within Afram Headwaters with indigenous tree species for biodiversity conservation' commenced in 2009 and the focus was to develop a model for rehabilitating degraded forest landscapes. Results showed a higher species diversity in the natural forest with *Broussonetia papyrifera* an invasive species, dominating in the degraded sites. The project team planted *Terminalia superba*, *Khaya anthotheca* and *Nauclea diderichii* seedlings on some portions of the degraded site.

A study titled 'Biodiversity and ecosystem services from Tano Sacred Grove and surrounding landscapes' investigated among other issues, the local and external factors (drivers) that influence the conservation of the sacred grove.

CSIR-FORIG is still on course in its drive to explore lesser utilized species to offset forest decline. *Ficus sur* and *Cola gigantea* were two of such species studied within the year. The study revealed that *Cola gigantea* could be utilized in applications where bending and hardness were not critical requirements and *Ficus sur* was not recommended for structural purposes.

An additional study on movement in service of ten lesser used timber species concluded that two of the species studied were most suitable for many purposes because of their slight movement values.

The Biodiversity and Landuse Division explored land cover change and carbon stocks to determine the carbon sink potential of different land use or cover types.

Scope of the six donor funded projects covered different forestry related issues. CSIR-FORIG recognizes and commends the role of all donors, notably International Tropical Timber Organisation, European Union and West Africa Agricultural Productivity Programme for their unparalleled support in executing these research projects.

The Institute is still on course with its commercialization activities and a committee was set up to give new ideas to stimulate several activities to improve income generation. A summary of the committee's report is included.

Scientists published forty (40) journal papers and thirty (30) conference papers during the year under review. On the other hand, there was a decline in book publications compared with the previous year with only two (2) books published.

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## Composition of CSIR-FORIG Management Board

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

# 1.0 Introduction

Ghana, until recently, was one of the countries in sub-saharan Africa endowed with a great deal of forest resources. However, the last two decades have witnessed considerable reduction in forest cover. This situation is of grave concern both nationally and internationally because there is scientific evidence that the changing climate is attributable partly to the increasing loss of forest cover worldwide. Apart from their protective functions (maintenance of biodiversity, soil stabilization, stream flow, climate modernization) forests provide other prioritizing services that impact on the livelihoods of people, their health, employment, food security, etc.

Given the global importance of ensuring that these services and benefits from forests are maintained, CSIR-FORIG has focused its research activities over the last couple of years in contributing to the reversal of the negative impacts of forest cover loss. As part of this commitment, the Institute continued in 2011 to carry out research aimed at solving some of these problems. Notably, six key research activities were executed. In this report, we highlight the successes, achievements in contribution to national development, the constraints and the way forward for future research.

## 1.1 Mandate

The mandate of the Institute is to undertake forest, forest products and related research, disseminate and commercialise research outputs and services. High quality user-focused research within the Institute is in line with its objective to:

- Develop technologies for sustainable management of natural forests and biodiversity conservation;
- Develop technologies for plantation forestry;
- Generate technological properties and appropriate processing techniques for efficient utilisation of forest resources;
- Enhance sustainable management and utilisation of wildlife and non timber forest products (NTFPs);
- Mobilise, generate, process and disseminate information critical to the management of Ghana's forest resources;
- Strengthen capacity and use same for optimum research and commercialised services;
- Upgrade infrastructure and facilities for research and development (R&D);
- Undertake contract/commissioned research, consultancies, training and related technical services in forestry;
- Foster strong linkages across disciplines with local and international bodies and organizations;

- Contribute through research, to improve the social, economic and environmental well-being of Ghanaians.

## 1.2 Vision Statement

The Institute's vision is to be a centre of excellence and networking hub for forest and forest products research in the humid tropics.

## 1.3 Mission Statement

We conduct forest and forest products research for the social, economic and environmental benefits of society.

## 1.4 CSIR-FORIG's Activities

The focus of research activities are constantly reviewed to address national development objectives, sector specific policies, priority needs of stakeholders, emerging international (forestry) issues and relevant priority support themes of donors.

## 1.5 Divisions

The activities of CSIR-FORIG are undertaken in six (6) core and three (3) non-core research Divisions, namely:

- Forests, Livelihoods and Sustainable Development Division (FLSD)
- Forests and Wildlife Management and Governance Division (FWMG)
- Wood Industry Development and Trade Division (WIDT)
- Forest Products and Marketing Division (FPMD)
- Ecosystem Services and Climate Change Division (ESCCD)
- Biodiversity and Land-Use Division (BLUD)
- Administration Division
- Commercialisation and Information Division
- Finance Division

## 1.6 Research Centres and Laboratory Facilities

The Institute has five (5) research centres strategically located in all the ecological zones of the country. These centres are listed below:

| Name of Research Centre | Location | Region | Ecological Zone |
|---|---|---|---|
| Subri Research Centre (RC) | Benso | Western | Wet/Moist Evergreen |
| Bobiri R.C. | Kubease | Ashanti | Moist Semi-Deciduous N/W |
| Pra Anum R.C. | Amantia | Eastern | Moist Semi-Deciduous S/E |
| Afram Headwaters R.C. | Abofour | Ashanti | Dry Semi-Deciduous Fire Zone |
| Savannah R.C. | Bolga/Bawku | Upper East | Northern Savannah Zone |

An irrigated central research nursery is maintained at Mesewam, near Kumasi in addition to the National Tree Seed Centre at CSIR-FORIG campus. The Institute also maintains a herbarium and an insectary. The Bobiri Research Centre currently serves as an ecotourism site.

The laboratories of the Institute have a wide range of research equipment, including impregnation plants, seasoning kilns, furniture testing machines, an "INSTRON" strength testing machine, wood-working machines, steam generators, microscopes, an autoclave, drying ovens, a growth chamber and UV spectrophotometer, among others.

## 1.7 Human Resource

One major asset of CSIR–FORIG is the number of highly qualified staff in all the Divisions. The current staff strength of the Institute is 261 made up of 56 Senior Members, 75 Senior Staff and 131 Junior Staff as against the approved 2005 manpower ceiling of 296. The names of senior members and senior staff are as follows:

### 1.7.1 List of Senior Members

| | |
|---|---|
| **Administration Division** | |
| Victor K. Agyeman | B.Sc. Nat. Res. Mgt., MPhil Silviculture, PhD Forest Ecology, LLB **Director** |
| Comfort Konto (Ms.) | Dip. Education, B.A. (Hons) Economics, MBA Strat. & Consultancy Mgt., *Administrative Officer,* **Head of Administration** |
| F. Osei-Amofah | B.A. Secretaryship, Dip. Ed., Postgraduate Dip. Mgt. Studies, *Administrative Officer* |
| N. Obiri-Yeboah Darko | BSc. (Hons) Civil Engineering, *Maintenance Engineer* |
| Georgia Coffie (Mrs.) | B. Ed. Secretarial & Mgt., MSc E-Comm. & Marketing, *Administrative Officer* |
| **Forests, Livelihoods and Sustainable Development Division** | |
| Ebenezer Owusu-Sekyere | BSc. Nat. Res. Mgt., MSc. Agroforestry, PhD Agroforestry, *Principal Research Scientist,* **Head of Division** |
| Dominic Blay Jr[**] | BSc. Botany, MSc. Forest Resources Mgt., PhD Forest Ecology, *Principal Research Scientist* |
| Emmanuel Marfo | BSc. Nat. Res. Mgt., MSc. Tropical Forestry, PhD Environmental Science, *Senior Research Scientist* |
| Eric E. Nutakor [ΔΔ] | B.A. Social Science, MPhil. Silv. & Forest Mgt., *Research Scientist* |
| Elizabeth Obeng (Mrs.) | BSc. Agric, MSc. Sustainable Res. Mgt., *Research Scientist* |
| William Dumenu | BSc. Nat. Res. Mgt., MSc. Forest Ecol. and Mgt., *Research Scientist* |
| **Forests and Wildlife Management and Governance Division** | |
| Mary M. Apetorgbor (Mrs.) | BSc. (Hons) Botany, PhD Plant Pathology/ Mycology, *Senior Research Scientist,* **Head of Division** |

| | |
|---|---|
| Stephen Adu-Bredu | BSc. Nat. Res. Mgt., MSc. Silv. Mgt., PhD Silv. Mgt./Ecophysiology, *Senior Research Scientist* |
| Emmanuel Opuni-Frimpong | BSc. Nat. Res. Mgt., MPhil. Silv. Mgt., PhD Forest Entomology, *Senior Research Scientist* |
| Bright O. Kankam | BSc. Nat. Res. Mgt., MPhil. Wildlife and Range Mgt., PhD Primatology, *Research Scientist* |
| Theresa Peprah (Mrs.) | BSc. Nat. Res. Mgt., MPhil. Tree Improvement, *Senior Research Scientist* |
| Kwame Antwi Oduro Δ Δ | BSc. (Hons) Nat. Res. Mgt., MSc. Forestry and its relation to Land Use, *Research Scientist* |
| Akwasi Duah Gyamfi | BSc. Nat. Res. Mgt., MPhil. Ecology & Mgt., *Research Scientist* |
| John K. Mensah | BSc. Botany, MSc. Plant Pathology, *Research Scientist* |
| **Wood Industry Development and Trade Division** | |
| Francis W. Owusu | BSc. Agric Engineering, MPhil. Wood Technology, *Research Scientist,* **Head of Division** |
| Joseph Ofori** | BSc. Chemical Tech., MSc & DIC Timber Tech., PhD Wood Technology, *Chief Research Scientist* |
| Daniel Sekyere** | BSc. Chemistry, MSc. Chemistry, PhD Pulp & Paper Tech., *Principal Research Scientist* |
| Joseph K. Appiah | BSc. Nat. Res. Mgt., MPhil. Wood Science, *Research Scientist* |
| Lawrence Damnyag ΔΔ | BA. Economics, MPhil. Economics, *Research Scientist* |
| Stephen Tekpetey Lartey | BSc. Nat. Res. Mgt, PhD Wood Science, *Research Scientist* |
| Emmanuel Appiah-Kubi | BSc. Civil Engineering, MPhil. Civil Engineering, *Research Scientist* |

| | |
|---|---|
| Charles Essien [Δ] | BSc. Nat. Res. Mgt., *Asst. Research Scientist* |
| **Forest Products and Marketing Division** | |
| Beatrice Darko-Obiri (Mrs.) | BSc. Agric, MSc. Agroforestry, PhD Agroforestry, *Senior Research Scientist,* **Head of Division** |
| Nana S.A. Derkyi | BSc. Chemistry, MSc. Organic Chemistry, PhD Chemistry, *Senior Research Scientist* |
| Andrew Oteng Amoako[**] | BSc. Wood Technology, MSc. Wood Science, PhD Wood Products & Eng., *Chief Research Scientist* |
| Emmanuel Ebanyenle [ΔΔ] | BSc. Nat. Res. Mgt., MPhil. Wood Science, *Senior Research Scientist* |
| Samar B. Sparkler, | BA. Arts (Econs. & Geog.), MA. Geog. & Rural Dev., *Research Scientist* |
| **Ecosystem Services and Climate Change Division** | |
| Ernest G. Foli | BSc. Nat. Res. Mgt., MPhil Forest Men./ Inventory, PhD Silv. & Mgt., *Senior Research Scientist,* **Acting Deputy Director** |
| Paul P. Bosu | BSc. Biological Science, MPhil. Biological Science, PhD Forest Entomology, *Senior Research Scientist,* **Head of Division** |
| Joseph Cobbinah[**] | BSc. Biological Science, PhD Forest Entomology, *Chief Research Scientist* |
| Stephen E. Akpalu | BSc. Agric, MPhil. Env. Science, *Research Scientist* |
| Gloria D. Djagbletey (Mrs.) [ΔΔ] | BSc. Nat. Res. Mgt., MPhil Silv. & Forest Mgt., *Research Scientist* |
| George K. Ametsitsi | BSc. Nat. Res. Mgt., MSc. Env. Res. Mgt., *Research Scientist* |
| Daniel Shalom Addo-Danso | BSc. Nat. Res. Mgt., MSc Forest Ecol. and Mgt., *Research Scientist* |

| Biodiversity and Land-Use Division | |
|---|---|
| Luke C.N. Anglaaere | BSc. Nat. Res. Mgt., MSc. Silv. & Forest Biology, PhD Agroforestry, *Senior Research Scientist,* **Head of Division** |
| Daniel A. Ofori* | BSc. Agric, MPhil. Tree Improvement, PhD Molecular Biology, *Chief Research Scientist* |
| Kwame Asamoah Adam | BSc. Nat. Res. Mgt., MSc. Forest Mgt. & Planning, PhD Forest Management, *Senior Research Scientist* |
| K. Owusu-Afriyie | BSc. Nat. Res. Mgt., MSc. Forest Mgt., PhD Plant Science, *Research Scientist* |
| Lucy Amissah (Mrs.) Δ Δ | BSc. Nat. Res. Mgt., MPhil. Silv. & Forest Mgt., *Research Scientist* |
| Joseph Asomaning | BSc. Agric, MSc. Seed Technology, PhD Seed Science and Technology, *Research Scientist* |
| Francis Dwomoh Δ Δ | BSc. Nat. Res. Mgt., MSc. GIS & Earth Obs., *Research Scientist* |
| William K. N. Bandoh Δ | BSc. Nat. Res. Mgt., *Asst. Research Scientist* |
| **Commercialization and Information Division** | |
| Stella Britwum Acquah (Mrs.) | BSc. Computer Science, MBA. Mgt. Info. Systems, *Computer Programmer,* **Head of Division** |
| Margaret Sraku-Lartey (Mrs.) | BA. Social Science, Post. Grad. Dip. Lib. Studies, MA. Industrial Mgt., *Principal Librarian* |
| Kennedy K. Asamoah | BA. (Hons) Geography, Post Grad. Dip. Lib. Studies, MA Geog. & Rural Development, *Assistant Librarian* |
| Sarah Pentsil (Mrs.) | BSc. (Hons) Nat. Res. Mgt., MSc. Dev. Policy & Planning, *Scientific Secretary* |
| Naomi Appiah (Mrs.) | BA. Publishing Studies, MBA Marketing, *Marketing Officer* |

| | |
|---|---|
| Darimani Bukari | BA. Publishing Studies, MPhil. Art and Culture, *Information Officer* |
| **Finance Division** | |
| Francis Kumah | BA. (Hons) Accounting & Econs., *Asst. Accountant* , **Head of Division** |
| Osei Yaw Agyei | BSc., MBA, ACCA , *Accountant* |
| K. Agyeman Prempeh | ICA, *Accountant* |

* Sabbatical Leave ** Post Retirement Contract
ΔΔ PhD Student Δ MSc/MPhil Student

### 1.7.2 List of Senior Staff

| NAME | RANK |
|---|---|
| A. Mohammed Issah | *Chief Technical Officer* |
| Michael Mensah | *Chief Technical Officer* |
| Bridgette Brentuo | *Chief Technical Officer* |
| Emmanuel Zagblenku | *Chief Technical Officer* |
| Leticia A. Asamoah | *Chief Technical Officer* |
| Georgina Agyeman | *Chief Administrative Assistant* |
| Isaac Mensah Bonsu | *Chief Accounting Assistant* |
| Mavis Serwaah Kwarteng | *Chief Accounting Assistant* |
| Evelyn Owusu Agyeman | *Chief Accounting Assistant* |
| John Agbozo | *Chief Technical Officer* |
| Paul Kankam | *Chief Technical Officer* |
| Asiamah Yeboah Konadu | *Chief Admin. Assistant* |
| Elizabeth Ampah | *Principal Technical Officer* |
| Prempeh Bandoh | *Principal Technical Officer* |
| Philip T. Boampong | *Principal Technical Officer* |
| Sarfo Kwame Bonsu | *Principal Technical Officer* |
| Francis Asare Abetia | *Principal Administrative Assistant* |
| Richard Adjei | *Principal Technical Officer* |

| NAME | RANK |
|---|---|
| Awurama Andoh | *Principal Administrative Assistant* |
| Eric Frimpong | *Principal Technical Officer* |
| Jane Nketiah | *Senior Administrative Assistant* |
| Gabriel Lumor | *Technical Officer* |
| Wendy O. Amankwa | *Accounting Assistant* |
| Ezuame Constant | *Technical Officer* |
| Elvis Nkrumah | *Technical Officer* |
| George K. Nyantakyi | *Senior Security Officer* |
| Frank Baffour Asuming | *Principal Technical Officer* |
| John Sackey | *Principal Works Superintendent* |
| Paul Adusei | *Principal Works Superintendent (Traffic)* |
| Samuel K. Appiah | *Principal Works Superintendent (Traffic)* |
| Godzon K. Zorve | *Principal Technical Officer* |
| J. J. Mensah | *Principal Accounting Assistant* |
| Caleb Ofori Boateng | *Principal Technical Officer* |
| Isaac Boahen | *Principal Accounting Assistant* |
| C.C. Acheampong | *Principal Accounting Assistant* |
| Samuel Atusong | *Principal Accounting Assistant* |
| Maud M. Prempeh | *Principal Technical Officer* |
| Albert K. Nyeha | *Principal Technical Officer* |
| Peter L. Arthur | *Principal Technical Officer* |
| Jonathan Dabo | *Senior Technical Officer* |
| Emmanuel A. Manu | *Senior Technical Officer* |
| Samuel A. Kyei | *Principal Technical Officer* |
| Daniel Peprah | *Senior Technical Officer* |
| Jacqueline Twintoh | *Principal Technical Officer* |
| Sandra Owusu | *Senior Technical Officer* |
| Samuel Larbi | *Senior Administrative Assistant* |
| Kwaku Asumadu | *Senior Technical Officer* |

| NAME | RANK |
|---|---|
| Jemima Owusu | *Senior Technical Officer* |
| Daniel K. Debrah | *Senior Technical Officer* |
| Govina J. Kudjo | *Technical Officer* |
| Rebecca Okyere Darko | *Stores Superintendent* |
| Anastasia Duah-Gyamfi | *Administrative Assistant* |
| Daniel Damte | *Draughtsman* |
| Anthony Boateng | *Asst. Transport Officer* |

## 2.0 Research Projects

The six core Divisions of the Institute undertake research funded with IGF. The research projects funded during the year are as follows:

1. Floristic Composition of the Bobiri Forest Reserve with Special Reference to Medicinal, Mycorrhizal Plants and Macrofungi of Economic Importance
2. Rehabilitation of Fragmented Areas within Afram Headwaters with Indigenous Tree Species for Biodiversity Conservation
3. Biodiversity and Ecosystem Services from Tano Sacred Grove and surrounding Landscapes
4. Promotion and Utilization of two Lesser-Used Timber Species from Afram Headwaters Forest Reserve
5. Determination of Movement in Service of ten Ghanaian Lesser Used Timber Species
6. Impact of Land Cover Change on Carbon Stocks in the Moist Semi-Deciduous Forest Zone of Ghana: The case of Bobiri Forest Reserve and its surroundings

### 2.1 Floristic Composition of the Bobiri Forest Reserve with Special Reference to Medicinal, Mycorrhizal Plants and Macrofungi of Economic Importance

**Project Team:** Apetorgbor, M.M., Mensah, J.K., Dabo, J. and Adu-Bredu, S.A.

**Start Date:** August, 2009

**Expected Completion Date:** December, 2011

#### Introduction

Bobiri Forest Reserve has played a significant role in education, research and recreation since its establishment in 1939. It is the most popular forest reserve designated as a butterfly sanctuary in Ghana. The forest, although perceived to be floristically rich, lacks carefully compiled and up-to-date data on flora composition, richness, abundance and diversity. This knowledge gap does not only undermine the effective functioning of the reserve, but also fails to depict modern practices and trends in forest reserve management.

Understanding of the floristic composition and structure of forest reserves is thus of primary importance in identifying essential elements of plant diversity, protecting threatened and economic species, monitoring the state of the forest and ultimately in planning and implementation of biological diversity conservation.

## Objective

To assess the abundance and diversity of medicinal, ectomycorrhizal tree species and macrofungi of economic importance and their relationship with the flora of the reserve.

## Methodology

Root samples were collected from wildlings of *Albizia ferruginea, Aningeria altissima, Nesogordonia papaverifera, Sterculia rhinopetala, Tieghmella heckelii, Triplochiton scleroxylon, Terminalia ivorensis, Guarea cedreta, Carapa procera, Milicia regia, Pipterdiniastrum africanus, Antrocaryon micraster, Turraenthus africanus, Mansonia altissima, Mammea africana, Pericopsis elata, Ceiba pentandra* and *Antiaris toxicaria*. Root colonization was assessed based on the methods described by Koske and Gemma (1989). Fifteen root pieces (1.5cm in length cut from the tip) of each tree species were observed at 400x magnification and colonization by arbuscular mycorrhizal fungi was recorded.

## Results

Out of the eighteen (18) indigenous commercial timber species investigated, fourteen (14) species (79%) were found to have endomycorrhizal association. Species such as *Guarea cedreta, Carapa procera and Nesogodornia papaverifera* did not show any presence of arbuscular mycorrhizal structures.

## Conclusion

Results from the previous year' study indicated that for a two (2) hectare plot in the disturbed area, 169 plant species belonging to 58 families were recorded with tree species being the most abundant. Indigenous commercial timber species in the Bobiri forest reserve showed high endomycorrhizal association. Further studies are necessary to determine the mycobiont associated with the timber species. This would enable the incorporation of mycorrhizal fungi into nursing of such timber species at the nursery to enhance their survival and reduce the cost involved in the use of fertilizers.

## 2.2 Rehabilitation of Fragmented Areas within Afram Headwaters with Indigenous Tree Species for Biodiversity Conservation

**Project Team:** Peprah, T., Opuni-Frimpong, E., Duah-Gyamfi, A., Mensah, J.K., Oduro, K.A., Adu-Bredu, S. and Apetorgbor, M.M.

**Start Date:** January 2009

**Expected Completion Date:** December 2011

### Introduction

Extensive and persistent deforestation of the forest estate resulting from conversion to agriculture, logging, fuel wood gathering, mining, infrastructure development and forest fires is threatening the forest ecosystem. This threat does not only affect individual forest estates but also areas between reserves which were created close to each other to preserve connectivity, and to allow plants and animals to disperse and migrate between and within reserves and for the exchange of genetic material among populations. The net effect is the creation of islands of forest reserves with isolated and fragmented populations of restricted biological systems.

**Figure 1:** *Cleared fragmented area adjacent to an undisturbed site*

This project therefore seeks to develop a model for rehabilitating degraded forest landscapes or fragments within Afram Headwaters Forest Reserve with indigenous tree species for biodiversity conservation.

The specific objectives of the study are to:

- Identify important indigenous species for biodiversity conservation.
- Determine carbon stock enhancement in established plots.
- Develop growth models for selected indigenous species.

## Methodology

An undisturbed forest (Figure 3) and a fragmented or disturbed area with a size of three hectares each were identified and selected for the study. An inventory of plants to assess richness, abundance, basal area and density using a Modified-Whittaker plot for biodiversity assessment was subsequently conducted in the two areas. In each vegetation type, three plots were randomly located with the long axis parallel to the environmental gradient. Collection and identification of macro-fungi and butterflies was done both within the undisturbed and degraded sites.

The identified sites for plot establishment was demarcated into sub plots and eight (8) indigenous species were planted at a distance of 3m by 3m. The design used in both cases was a randomized complete block design.

## Results

On the whole, 65 plant species were recorded in the natural forest with 16 species in the degraded site. All the characteristics considered (plant richness, abundance, basal area and density) were higher in the natural forest and significantly different between the two sites, except density of stems.

The dominant non-timber species in the natural forest were *Rinorea oblingifolia* with *Guarea cedrata* and *Entandrophragma angolensis* as the most common timber species (Table 1). *Broussonetia papyrifera,* an invasive species dominated the degraded site.

**Table 1:** Some common plant species recorded from two sites at Afram Headwaters Forest Reserve

| Plant species | Stocking Density (Trees $ha^{-1}$: dbh >5cm) | | Guild | Star | Life form |
|---|---|---|---|---|---|
| | Intact Forest | Degraded forest | | | |
| *Rinorea oblingifolia* | 133 | - | NPSH | - | t |
| *Antiaris toxicaria* | 3 | - | NPLD | Red | T |
| *Albizia zygia* | 3 | 10 | NPLD | Pink | T |
| *Blighia sapida* | 10 | 7 | NPLD | - | T |
| *Broussonetia papyrifera* | 43 | 380 | P | - | t |
| *Cola gigantea* | 3 | - | NPLD | - | |
| *Terminalia ivorensis* | - | 7 | P | Red | T |
| *Pycnanthus angolensis* | 10 | - | NPLD | Red | T |
| *Guarea cedrata* | 57 | - | NPSH | Red | T |
| *Entandrophragma angolensis* | 17 | - | NPLD | Scarlet | T |

P: Pioneer; NPLD: Non-pioneer light demander; NPSH: Non-pioneer shade bearer; t: non-timber; T: timber

In 2010 and 2011, *Terminalia superba*, *Khaya anthotheca* and *Nauclea diderichii* were planted in some degraded sites in the study area. Assessment of seedling growth showed a higher growth in height for pioneers compared to non-pioneers. Relative growth rate in height between age 3.0 months and 6 months was greater than age 6.0 to 12 months for all the species.

**Figure 2:** *Vegetation assessment in the degraded site*

**Figure 3:** *A portion of the undisturbed site*

A number of macrofungi were present at the selected sites. The family Polyporaceae accounted for the highest number of species and subsequently Xylariaceae and Agaricaceae. Some of the polypores identified include *Microporus xanthopus* and *Auricularia auricula-judae* (Figures 4 & 5), an agaric and an edible mushroom harvested by local communities for both domestic and commercial purposes.

**Figure 4:** *Microporus xanthopus*

**Figure 5:** *Auricularia auricula-judae*

Thirty two (32) butterflies of six (6) different species were identified on the plots which had tree cover as the dominant vegetation. The most frequently encountered species were *Euphaedra medon* (Figure 6) and *Euphaedra xypete* (Figure 7) notably associated with degraded forest landscapes. However, no butterfly was encountered in areas dominated by *Chromolaena odorata* and other weeds.

**Figure 6:** *Euphaedra medon*

**Figure 7:** *Euphaedra xypete*

## Conclusion

The results show that although the degraded area was scantily stocked in terms of woody plants ≥ 5cm dbh, the understorey layer was similar to that of the undisturbed area, and thus apt for rehabilitation or restoration activities aimed at biodiversity conservation.

## 2.3 Biodiversity and Ecosystem Services from Tano Sacred Grove and surrounding Landscapes

**Project Team:** Bosu, P., Djagbletey, G., Ametsitsi, G., Addo-Danso, S., Foli, E., Cobbinah, J.R., Bandoh, P.K. and Nkrumah, E.

**Collaborating Scientist:** Gyamfi, A.D.

**Start Date:** January 2011

**Expected Completion Date:** December 2011

## Introduction

In Ghana, small areas of intact or slightly degraded forests reserved for religious and traditional beliefs can be found in many places. These sacred groves, as they are called, have various underlying beliefs and prohibitions, most common is that cutting of trees for timber is not allowed. Though these groves add considerable value to the protected area of forests of high genetic value, which are poorly represented in state-managed forest reserves, yet they have come under intense pressure recently with many experiencing various degrees of deforestation and forest degradation. As 'forest islands' they remain among the most valuable biodiversity hotspots for which much could be obtained for the conservation and sustainable management of forests for the future.

In recent times, the role of local religious and cultural edicts for the preservation of these sacred groves has waned significantly and this is not peculiar to Ghana, but worldwide. Sacred groves and other small remnant forests could be important sources of ecosystem services (ES) not just for fringing local communities but also for entire landscapes.

The specific objectives of the project are as follows:

1. Assess biodiversity in selected sacred groves or remnant forests and determine the corresponding ecosystem services derived from them.
2. Evaluate current and potential impacts of ecosystem services from sacred groves on the livelihoods of fringing local communities.
3. Identify local and external factors (drivers) that may influence the conservation of the sacred grove.

## Methodology

Three, one hectare plots with nested subplots were established and assessed for vegetation diversity. Within each plot, 25 subplots were established to take inventory of all trees, woody vines (lianas), palms and other hemi-epiphytes ≥locm diameter at breast height. A survey was carried out in addition to the field work to assess the flow of ecosystem services to the local people.

## Results

A total of 868 individual trees representing 56 species and 30 families were recorded. The most varied families were Fabaceae, Combretaceae, Mimosaceae and Moraceae. The most numerous species recorded included *Broussonetia papyrifera* and *Anogeissus leiocarpus*. Average stand density and basal area were 5.1 stems $ha^{-1}$ and 9.65 $m^2 ha^{-1}$ respectively. *Broussonetia papyrifera* and *Anogeissus leiocarpus* dominated Plots 1 and 3. The most recurrent species on plot 2 was *Bridelia ferruginea*. Despite the importance of the sacred grove in conserving biodiversity, the high stem per hectare of *Broussonetia papyrifera* which is an invasive species poses a threat to the integrity of the grove.

Figure 8 gives a list of ecosystem services mentioned. Ecotourism was the most frequently mentioned due mainly to efforts in the past to develop the grove as an ecotourism destination with pollination as the least.

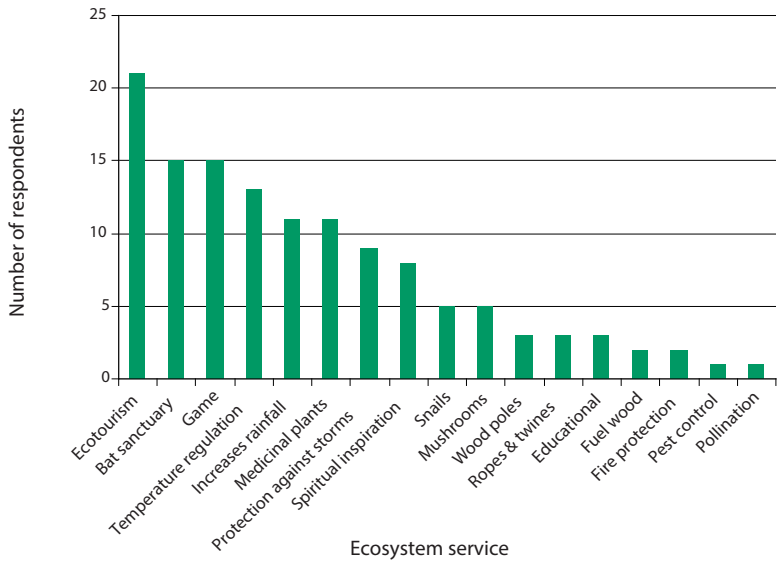


**Figure 8:** *Various ecosystem services from the Tano Sacred Grove (TSG)*

### Household energy sources

The survey showed that energy for domestic activities is derived essentially from the ecosystem. In spite of the availability of the fuel wood in the TSG, collection is prohibited by taboos. All the households interviewed got part of their energy requirements from firewood obtained from the vegetation outside the grove. None of the households interviewed use liquefied petroleum gas (LPG) Figure 9.

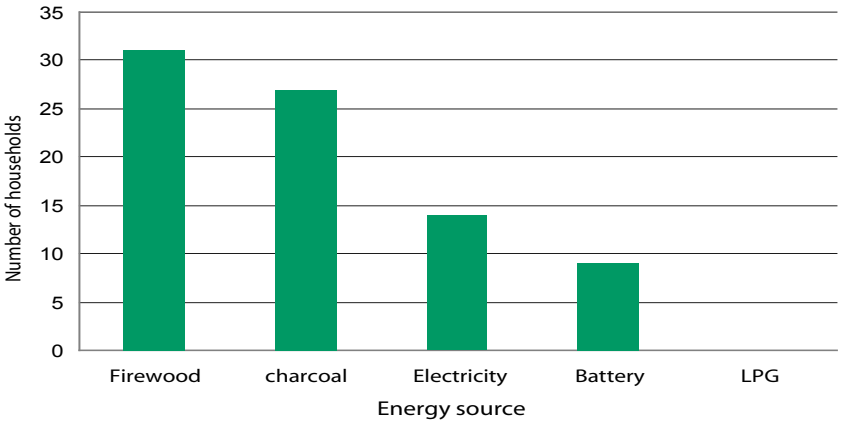


**Figure 9:** *Energy sources*

## Conclusion

The Tano Sacred Grove is colonized by *Broussonetia papyrifera* which is an invasive species which has potentially negative impact on the forest ecosystem because it spreads very rapidly and can competitively exclude native species within a relatively short time when conditions are favourable. Action should be taken to contain the species to prevent it from completely taking over the forest. Respondents showed that communities are fairly knowledgeable about the potential of the grove to provide ecosystem services to improve their livelihoods. However, environmental services such as pollination, pest control, water provision and purification are less recognized. Education and public awareness campaigns may be needed in the communities if the sacred grove is to be conserved.

## 2.4 Promotion and Utilization of two Lesser-Used Timber Species from Afram Headwaters Forest Reserve

**Project Team:** Owusu, F.W., Appiah, J.K., Sekyere, D., Apetorgbor, M.M., Appiah-Kubi, E., Essien, C., Tekpetey, S. and Mensah, J.K.

**Start Date:** January 2011

**Expected Completion Date:** December 2011

## Introduction

Wood has always held a significant place in human history. It has served man as a structural material for buildings, furnishings, tools and weapons and until

recently as the only readily available fuel. Wood represents one of the most important renewable natural resource.

Currently, Ghana's timber industry is faced with diminishing volumes of forest resources and threatened with possible extinction of most traditional timber species. The industry's concentration on international trade with a few major timber species is a critical constraint that has led to over-harvesting of the more popular species. With the dwindling volumes of these primary timber species, it has become necessary that the industry utilizes these promotable lesser-used and lesser known timber species (LUS/LKS) that relatively abound in the forest. Notwithstanding their distribution and abundance in most forest reserves, information on their basic and technological properties for efficient promotion is lacking. Two of such species, *Cola gigantea* and *Ficus sur,* were selected for study.

## Objectives

The main objective of the study was to determine the basic and technological properties and develop appropriate processing techniques for the efficient utilization of *Cola gigantea* and *Ficus sur* in Ghana.

## Methodology

Felled trees of *Cola gigantea* and *Ficus sur* were prophylactically treated after crosscutting into lengths from 1.33m to 2.53m.

**Figure 10:** *Setting of the wood-mizer saw*

**Figure 11:** *Disc samples*

The volume of the lumber obtained from each log was computed by measuring the length, width and thickness of each lumber piece generated, at 20mm from both ends of the board. Natural durability of the two species was determined by exposing samples to the test fungus, *Coriolopsis polyzona* (white rot), for 12 weeks.

German standards DIN 52183, DIN 52182 and DIN 52184 were used to determine green moisture content, basic density and directional shrinkage respectively for

the two species. Information from Alipon *et al*., 2000 was used to determine volumetric shrinkage of the two species.

The machining properties of the species was determined using a combined surfacing and thicknessing machine, a narrow band saw (Wadkin C5), Swdgwick SM4 spindle moulder, Wadkin lathe machine (model RS 500) and woodturning tool set of six pieces, a vertical single-spindle drilling type and a belt sander of model CL300.

For the chemical analyses, preparation of extractive free samples was by treatment with alcohol benzene, alcohol and hot water as described by Tappi Standard T12.

Static bending tests were carried out using a 3-point bending method on an Instron testing machine. Treatability study was conducted using 0.5% Copper Chrome Arsenate type C (CCA – C) preservative AWPA P5 – 08 and vacuum-pressure impregnation method by varying the pressure magnitudes (600kPa to1200kPa) and treatment durations (30 to 240 minutes).

## Results

*Ficus sur* generated a relatively higher lumber yield in terms of volume in contrast with *Cola gigantea*. Comparing the wood decay resistance classes adopted from ASTM designation, the sapwood of *Cola gigantea* and *Ficus sur* were both susceptible to attack by the decay fungus *C. polyzona* in all the zones except for the butt which was moderately resistant. The inner and outer heartwoods of *Cola gigantea* and *Ficus sur* were moderately resistant in all the wood zones.

Basic density of *Ficur sur* was light and medium for *Cola gigantea*. The tangential and radial shrinkage values obtained were indicative that shrinkage is small and medium for *Ficus sur* and *Cola gigantea* respectively.

Machine ability of the two species was generally good. The ease of working with hand tools for example, was 'easy' for *Ficus sur* and 'slightly easy' for *Cola gigantea*.

**Figure 12:** *Garden chair produced from Cola gigantea*

With regard to treatability, results indicate that both species are treatable and could be impregnated with adequate preservatives to prolong their service life.

For all the species, most of the strength properties increased as the moisture content decreased. The strength (modulus of elasticity) of *Cola gigantea* was 9818 N/mm$^2$ and this is classified as 'low/medium' whilst *Ficus sur* had 'low' strength of 6848 N/mm$^2$ at the dry state.

## Conclusion

Based on low or medium mechanical strength classification, *Cola gigantea* could be generally good for end-uses where bending and hardness are not critical requirements. These possible end-uses include applications such as: medium grade furniture (Figure 12) and cabinets, millworks, ceiling and acoustic panels, picture frames, mouldings, sidings, sash doors and windows, manufacture of toys, pencil slates, match sticks, veneer and plywood production.

*Ficus sur* had low bending strength of 41 N/mm$^2$ and is consequently not recommended for structural purposes. Further analysis is in progress to provide information on the most suitable end use for this species.

## 2.5 Determination of Movement in Service of ten Ghanaian Lesser Used Timber Species

**Project Team:** Brentuo, B. and Ofori, J.

**Start Date:** January 2009

**Expected Completion Date:** December 2011

## Introduction

Wood is a hygroscopic material and its moisture content will always have a tendency to change until it is in equilibrium with the amount of water vapour in the surrounding atmosphere. It is important for users of wood to have a good understanding of the effects of moisture content on its properties. Movement is a dimensional change that occurs during the service life of seasoned wood due to environmental changes. Movement of timbers with higher values results in the loosening of joints and in the development of unsightly gaps.

## Objective

To determine the tangential and radial dimensional changes in ten Ghanaian lesser-used timber species.

## Methodology

Lumber from ten air dried lesser utilized species (LUS) from four forest reserves in four different ecological zones were used for the experiment. The

species are as follows: *Piptadeniastrum africanum* (Dahoma), *Nauclea diderrichii* (Kusia), *Nesogordonia papverifera* (Danta), *Celtis mildbraedii*, *Celtis zenkeri*, *Combretodendron africanum* (Essia), *Sterculia rhinopetala* (Wawabima), *Strombosia glaucescens* (Afina), *Cynometra ananta* (Ananta) and *Lophira alata* (Kaku).

Four different saturated salt solutions were contained in different chambers to provide different relative humidity in the conditional chamber. The relative humidity range was between 12 to 98 per cent. Six each of radial and tangential samples of all the species were sawn into 10cm x 5cm x 1.0cm thickness using circular and band saws.

Lithium chloride (LiCl), magnesium chloride ($MgCl_2$), sodium chloride ($NaCl_2$) and copper sulphate ($CuSO_4$) saturated salt solutions respectively were used to attain 12 per cent, 33 per cent, 76 per cent and 98 per cent relative humidity at 25°C before oven drying to a temperature of 105°C.

The dimensions (length, width and thickness) and the masses of the samples were recorded at equilibrium by digital calipers/micrometer screw gauge and analytical balance respectively.

## Results

The mean air dried densities ranged from a high of 1040kg/m$^3$ for *Lophira alata* to a low of 626kg/m$^3$ for *Piptadeniastrum africanum*. The density increased with an increase in relative humidity for all the species. The tangential and radial movements were high in *Sterculia rhinopetala* and *Nesogordonia papverifera* and low in *Celtis zenkeri* and *Strombosia glaucescens*.

## Conclusion

Timbers with low movement values are always in demand, particularly for high-quality joinery work, paneling and domestic flooring. From the 10 LUS studied, *Celtis zenkeri* and *Strombosia glaucescens* had the least movement values making them most suitable for the aforementioned purposes.

## 2.6 Impact of Land Cover Change on Carbon Stocks in the Moist Semi-Deciduous Forest Zone of Ghana: The case of Bobiri Forest Reserve and its surroundings

**Project Team:** Owusu-Afriyie, K., Dwomoh, F., Anglaaere, L.C.N., Bandoh, W., Asomaning, J.M. and Amissah, L.

**Start Date:** January 2010

**Expected Completion Date:** December 2011

## Introduction

The country's attempt to implement land-based carbon projects is hampered by lack of baseline information especially on carbon stocks. Presently, our knowledge of Ghana's carbon budget is limited by inadequate data on carbon stocks in the various cover types as well as the spatial distribution of these sinks. Moreover, quantifying forest cover changes is a key requirement in the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol implementation. Though there is national awareness about the alarming pace of forest cover change in Ghana, estimation of this change is however based on "best guesses" rather than on scientifically robust methods.

Thus, there is an urgent need to determine more reliable estimates of forest cover changes and associated carbon stocks at a resolution consistent with the scale of deforestation in the country.

The objectives are to:

- Identify and map different land use or cover systems in the moist semi-deciduous forest zone;
- Determine the C sink potential of the different land use or cover types;
- Determine changes in land cover and carbon stocks over time.

## Methodology

Fifteen (15) sample points (replicates) were taken per land use or cover type in the areas surrounding Bobiri Forest Reserve for the assessment of carbon pools in the soil, leaf litter, herbaceous layer and in trees. Five broad land uses were identified and mapped. These include: a natural forest (Bobiri Forest Reserve), fallow lands, teak plantations, mixed crop farms and cocoa (agro-forest) plantations.

## Results

### Carbon stocks in trees

The carbon stocks per ha in trees (dbh > 5cm) in the different land cover types are presented in Table 2. There were significant differences in carbon stocks in trees (dbh ≥ 5cm) among land uses (ANOVA, $n = 75$, $df = 74$, $F = 29.59$, $P < 0.001$). The vast difference in mean carbon stocks per hectare between the forest reserve (natural forest) and the remaining land cover types gives an indication of the extent of loss of tree cover (degradation). This could be explained by the fact that the entire Ejisu-Juaben Municipality is now peri-urban and so the present land use does not conserve trees. Similarly, the large standard deviation in all the cover types except cultivated areas (mixed farms) is an indication of high variability among samples of the same cover type. For example, in the case of fallow lands, the age of fallow ranged from three to ten years obviously giving rise to high variability in tree cover. Cultivated lands (mixed farms) were in most cases depleted of trees which are harvested for fuel thus accounting for the lower carbon stocks in trees.

Some of the cocoa agro-forest plantations were over-shaded with trees whereas others were completely without shade trees.

**Table 2:** Carbon stocks (Mg C ha-1) in trees (dbh ≥ 5cm) in different land cover types

| Land use/cover | Mean | Minimum | Maximum | Standard deviation |
|---|---|---|---|---|
| Forest reserve | 240.3459 | 63.99734 | 327.3136 | 83.59039 |
| Fallow lands | 77.03495 | 1.618589 | 207.3008 | 56.33706 |
| Mixed farm (Cultivated lands) | 7.118303 | 0 | 57.78715 | 15.63216 |
| Teak plantations | 85.52952 | 17.14423 | 329.5251 | 71.93943 |
| Cocoa agro-forest* | 81.72781 | 21.24841 | 201.7062 | 55.09178 |

*In this study, cocoa agro-forest includes cocoa trees and shade trees

For each land cover type, number of sample points, N = 15

**Table 3:** Land cover change between 1986 and 2010

| Land cover class | Area (ha) | | Percentage of total area | |
|---|---|---|---|---|
| | 1986 | 2010 | 1986 | 2010 |
| Forest | 17,916 | 9,020 | 28 | 14 |
| Secondary forest | 28,207 | 30,727 | 45 | 49 |
| Grass | 5,734 | 8,094 | 9 | 13 |
| Agric | 9,744 | 11,132 | 15 | 18 |
| Bare | 1,428 | 4,054 | 2 | 6 |
| Total area | 63,028 | 63,028 | 100 | 100 |

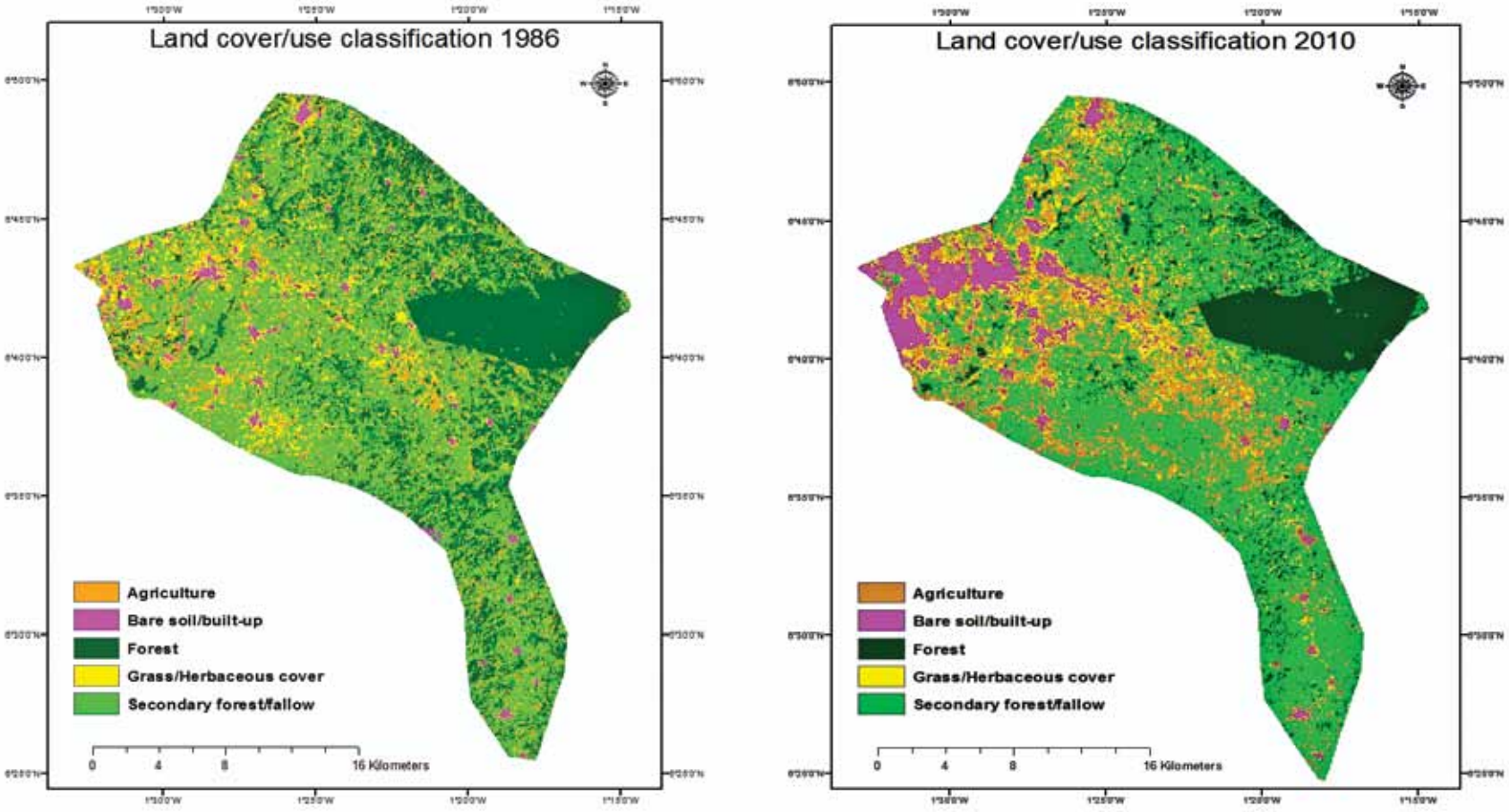


**Figure 13:** *Maps indicating land cover or use change within Ejisu-Juaben Municipality between 1986 and 2010*

### Land cover change over time

Land cover types changed drastically between 1986 and 2010 in the study area (Figure 13). For example, areas that were natural forests in the baseline year of 1986 reduced by 50% as at 2010. These were converted to other land uses (Table 3) including secondary forests (i.e. fallow lands), cultivated or agricultural lands, built up and bare areas with consequential impacts on carbon stocks in trees.

## Conclusion

The results suggest that vast differences exist in carbon stocks of above ground trees between the various land uses in the Bobiri Forest Reserve and its surroundings, with the natural forest (forest reserve) sequestering more carbon. Over time, these differences are being compounded by a shift from tree-based land use to tree-less land use epitomized by the change in status of the study area from Ejisu-Juaben District to Ejisu-Juaben Municipality.

# 3.0 DONOR FUNDED PROJECTS

## 3.1 Reducing Emissions from Deforestation and Forest Degradation through Collaborative Management with Local Communities

**Project Team Leader:** Blay, D.

**Start Date:** 2010

**Expected Completion Date:** 2014

The Ankasa Conservation Area, which incorporates the Nini-Suhien National Park and the Ankasa Resource Reserve, is considered the most biologically diverse forest ecosystem in Ghana. However, due to encroachment by local communities for unsustainable shifting cultivation and illegal logging in and around the area, the conservation area is being over-exploited resulting in deforestation and degradation. This leads to poverty-forest resource depletion cycle and decreased quality of environmental services including increased emission of greenhouse gases. Hence this project aims to contribute to sustainable management and conservation of Ankasa conservation area to improve the provision of environmental services and reduce GHG emissions.

Specifically its focus is to develop and implement participatory, good governance and management system for the Ankasa conservation area, determine the financial value of the environmental services as well as methods for measurement, assessment, reporting and verification (MARV) for forest carbon.

The outputs of the project include: a developed participatory management system; provision of financial value of environmental services by the conservation area; good governance mechanisms and benefit sharing arrangements; a well developed participatory method for measurement, assessment reporting and verification (MARV) for forest carbon. The project is participatory and thus builds on a high level of community involvement and capacity building to ensure sustainability.

## 3.2 Comparative studies on yield of *Volvariella volvacea* (oil palm mushroom), Pleurotus tuber-regium (Oyster mushroom) and *Auricularia auricula-judae* (wood ear mushroom) 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 2010

**Expected Completion Date:** November 2011

The project is sponsored by the West Africa Agricultural Productivity Programme (WAAPP). Mushrooms are well known and contribute food nutrients to the diet of many people especially the rural folks in several countries. They are normally collected from the wild but with the current rate of bush burning and

deforestation, collection of mushrooms from the wild in Ghana is generally threatened, leaving protected forest reserves as the only remaining source. 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. There is the need therefore, to improve upon the appropriate substrate and technology for maximum cultivation of indigenous edible mushrooms to avoid the over-dependence on the forest reserves or the cultivation of exotic mushrooms.

Ghana is endowed with enormous quantities of agricultural (e.g. cassava and yam peels) and forestry wastes and there is the need to utilise these, especially root and tuber wastes, to improve on the yield of edible and medicinal local mushrooms.

For this research, oil palm mushrooms were cultivated on low beds with dry cassava and yam peels. Cassava and yam peels were separately used on beds and then variously mixed with leucaena leaves, calcium carbonate and plantain leaves. Cassava and yam peels supplemented with plantain leaves induced early formation of pinheads. Combination of plantain leaves with either cassava or yam peels gave better yield than the cassava or yam peels alone. Cassava or yam peels supplemented with leucaena leaves and lime improved yield as compared to the yield from the yam or cassava peels only. 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.

## 3.3 Strengthening the capabilities of Forest Fringe Communities in Southern Ghana to halt Illegal Logging

**Project Team Leader:** Blay, D.

**Start Date:** 2011

**Expected Completion Date:** 2012

The developmental objective of this project is to improve the contribution of local communities to sustainable forest management (SFM) and reduce emissions from deforestation and forest degradation (REDD). The specific objective is to build capacities of local communities in forest policy, laws and agreements and determine motivational needs for monitoring and reporting of illegal logging in local communities. These objectives would be achieved through three outputs. The first involves sensitization of local communities with regard to National Forest Policy, Forest Laws, FLEGT/VPA and other agreements. The second output focuses on the development of local community capacity in monitoring and reporting and the last output entails an assessment of motivational needs of local communities to monitor and report illegal logging.

A study of the legal framework for forest reserves in Ghana indicates that most of the reserves are owned by corporate customary stools or clans. Customary law provides no restriction on destruction or use of trees, and national legislation seeks only to prohibit the destruction or sale of commercial timber

trees. An analysis of the procedures related to forest reserves showed that the laws governing them have stifled the local land-tenure systems and given local communities a disincentive to protect reserves. These procedures fail to properly take into account community rights and benefits for villages near the reserves and have alienated local communities. With few or no rights in the reserves, nearby farmers and communities have had no incentives to protect, manage, or invest in the resource. Outside the reserves, the lack of tree tenure and payments to farmers, together with inadequate compensation by concessionaires for damage to farms, have created not only a disincentive to plant or protect timber trees but also a strong motivation to destroy them before concessionaires can harvest them. Thus many landowners and farmers would rather negotiate secretly with chain-saw operators to have the trees on their land illegally harvested than allow the legitimate concessionaires to harvest the trees and pay token compensation.

**Figure 14:** *Illegal chainsaw activities at Afram Headwaters RWC*

To tackle illegal logging, Ghana signed and ratified FLEGT/VPA Agreement in 2009 but a report by Chatham House in July 2010 mentioned that 'Ghana did not appear to see any improvement in halting illegal logging over the last decade'. Illegal logging remains rampant in Ghana, estimated at two-thirds of its total production, most of which comes from artisanal logging. Illegal logging has not halted or even reduced because the local groups who in most instances initiate the logging are not involved in efforts to halt illegal logging. Another key problem is the lack of capacity on forest issues related to logging. Additionally, no efforts have been made to determine the motivational needs of local groups for monitoring and reporting of illegal logging. The causes of this are (1) lack of sensitization and training on logging issues such as forest policy, laws and agreements (2) lack of capacity in monitoring and reporting (3) lack of determination of motivational needs for monitoring and reporting which are the core issues that the project seeks to address. This project is funded by ACP/EU/FAO.

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

**Project Team Leader:** Opuni-Frimpong, E.

**Start Date:** 2010

**Expected Completion Date:** 2014

Sustainable supply and conservation of mahogany is threatened by overexploitation of natural mahogany forests which has exceeded natural regeneration for decades. Exacerbating the situation is the inability to establish mahogany plantations in their native range as a result of the incidence of *Hypsipyla robusta* (mahogany shoot borer). Mahogany shoot borer kills the main stem of the young trees, causing excessive forking and branching which results in tree mortality. As a consquence 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 to restore and conserve African mahogany. The developmental objective is to improve the sustainability of indigenous mahogany in Ghana by developing superior mahoganies that are ecologically adapted and insect tolerant and expand collaboration with industry and community tree farmers. The specific objective seeks to refine 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 mahogany manual.

In the second year of project implementation, some activities were undertaken to help realize the objectives of the project. These include: expansion of mahogany nurseries and provenance experimental plots to determine seed source with superior characteristics comprising of best growth rate, better tree form and tolerance to *Hypsipyla robusta* attack.

The implementation of the mahogany project has demonstrated that mahoganies can be grown in Ghana despite problems with pests though the final project results are not yet available to the public. The main challenge is to keep the interest in planting mahogany growing to restore the lead role mahogany plays in the timber industry in Ghana.

## 3.5 Domestication of *Allanblackia parviflora* in Ghana

**Project Team Leader:** Ofori, D.A.

**Start Date:** 2003

**Expected Completion Date:** on-going

This project is a Novella Africa initiative. *Allanblackia parviflora,* is a multipurpose indigenous fruit tree species that could be used in agroforestry systems with both environmental and economic benefits. The seed oil is of prime importance as a foreign exchange earner and is being developed as a rural based enterprise in many African countries notably Ghana, Nigeria, Cameroon and Tanzania. The seed oil is in high demand by Unilever Ghana for its food products and cosmetics. Currently, the supply of seeds from the wild is 5 per cent of the demand. There is therefore a need to domesticate *Allanblackia* to sustain the supply of *Allanblackia* seeds to feed both the local and foreign markets. Partners of Novella Africa are therefore encouraging the cultivation of the species for a sustainable supply of seed oil for the manufacturing of products such as soap, margarine etc.

**Figure 15:** *Allanblackia parviflora*

The objectives of this project are to sensitize and encourage farmers to participate in *Allanblackia* domestication and to integrate *Allanblackia* in farming systems and agroforestry development.

The project began by sensitization of farmers to take on *Allanblackia* domestication. This was followed by an inventory within Ghana to zone out its distribution. Fruits and seeds were collected from the distribution zone for genetic diversity analysis and also for the establishment of gene banks at Benso and Amantia. *Allanblackia* seeds are very dormant and can take seven (7) months to as long as four (4) years to germinate but the dormancy period is partially reduced by removal of seed coat before sowing.

**Figure 16:** *Germinated seeds of Allanblackia parviflora*

Large variations in morphological characteristics such as fruit and seed morphology were observed. Based on this, plus trees have been selected for mass propagation. The observed variations occur both within and among different populations. This suggests that the observed variability may have little to do with environmental factors but rather has a genetic basis that may be reflected in molecular DNA analysis currently in progress.

The study showed that addition of soil collected under an *Allanblackia* tree and/or commercial mycorrhiza to the potting medium significantly ($P < 0.05$) enhanced seedling growth and development. Shading (30 - 40% incident light) enhanced the survival of seedlings after potting. In order to improve the root system, quality cuttings and stock plant management practices are being undertaken. Management of wildlings of *Allanblackia* in cocoa farms and a study of the behavior of different propagule types of *Allanblackia* (seedlings, cuttings and grafts) in farming systems are in progress.

## 3.6 Developing alternatives to illegal Chainsaw Milling through Multi-Stakeholder Dialogue in Ghana and Guyana an EU Chainsaw Project

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

**Start Date:** 2007

**Expected Completion Date:** 2012

This project assessed among other things the background of chainsaw milling in Ghana; comparison of chainsaw milling with conventional sawmilling; drivers of chainsaw milling and analysed the effectiveness of policy and legal framework on the chainsaw ban.

In general, the study confirmed that the enforcement of the chainsaw ban has been ineffective, driven by a lack of adequate policy response to domestic

timber demand, price differentials of chainsawn and sawmill timber, high rural unemployment, uncertainties with tree tenure and benefit sharing, unclear legal framework, corruption and weak institutional governance and political interference.

The study concluded that enforcing chainsaw milling ban will be challenging unless the following critical conditions are simultaneously met:

- The timber industry is prepared to supply wood to the domestic market;
- Forest Services Division' (FSD) procedures are streamlined to allow for the processing of timber for domestic use;
- Resource governance is significantly improved and genuine political will for addressing chainsaw milling is secured.

Some policy interventions that could address the problem involves the enforcement of a scientifically supported sustainable annual allowable cut in the forest estate especially the reserves and stimulating tree planting to increase future supplies.

CSIR-FORIG in addition, participated in the development of a proposal for phase two which was approved by EU titled '*Supporting the integration of legal and legitimate domestic timber markets into Voluntary Partnership Agreements*' with a total budget of about 2.5 million Euros. This second phase technically begun in April 2011 and CSIR-FORIG is a partner expected to identify user-defined topics for research, synthesize, publish information and participate in a process to translate recommendations of phase 1 into policies. CSIR-FORIG participated in an International Project Coordination Meeting to define broad programme and activity areas on behalf of partners for 2012.

# 4.0 Commercialization And Information Division

The Division is comprised of three (3) sections namely: Information and Publications, Computer, Public Relations and Special Services. The Division is responsible for the coordination of all commercial activities of the Institute.

## 4.1 Commercialization Activities

The actual commercialization activities are however, undertaken by the special services section. The income generating activities are centered mainly on the following:

1. Sale of processed seeds
2. Sale of improved seedlings
3. Sale of wood thinnings
4. Consultancy services
5. Prekese syrup and honey production

During the year under review, a major activity carried out by the Institute as part of its commercialisation drive was to establish five hundred hectares (500 ha) of tree plantation at the Mankran Forest Reserve in the Offinso Forest District as part of Forestry Commission and Timber Industry Plantation project. Others include:

1. Synthesizing information on all technologies developed; and
2. Restructuring of all revenue generating sections to improve efficiency.

### Five hundred hectare plantation to support the timber industry

The forestry sector in Ghana contributes about 6 per cent to the gross domestic product. About 2.5 million people are directly or indirectly employed by the forest industry whose exports earned about US$180 million in the year 2007. To meet the shortfall in supply of wood raw materials, more intensive plantation forestry as opposed to mere exploitation forest management has been proposed. In view of this, the CSIR-FORIG was tasked by the Forestry Commission - Timber Industry (FC/Industry) Fund Committee to establish five hundred hectares (500 ha) of tree plantation at the Mankran Forest Reserve of Offinso Forest District in 2011.

One hundred and sixty one thousand five hundred (161,500) seedlings were nursed at the Mankran nursery site and three hundred and forty two thousand (342,000) seedlings at the National Tree Seed Centre (NTSC) at CSIR-FORIG. Two hundred and forty-six thousand (246,000) of these seedlings were sent to the site for planting. Species of seedlings nursed comprise of the following: *Cedrela odorata, Terminalia superba*, *Ceiba pentandra*, *Nauclea diderrichii*, *Cola gigantea* and *Tectona grandis*.

## CSIR-FORIG creates employment under FC-Industry Development Project

Two hundred and fifty (250) people were employed from Chiraa, Asuakwa, Akumadan, Tanokwaem and surrounding communities. They were engaged in nursery activities and site preparation as well as plot establishment. Bush fire and the use of agro chemicals by farmers has been a major obstacle to reforestation in the area. Therefore, 40 people were also engaged in fire patrolling especially during the dry season.

## Handbook on technologies developed at CSIR-Forestry Research Institute of Ghana

One initiative of the Division in 2011 was to prepare a handbook on technologies developed by the Institute. This project started in 2011 and is expected to be completed in 2013. In all, thirty five technologies have been identified under four broad themes namely: Forest Management and Plantation Development, Wood Processing and Utilization, Non-Timber Forest Products and Agroforestry. This publication will help create awareness amongst policy makers and all stakeholders on the achievements of CSIR- FORIG since its inception and would also enhance the image of CSIR-FORIG by bringing to light technologies developed over the years.

## Restructuring income generating sections

The Management Board of CSIR-FORIG at its last meeting during the year under review, recommended for a restructuring of the Revenue Generating Sections of the Institute for efficiency and profitability. Subsequently, a committee was constituted by the Director of CSIR-FORIG to critically examine all revenue generating sections and to propose solutions for improvement.

The committee listed products and services into three main categories namely: commercially viable ventures, potentially viable ventures and commercially unviable ventures. Recommendations by the Committee to improve revenue sections are as follows:

**Commercially viable ventures**

- The Institute should give priority to manufacturing of wood products because it has the potential to generate more income. The committee was of the view that CSIR-FORIG should continue operating the production section but all activities should be restricted to the production of coffins and doors. Other carpentry works such as furniture and souvenirs should be handled by the Wood Industry and Trade Division (WITD).
- Prekese syrup is one product that has been produced for many years by CSIR-FORIG but there is a lack of skilled personnel. The Institute should endeavour to train personnel to handle this venture. The Chemistry Section should provide ample information on the product and this should include:

active ingredients, nutritional value, medicinal value and shelf life or expiry date. In addition to this, the committee tasked the section to come out with other products from prekese such as prekese cube, powder and drink.

- To ensure continuity and excellence in seedling production, several people need training in the production of seedlings and outstations could also be tasked to raise seedlings upon instructions from the Institute. In addition to traditional species, the Institute should broaden its range to include ornamental plants.
- Honey production was also identified to have a huge potential to generate income due to its low cost of production. Beehives ought to be placed on CSIR-FORIG campus, increase the number of beehives at Bobiri Forest Reserve and other outstations to guarantee an all year round production. The committee recommended to the Institute to employ someone to harvest honey produced on behalf of the Institute at an agreed fee.
- A CSIR-FORIG shop must be established where all products will be sold. The block, adjacent to the exhibition room was identified as the ideal structure to be converted into a CSIR-FORIG shop subject to whether the occupants of that office could be relocated.

**Potentially viable ventures**

- As regards consultancy services, it is the view of the committee that every effort should be channeled into reorganization of the consultancy wing of CSIR-FORIG to include consultancies, contract research and part-time lecturing. Consultancy services that go to individuals must be discouraged.
- Training is an integral part of technology transfer and for it to be successful a training centre should be established. CSIR-FORIG has a number of technologies that could be transferred through training courses. Regular, well planned and scheduled training courses could be run as a commercial venture.

**Commercially unviable ventures**

- The committee noted that seed production was not a sustainable and profitable enterprise. As such it was not recommended as a revenue generating activity. Rather CSIR-FORIG should concentrate on the development of the National Tree Seed Centre to provide seeds to various stakeholders as a national duty.
- The committee was of the view that wood sales should not be classified as a commercial venture due to its unsustainable nature. However, if significant amounts of plantations could be established, it could go a long way to earn revenue on a sustainable basis for the Institute.
- The growing of mushrooms on a commercial scale was discouraged due to its short shelf life and effort required to grow them, it was anticipated that CSIR-FORIG could run into problems marketing and selling them. Its production on a commercial scale was therefore not recommended.

However, CSIR-FORIG could explore the possibility of producing compost bags of oyster mushrooms for sale. The committee observed that the processing area for producing the spawns was unhygienic and therefore recommended to Management to either change the location or improve the existing conditions.

# 5.0 Administration

The objectives of the Division are to:

- Provide support services and create an enabling environment to facilitate effective and efficient performance of work by all Divisions.
- 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 Administrative Matters

### 5.1.1 Upgrading and Promotions

The following officers were upgraded:

- Mrs. Naomi Appiah was upgraded to Marketing Officer with effect from 1st June, 2010.
- Mr. Shalom Daniel Addo-Danso was upgraded to Research Scientist effective 30th August, 2010
- Mr. William Kwadwo Dumenu was upgraded to Research Scientist effective 30th September, 2010
- Dr. Stephen Tekpetey-Lartey was upgraded to Research Scientist effective 1st July, 2011.

### Senior and Junior Staff Promotion

In all a total of 40 Senior and Junior Staff were promoted during the year 2010 and this took effect from 1st January, 2011.

The breakdown is as follows:

- Daily Rated Staff - 11
- Junior Staff - 17
- Senior Staff - 12

### 5.1.2 New Appointments

- One (1) new staff (Senior Staff) has been recruited for the Accra Guesthouse and two (2) Principal Technical Officers were recruited for CSIR-FORIG/FC/ Industry Plantation Project.

### Appointment of Acting Deputy Director

The Council approved the appointment of Dr. E.G. Foli, Senior Research Scientist as the new Acting Deputy Director effective 1st April, 2011.

## 5.2 Training

- Ten (10) officers are in school offering, BSc, MSc and PhD Programmes.

### Back from training

The following officers have completed their training and have since returned to post. They are:

1. Dr. Joseph Mireku Asomaning, PhD Seed Science Technology, KNUST
2. Dr. Sarfo Agyeman Derkyi, PhD Chemistry, KNUST
3. Dr. Stephen Lartey Tekpetey, PhD Wood Science and Technology, KNUST

## 5.3 Awards

The former Deputy Director, Dr. D.A. Ofori, all past Heads of Division, former TUC Chairman and an RSA representative on Internal Management Committee (IMC) were awarded for their dedicated service to the Institute during a Staff Durbar held on 17th May, 2011.

### Award for Prekese Syrup Production

CSIR-FORIG received an award for its Prekese syrup production. The Institute was selected as one of six (6) organizations for the 2010 SEED Initiative. The award consists of a plaque and cash amount of US$5,000.

### Award for CSIR-FORIG Management Board Members

The Management and Staff of CSIR-FORIG awarded three (3) Management Board Members with citations and gifts on 21st December, 2011. They include:

- **Mr. Edward Osei Nsenkyire** (Board Chairman)
  For his immense contribution to sustainable development of the forestry sector in Ghana in the area of Forest Administration and Management.
- **Nana Dwomoh Sarpong**
  For his significant contribution to the protection and sustainable management of water-bodies, sanitation and forest in Ghana.
- **Mr. Jacob Gyan Kwabena Owusu**
  For his significant contribution to the sustainable development of the forestry sector in the area of forestry education.

## 5.4 CSIR-FORIG hosts 228th Directors Management Committee meeting

CSIR-FORIG hosted the 228th Directors Management Committee (DMC) meeting held from 10th to 11th August, 2011. As part of the programme, members of the DMC

met all staff at a durbar on Thursday, 11th August, 2011. In attendance were the Director-General, Deputy Director-General and Directors of the various Institutes.

## 5.5 Sabbatical Leave

### On Sabbatical Leave

Dr. D.A. Ofori, a Chief Research Scientist and Deputy Director was offered a two-year sabbatical leave tenable at the World Agroforestry Centre (ICRAF) in Nairobi, Kenya effective 1st August, 2011 to 31st July, 2013.

### Back from Sabbatical Leave

Mrs. Margaret Sraku-Lartey, Principal Librarian returned from a two-year sabbatical leave on 1st September, 2011.

## 5.6 Retirements

Five (5) staff (One senior member, three senior staff and one junior staff) were retired compulsorily during the year 2011. A send-off party was organized for them on 21st December, 2011 and gifts were presented for their dedicated service to the Institute.

## 5.7 Bereavement

The Institute lost three (3) members of staff during the year under review namely: Messrs Kofi Asare (CSIR-FORIG campus Grounds and Gardens Section), Stephen Yankyerah (Mesewam Nursery) and Daniel Kontoh (Pra-Anum Research Centre).

## 5.8 Auction

Three (3) unserviceable vehicles (viz. a tractor and trailer, a bus and pick-up) were successfully auctioned in June 2011.

## 5.9 Visits to Forestry Research Institute of Nigeria (FRIN)

The former Deputy Director, Dr. D.A. Ofori led an eleven member delegation to the Forestry Research Institute of Nigeria (FRIN) from 28th February to 5th March, 2011. The purpose of the visit was to afford staff the opportunity to interact with a research institution in the region and to identify areas for possible collaboration.

## 5.10 Visits by distinguished persons

1. Dr. T. Wakatsuki, Kinki University, Japan.
2. Dr. Hamisi Dulla, ACT, Nairobi, Kenya.
3. Dr. Jules Bayala, ICRAF in Bamako, Mali.

4. Mr. Saidi Mkomwa, ACT in Nairobi, Kenya.
5. Dr. Kenneth Masuki, ICRAF, in Kampala, Uganda.
6. Mr. Jonathan Manuki, ICRAF, Nairobi, Kenya.
7. Dr. Jeremias Nowo, ICRAF, Nairobi, Kenya.
8. Dr. March Winwood, Harogate, UK.
9. Miss Sallyannie Muhoro, ICRAF, Nairobi, Kenya.
10. Dr. Moses Munjuga, ICRAF, Nairobi, Kenya.
11. Dr. Hamisi Sesiwas, ICRAF, Nairobi, Kenya.
12. Dr. Juan Oosteuenh, Unilever, Netherlands.
13. Mr. Rijk Sools, FORM International in Holland.
14. Dr. Ebenezer Asaah, ICRAF, Yaounde Cameroon.
15. Dr. Roger Leakey, Scotland
16. Dr. Fidelis Rutatina, Novel Development Limited, Tanzania
17. Dr. Ramni Jamnendaas, ICRAF Headquarters, Nairobi, Kenya.
18. Dr. Chris Buss, IUCN, Switzerland.
19. Miss M. Misbah, Unilever, Nigeria.
20. Dr. Stuart Crocker, United Arab Emirates.
21. Dr. Marc Graf, SECO-Bern, Switzerland.
22. Mrs. Brigitte Cucudet, Swiss Embassy, Accra.
23. Miss Patricia Poschner, BFH, Switzerland.
24. Mr. Kalevi Tervanen, Business Council, Finland.

## Visits to CSIR-FORIG' Exhibition Hall

A number of individuals and students visited the exhibition hall. Below is a list of some of the visits.

- Ninety students from the Department of Applied Biology, Faculty of Applied Sciences, UDS, Navrongo Campus visited CSIR-FORIG and the exhibition hall on 15th February, 2011.
- Sixty seven students from Kristo Asafo School at Gyinyase visited CSIR-FORIG and the exhibition hall on 18th March, 2011.
- One hundred and twenty students visited the exhibition hall as part of the Ghana Education Service Second National Science, Technology, Mathematics and Innovation Education (STMIE) camp for Senior High School Students.

- The Evergreen Club of Odumaseman Senior High School from the Manya Krobo District embarked on an educational visit to FORIG on l$^{st}$ April, 2011.
- Ninety final year students from the Department of Horticulture, University of Development Studies, Nyankpala Campus visited FORIG on 9$^{th}$ June, 2011 as part of their practical training programme.

## 6.0 Finance Division

Objectives of Finance Division are to:

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

**Table 4:** Financial summary for the year

| Government of Ghana | Inflows (GH¢) | Outflows (GH¢) | Variance (GH¢) |
|---|---|---|---|
| Personnel Emolument (P.E.) Note 1 | 3,447,547.00 | 3,840,227.00 | 392,680.00 |
| Administrative Expenditure (Note 2) | 130,600.00 | 282,618.00 | 152,018.00 |
| Service Expenditure (Note 1) | - | 37,400.00 | 37,400.00 |
| IGF | 206,905.00 | 131,162.00 | 75,743.00 |
| Guest Houses | 72,392.00 | 25,138.00 | 47,254.00 |
| Production Unit | 50,840.00 | 38,488.00 | 12,352.00 |
| **Total** | **3,908,284.00** | **4,355,033.00** | **446,749.00** |

| Donor (Note 3) | Inflows | Outflows | Variance |
|---|---|---|---|
| Total | 791,223.92 | 613,961.00 | 177,262.92 |

Note 1: P.E. received during the year includes GH¢579,330 which was part of arrears from the previous year. By close of 2011, P.E. for the last quarter had not been received.
Note 2: Administrative grant for the year was received up to June 2011.
Note 3: Donor inflows in various currencies have been converted to US Dollars.

# 7.0 Appendices

## Appendix I

### Publications/Training Programmes/Conferences Attended

### Books

**Tekpetey, S.L.** 2011. Bamboo Resources in Ghana: Diversity, Properties, Products and Opportunities. ITTO sponsored publication, 96 pp. ISBN 978-9988-1-62696.

**Hawthorne, W.D., Marshall, C.A.M., Abu-Juam, M. and Agyeman, V.K.** 2011. The Impact of Logging Damage on Tropical Rainforests, their Recovery and Regeneration: an Annotated Bibliography. Oxford Forestry Institute. 123 pp. ISBN 9780850741688.

### Book Chapters

**Foli, E.G. and Makumgwa, S.** 2011. Enhancing Adaptation of Forests and People In Africa: Development of Pilot Cases for Selected Forest Ecosystems in Ghana and Malawi (Editor: M. Kleine). IUFRO/FORNESSA/GIZ. Vienna, 2011. 67pp.

**Oduro, K.A., Foli, E.G., Mohren, G.M.J. and Dumenu, W.K.** 2011. *Sustainable Management of Tropical Rainforests - The CELOS Management System: Experiences from Ghana*. (Chapter 14, pp 242-254) Tropenbos International Ghana, Ltd. ISBN 978-90-5113-101-7.

### Refereed Journal Papers

**Abugre, S., Apetorgbor, A.K., Antwiwaa, A. and Apetorgbor, M.M.** 2011. Allelopathic effects of ten tree species on germination and growth of four traditional food crops in Ghana. *Journal of Agricultural Technology* 7(3): 825-834.

**Amissah, L., Kyereh, B. and Agyeman, V.K.** 2011. Wildfire as dominant force driving farming systems in the forest transition zone of Ghana. *Ghana Journal of Forestry* Volume 27 (2), 52-65.

**Apetorgbor, M.M. and Bosu, P.P.** 2011. Occurrence and control of Paper Mulberry (*Broussonetia papyrifera*) in parts of Southern Ghana. *Ghana Journal of Forestry* Vol. 27 (2): 40-51.

**Appiah-Kubi, E., Adom-Asamoah, M., Frimpong-Mensah, K. and Tekpetey, S.L.** 2011. Capacity of Sawmills and Carpentry Workshops for Processing Lesser Used Species in Ghana. *Ghana Journal of Forestry*. Vol. 27 (3), 2011, pp63 – 70.

**Anglaaere, L.C.N., Cobbinah, J., Fergus, L., Sinclair, M. and McDonald, A.** 2011. The effect of land use systems on tree diversity: farmer preference and species

composition of cocoa-based agroecosystems in Ghana. *Agroforestry Systems* 81: 249 – 265.

**Anyomi, K.A., Dieter, R.P., Kyereh, B. and Anglaaere, L.C.N.** 2011. Influence of age and cropping system on tree population structure in South West Ghana. *African Journal of Agricultural Research* 6(4): 873-881.

**Asomaning, J.M.** 2011. Seed Germination in *Khaya anthotheca*, *Entandrophragma angolense* and *Mansonia altissima*- three Important Indigenous Forest Trees Species in Ghana. *Ghana Journal of Forestry Vol. 27(3): 33-44.*

**Asomaning, J.M., Olympio, N.S. and Secande, M.** 2011. Dessication Sensitivity and Germination of Recalcitrant *Garcinia kola* Heckel Seeds. *Research Journal of Seed Science 4(1): 15-27*, 2011. *ISSN 1819-3552/ DOI: 10.3923/rjss. 2011.15.27.*

**Asomaning, J.M., Secande, M. and Olympio, N.S.** 2011. Germination Responses of *Terminalia superba* Engl. and Diels Seeds on the 2-Way Grant's Thermogradient Plate. *Research Journal of Seed Science* 4(1): 28-39, 2011. ISSN 1819-3552/ DOI: 10.3923/rjss. 2011.28.39.

**Asomaning, J.M., Moctar, S. and Olympio, N.S.** 2011. Water Sorption Isotherm Characteristics of Seeds of Six Indigenous Forest Tree Species in Ghana. *West African Journal of Applied Ecology,* Vol. 18: 15-28.

**Asamoah, K.A., Duah-Gyamfi, A. and Dabo, J.** 2011. Ecological impacts of uncontrolled chainsaw milling on natural forests. *Ghana Journal of Forestry* 27: 12-23, 2011.

**Asamoah, K., Appiah, N. and Daramani, B.** 2011. *Ghana Journal of Forestry*: Trend, Challenges and Way Forward, *Ghana Journal of Forestry*, Vol. 27 (2), pp. 112-121.

**Ayarkwa, J., Owusu, F.W. and Appiah, J.K.** 2011. Steam bending qualities of eight timber species of Ghana. *Ghana Journal of Forestry*, Vol. 27 (2), 2011, pp11 – 22.

**Ayarkwa, J., Owusu, F.W. and Appiah, J.K.** 2011. Cold bending performance of some selected timber species in Ghana. *Ghana Journal of Forestry*, Vol. 27 (3), 2011, pp94 – 104.

**Acheampong, E. and Marfo, E.** 2011. Chainsaw operators' perception of the availability of timber resources and their willingness to pay for timber harvesting rights. *Ghana Journal of Forestry* Vol. 27, pp37-49.

**Acheampong, E. and Marfo, E.** 2011. The impact of tree tenure and access on chainsaw milling in Ghana. *Ghana Journal of Forestry* Vol. 27, pp 68-86

**Bosu, P.P. and Nkrumah, E.E**. 2011. Companion planting of insect repellent plants with *Khaya ivorensis* and its impact on growth and *Hypsipyla* shoot borer attack of the host species. *Ghana Journal of Forestry* Vol. 27 (2), 40-51

**Bonsi, R., Hammett, A.L. and Ametsitsi, G.** 2011. Assessing the Current Situation of Ghana's Forest Products Industry. *Ghana Journal of Forestry*, 27: (3), 1-14.

**Derkyi, N.S.A., Adu-Amankwa, B., Sekyere, D. and Darkwa, N.A.** 2011. Rapid Prediction of extractives and polyphenolic contents in *Pinus caribaea* bark using near infrared reflectance spectroscopy. *International Journal of Applied Sciences* (IJAS), Volume (2): (1): 1 – 11.

**Derkyi, N.S.A., Amankwa, A., Sekyere, D. and Darkwah, N.A.** 2011. Application of near Infrared spectroscopy in cheometric modeling of Tannin content stiasny number of *Pinus carribaea* Bark: *Journal of Emerging Trends in Engineering and Applied Sciences* (TETEAS) 2 (1): 132-136.

**Derkyi, N.S.A., Amankwa, A., Sekyere, D. and Darkwah, N.A.** 2011. Optimization of process parameters using Response surface methodology for the Extraction of Formaldehyde-condensable Phenolics from *Pine* Bark: *Journal of Emerging Trends in Engineering and Applied Sciences* (JETEAS) 2(1): 64-69.

**Derkyi, N.S.A., Amankwa, A., Sekyere, D. and Darkwah, N.A.** 2011. Optimum Acetone and Ethanol Extraction of polypheanols from *Pinus caribaea* Bark: Maximizing Tannin Content using response surface methodology. *Chemical product and process modeling*, Vol. 6, Issue 1, Berkely Electronic Press.

**Derkyi, N.S.A., Amankwa, A., Sekyere, D. and Darkwah, N.A.** 2011 Development of bioenergy conversion alternatives for climate change mitigation: *International Journal of Energy and Environment*, Vol. 2 Issue 3, pp 525-532.

**Derkyi, N.S.A., Amankwa, A., Sekyere, D. and Darkwah, N.A.** 2011. Rapid prediction of extractives contents in *Pinus caribaea* using Near Infra-red Reflectance spectroscopy: *International Journal of Pure and Applied Sciences*. Vol. 6: No.3; pp377 -383.

**Djagbletey, G.D., Addo-Danso, S.D., Foli, E.G., Cobbinah, J.R., Oteng-Amoako, A.A., Nkrumah, E.E. and Frimpong-Mensah, K.** 2011. Resistance of *Milicia* species to *Phytolyma lata* (Psyllidae): the role of leaf anatomical and morphological structures. *Ghana Journal of Forestry*, 27(3): 71-79.

**Djagbletey, G.D., Ofori, D.A. and Cobbinah, J.R.** 2011. Artificial flowering in *Triplochiton scleroxylon*. *Journal of Tropical Forest Science* 23(2): 152–158.

**Feldpausch, T.R., Banin, L., Phillips, O.L., Baker, T.R., Lewis, S.L., Quesada, C.A., Affum-Baffoe, K., Arets, E.J.M.M., Berry, N.J., Bird, M., Brondizio, E. S., De Camargo, P., Chave, J., Djagbletey, G.D., Domingues, T.F., Drescher, M., Fearnside, P. M., França, M.B., Fyllas, N.M., Lopez-Gonzalez, G., Hladik, A., Higuchi, N., Hunter, M.O., Iida, Y., Salim, K.A., Kassim, A.R., Keller, M., Kemp, J., King, J.C., Lovett, B.S., Marimon, B.H., Marimon-Junior, E., Lenza, A.R., Marshall, D.J., Metcalfe, E.T.A., Mitchard, D.A., Moran, E.F., Nelson, B.W., Nilus, R., Nogueira, E.M., Palace, M., Patiño,**

**S., Peh, K.S.H., Raventos, M.T., Reitsma, J.M., Saiz, G., Schrodt, F., Sonké, B., Taedoumg, H.E., Tan, S., White, L., Wöll, H. and Lloyd, J.** 2011. Height-diameter allometry of tropical forest trees. Biogeosciences, Volume: 8, Issue: 5, Publisher: Copernicus Publications, Pages: 1081-1106.

**Frimpong-Manso, J., Obodai, M., Dzomeku, M. and Apetorgbor, M.M.** 2011. Influence of rice husk on growth and yield of *Pleurotus ostreatus* (Jacq. ex. Fr.) Kummer. *International Food Research Journal* 18: 249-254.

**Marfo, E. and Acheampong, E.** 2011. Estimating the number of jobs created by chainsaw activities in Ghana. *Ghana Journal of Forestry* Vol. 27, pp 1-11.

**Nutakor, E., Marfo, E. and Osei-Tutu, P.** 2011. Socio-political constraints to the enforcement of forest laws: a case study of chainsaw operations in Ghana. *Ghana Journal of Forestry* Vol. 27, pp 24-36

**Obeng, E., Mensah, K. and Pentsil, S.** 2011. Carving out indigenous tree species to sustain rural livelihood. *Ghana Journal of Forestry*, Vol. 27 (2), 85-96

**Obiri, B.D. and Damnyag, L.** 2011. Socio-economic contribution of illegal chainsaw milling to the Ghanaian rural economy. *Ghana Journal of Forestry*. Vol. 27, 50-67.

**Obiri, B.D., Agyeman, V.K., Kyereh, B., Nutakor, E., Obeng, E.A., Agyeman, A. and Britwum Acquah, S.** 2011. Perception and Participation of local communities in tree planting initiatives in Northern Ghana. *Ghana Journal of Forestry:* Vol. 27 (3), 80-93.

**Oduro, K.A., Agyeman, V.K. and Gyan, K.** 2011. Implementing timber legality assurance regime in Ghana: a review of stakeholders concerns and current institutional constraints. *Ghana Journal of Forestry*: 27 (2), 1-10.

**Oduro, K.A., Marfo, E., Agyeman, V.K. and Gyan, K.** 2011. One hundred years of forestry in Ghana: A review of policy and regulatory discourses on timber legality. *Ghana Journal of Forestry*: 27 (3), 15-32.

**Ofori, D.A., Peprah, T., Cobbinah, J.R., Atchwerebour, H.A., Osabutey, F., Tchoundjeu, Z., Simons, A.J. and Jamnadass, R.** 2011. Germination requirements of *Allanblackia parviflora* seeds and early growth of seedlings. *New Forests* 41:337-348.

**Owusu, F.W., Appiah, J.K., Damnyag, L. and Blay, D.** 2011. Comparative analysis of recovery efficiencies of some milling techniques in Ghana; *Ghana Journal of Forestry*, Vol. 27, 2011 (Special Edition), pp87 – 102.

**Schoneveld, G., German, L. and Nutakor, E.** 2011. Land-based investments for rural development? A grounded analysis of the local impacts of bio-fuel feedstock plantations in Ghana. *Ecology and Society*, Vol. 16, No. 4, Art. 10.

## Workshop And Conference Papers

**Amissah, L.** 2011. Fire Behaviour. A power-point presentation delivered at a Facilitation Forum for the Utilisation of Community Fire Guidelines and Manual for Ghana. Organised by the IUCN - World Conservation Body, 7th – 8th April 2011, Miklin Hotel, Kumasi, Ghana.

**Ametsitsi, G.K.D., Owusu-Afriyie, K. and Foli, E.G.** 2011. Climate change resilience status of Ghana. A power-point presentation delivered at the Scientific Renaissance of Africa Day Symposium, June 28, 2011. Ghana Atomic Energy Commission, Kwabenya, Accra.

**Appiah-Kubi, E. and Tekpetey, S.** 2011. Wood Processing Capacity of sawmills and carpentry Workshops in Ghana. 20th International Wood Machining Seminar (IWMS-20), Skelleftea, Sweden. Organized by Lulea University of Technology Skelleftea, Sweden, June 7-10, 2011. Sponsored IUFRO-SPDC.

**Appiah-Kubi, E. and Tekpetey, S.L.** 2011. Wood in Housing in Ghana: Why the low interest? Proceedings of FAO international conference on the joy and Art of Wood held at Bangalore, India, 19-22 October, 2011.

**Appiah-Kubi, E. and Tekpetey, S.** 2011. Quality Control and Grading of Sawn Timber from Mills in southern Ghana: Constraints and Opportunities 20th International Wood Machining Seminar (IWMS-20), Skelleftea, Sweden. Organized by Lulea University of Technology Skelleftea, Sweden, June 7-10, 2011. Sponsored IUFRO-SPDC.

**Appiah-Kubi, E. and Tekpetey, S.** 2011. Exploring barriers to the trade and use of lumber from sawmills in Ghana 65th Forest Product Society International Convention/SWST Annual Convention. Doubletree Hotel, Portland, Oregon, USA/. 19-22 June 2011.

**Appiah-Kubi, E. and Tekpetey, S.** 2011. Training Workshop on Legality Assurance System for FLEGT Implementation in Ghana 65th Forest Product Society International Convention / SWST Annual Convention. Doubletree Hotel, Portland, Oregon, USA/. 19-22 June 2011.

**Appiah-Kubi, E., Adom-Asamoah, M., Kankam, C. and Brunner, M.** 2011. The Mechanical Properties of four lesser known timber species in Ghana. Proceedings of the 5th National Conference of the Ghana Society of Agricultural Engineering held at the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, September 22-23, 2011.

**Ametsitsi, G.** 2011. The Role of Forestry Research Institute of Ghana (FORIG) in tropical forest research. Colloquium presented to Nature Conservation and Plant Ecology Group Wageningen University, The Netherlands. November 20, 2010.

**Ametsitsi, G., Owusu-Afriyie, K. and Foli, E.G.** 2011. Climate Change Resilience Status of Ghana. A paper presented on the occasion of Scientific Renaissance Day of Africa, marked at Ghana Atomic Energy Commission Accra, June 28, 2011.

**Ametsitsi, G., Bosu, P., Djagbletey, G., Addo-Danso, S., Foli, E.G. and Cobbinah, J.R.** 2011. Assessment of Coping and Adaptation Strategies to the Effects of Climate Change in Offinso North and South Districts of Ashanti – Ghana. A paper presented at the 22nd AGM held at Bunso, October 22, 2011.

**Ametsitsi, G.** The Role of African tropical rainforest on carbon sequestration and climate change: A case study of Ankasa National Park. Ghana Forestry Commission headquarters.

**Blay, D., Damnyag, L., Dwomoh, F.K., Anglaaere, L. and Owusu-Afriyie, K.** 2011. Community Fire Management, Livelihoods and Restoration of Fire-Degraded Areas: the Case of Three Forest Districts in Ghana. Paper presented at the 5th International Wildfire Conference, Sun City, South Africa, 9-13 May 2011.

**Dumenu, K.W., Obeng, E.A., Samar, S.B., Owusu-Sekyere, E. and Asiedu-Opoku, E.** 2011. Understanding the dynamics of climate change impact on forest dependent livelihoods in rural Ghana: Implication for climate change resilient policy. Paper presented at Klima 2011 conference for 7th – 12th November, 2011. (http://www.climate2011.net).

**Dwomoh, F.K.** 2011. Rehabilitating degraded tropical forest ecosystems by local communities: A case study from Ghana. Oral presentation at the Center for Forest Disturbance Science, Athens, Georgia USA, 6th June 2011.

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**Owusu, F.W., Appiah, J.K., Ofori, J., Foli, E., Essien, C., Sekyere, D., Zorve, G.K., Boakye, F. and Arthur, P.L.** 2011. Turning an invasive wood species into timber for the tertiary and construction industries in Ghana. The 5th National Conference of Ghana Society of Agricultural Engineering (GSAE). Theme: Agricultural engineering for commercial food production and environmental sustainability in Ghana. Held at KNUST, Kumasi from 21st – 23rd September 2011.

**Owusu, F.W.** 2011. Challenges to Promotion and marketing of Lesser Used Timber Species. 15th Annual General Meeting of Ghana Institute of Foresters. Theme: "Building Viable Wood and Forest Based Industries for Sustainable National Development- Role of the Forester". Held at Royal Lamerta Hotel, Kumasi from 10th – 11th November 2011.

**Owusu, F.W., Owusu, A.K., Duah-Gyamfi, K. and Ametsitsi, G.** 2011. Processing and utilization of timber species in Ghana; Optimization of timber through efficient processing and availability and utilization of bamboo species in Ghana. Training course for consultants from Gamwood Ltd, Nkawkaw. June 6-13, 2011, held at CSIR-FORIG, Fumesua.

**Owusu-Afriyie, K. and Foli, E.G.** 2011. Independent technical assessment of the National Forest Plantation Development Programme in the Brong Ahafo, Northern, Upper East and Upper West Regions: A progress report. A power-point presentation delivered at the Ministry of Lands & Natural Resources. December 16, 2011, MLNR, Accra.

**Obiri, B.D., Tetteh, F.M., Owusu-Afriyie, K. and Obeng, E.A.** 2011. Economic incentives necessary to induce adoption of mitigation practices in Agriculture. Paper presented at an IFPRI-SRI Technical Workshop on Climate Change Mitigation in Agriculture. November 10, 2011. CSIR-STEPRI, ACCRA. Sponsored by the International Food Policy Research Institute and organised by CSIR-Soil Research Institute.

**Owusu-Afriyie, K.** 2011. The Ghanaian forests and what they contain, with emphasis on the flora. A power-point presentation delivered at a Training Session organised for Consultants to Gamwood Ltd., Nkawkaw. JUNE 6, 10 & 13 2011. CSIR-Forestry Research Institute of Ghana, Kumasi.

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**Tekpetey, S. and Appiah-Kubi, E.** 2011. Development of Sustainable Bamboo Industries in Ghana: The Factors that interplay. 20th International Wood Machining Seminar (IWMS-20), Skelleftea, Sweden. Organized by Lulea University of Technology Skelleftea, Sweden, June 7-10, 2011. Sponsored IUFRO-SPDC

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## Technical/Consultancy Reports

**Appiah, J.K., Owusu, F.W., Damnyag, L. and Blay, D.** 2011. Physical properties and drying characteristics of trees on farmlands in the Central and Western regions of Ghana. Technical report submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities", Pp. 35-49, 2011.

**Damnyag, L., Blay, D. and Owusu, F.W.** 2011. Impact of on-farm tree revenues on rural livelihoods in two forest districts of Ghana. In: Owusu, F.W.**;** Appiah, J.K.;

Damnyag, L. & Blay, D., Technical reports submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities". Pp. 78-96.

**Foli, E.G. and Dumenu, W.K.** 2011. Proposal for Vertical and Horizontal Benefit Sharing Options for REDD+ Implementation in Ghana. Synthesis Report prepared for the IUCN Pro-Poor REDD (PPR) Project. CSIR-FORIG, Kumasi. December 2011. 22 pp.

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**Foli, E.G., Addo-Danso, S.D., Acquah, S.B. and Pentsil, S.** 2011. Proposal for Training and Capacity Building (CB) activities for REDD implementation in Ghana. Final Consultancy report submitted to International Union for the Conservation of Nature (IUCN), Ghana, 127 pp.

**Kleine, M., Foli, E.G., Agyeman, V.K. and Addo-Danso, S.D.** 2011. Enhancing adaptation of forests and people in Africa-development of pilot cases for selected forest ecosystems: the Offinso District in north-western Ghana. Final Report, IUFRO-FORNESSA/GIZ Project, IUFRO Special Programmes for Developing Countries. 58 pp.

**Marfo, E.** 2011. Analysis of implications of land tenure trends and conflicts in the Wassa Amenfi West District for REDD implementation in Ghana. Final Report to the IUCN Pro-poor REDD Project, June 2011.

**Marfo, E.** 2011. Analysis of what the Case for Incorporation of Customary law into and Administration Means for REDD Implementation in Ghana. Draft Report to IUCN Pro-poor REDD project, July 2011.

**Marfo, E., Blay, D., Owusu, F.W., Damnyag, L. and Appiah, J.K.** 2011. Identification of gaps in policy and regulatory frameworks on governance related to processing of trees on farmlands and logging residues. In: Owusu, F.W.; Appiah, J.K.; Damnyag, L. & Blay, D., Technical reports submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities". Pp. 97-137, 2011.

**Mikkola, E. and Britwum Acquah, S.** 2011. A root to knowledge exchange – Forestry Research Network of Sub-Saharan Africa. Wood Focus Magazine, Issue 1, 2 pp.

**Owusu, F.W., Appiah, J.K., Damnyag, L. and Blay, D.** 2011. Processing and utilization of trees on farmlands and logging residues through collaboration

with local communities. Technical reports submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 147 pp.

**Owusu, F.W., Appiah, J.K., Damnyag, L. and Blay, D.** 2011. Production of lumber from trees on farmlands and logging residues at six communities in Ghana. In: Owusu, F.W.; Appiah, J.K.; Damnyag, L. & Blay, D., Technical reports submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities". Pp. 3-20, 2011

**Owusu, F.W., Damnyag, L., Appiah, J.K. and Blay, D.** 2011. Processing of trees on farmlands with logosol facilities: Assessment of capacities of machine operators and supervisors. In: Owusu, F.W.; Appiah, J.K.; Damnyag, L. & Blay, D., Technical reports submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities". Pp. 61-67, 2011

**Owusu, F.W., Appiah, J.K., Damnyag, L. and Blay, D.** 2011. The mechanical strength properties of ten timber species from trees on farmlands at some communities in the Central and Western regions of Ghana. In: Owusu, F.W.; Appiah, J.K.; Damnyag, L. & Blay, D., Technical reports submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities". Pp. 50-57, 2011

**Owusu, F.W., Appiah, J.K., Damnyag, L. and Blay, D.** 2011. Evaluation and grading of lumber produced from trees on farmlands and logging residues. In: Owusu, F.W.; Appiah, J.K.; Damnyag, L. & Blay, D., Technical reports submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities". Pp. 21-32, 2011

**Owusu, F.W., Appiah, J.K., Damnyag, L. and Blay, D.** 2011. Environmental impacts assessment on farmlands: Processing of trees on farmlands into lumber using improved chainsaw (logosol) facilities in some communities of Ghana. In: Owusu, F.W.; Appiah, J.K.; Damnyag, L. & Blay, D., Technical reports submitted to ITTO on an ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities". Pp. 68-77, 2011

**Owusu, F.W., Damnyag, L., Blay, D. and Appiah, J.K.** 2011. Improved chainsaw milling in the small-scale informal timber sector of Ghana using logosol: A manual for domestic timber entrepreneurs. Final manual published and submitted to ITTO. ITTO-CSIR-FORIG project PD 431/06 "Processing and utilization of trees on farmlands and logging residues through collaboration with local communities". 35 pp.

**Oteng-Amoako, A.A. and Obeng, E.A.** 2011. *Diospyros kamerunensis* Gürke. [Internet] Record from Protabase. Lemmens, R.H.M.J., Louppe, D. & Oteng-Amoako, A.A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. < http://database.prota.org/search.htm>. Accessed 13 January 2012.

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**Obeng, E.A.** 2011. *Holoptelea grandis* (Hutch.) Mildbr. In: Lemmens, R.H.M.J., Louppe, D. & Oteng-Amoako, A.A. (Editors). Prota 7(2): Timbers/Bois d'œuvre 2. [CD-Rom]. PROTA, Wageningen, Netherlands. http://database.prota.org/PROTAhtml/Holoptelea%20grandis_En.htm

**Oppong, S.K., Addo-Danso, S.D., Adu-Bredu, S. and Obiaw, E.** 2011. Workshop Report: Capacity Needs for Redd+ Implementation in Ghana: *Submitted to African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE).* Excelsa Lodge, Kumasi. 4th November, 2011.

**Oppong, S.K., Addo-Danso, S.D., Adu-Bredu, S. and Obiaw, E.** 2011. Capacity Building For Reducing Emissions from Deforestation and Forest Degradation (REDD+) Readiness and Implementation in Africa: REDD+ Capacity Desk Study Country Report: Ghana. *Submitted to African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE)*

**Obiri, B.D., Fening, J., Yeboah, E., Gaisie, E. and Adjei, R.** 2011. Cassava Production, Processing, utilization and marketing in the Wenchi and Ejura Sekyere Odumase Districts of Ghana. Technical Report, WAPP Cassava-Legume Technology Project. SRI, Kwadaso

**Obiri, B.D. and Nutakor, E.** 2011. Assessment of the wood fuel market chain for the development and marketing of bamboo charcoal and briquette in Ghana. Technical Report, INBAR-China

**Ofori, D.A., Gyimah, A., Obiri Darko, B., Adam, K.A., Addae, A. and Jimoh, S.O.** 2011a. Ethnobotany of some selected medicinal plants. Technical Note No. 4, Forestry Research Institute of Ghana, 28 pp.

**Stanturf, J.A., Blay, D., Schelhas, J., Johnson, C., O'Brien, J.J., Dwomoh, F., Sparkler, S. and Otis, S.** 2011. Community-Based Carbon Monitoring Pilot Project, Ghana, 2009-2010. Final report to International Programs/US Agency for International Development-West Africa Mission.

**Wit, M., Zagt, R., Marfo, E., Nketiah, K.S., Mckeown, J.P. and Asare, A.** 2011. The formalisation and integration of the domestic timber market into Legality Assurance System: Ghana. Commissioned report for European Forest Institute, November 2011.

## Training Programmes Attended

**Addo-Danso, S.D.** Capacity Building Training Workshop in National Biological Diversity Clearing House Mechanism, Kumasi-Ghana, 21st -25th February, 2011

**Addo-Danso, S.D.** Hands-on Capacity Building Training Programme on Designing and Preparation of National Greenhouse Gas Inventory as part of Monitoring Reporting Verification (MRV) System for NAMAs and REDD+ in Ghana, Kumasi, Ghana , 23-30 October, 2011

**Addo-Danso, S.D.** In-Country Training Workshop on the Agriculture and Land Use (ALU) National Greenhouse Gas (GHG) Inventory Software and Other Inventory Tools, Asutuare, Ghana, 1st – 4th August, 2011

**Britwum Acquah, S.** Training Workshop on Blended Learning Techniques, University of Eastern Finland, 21st November – 1st December, 2011.

**Dwomoh, F.K.** Hexagon 2011 International Conference - ERDAS Sessions & Training, Orlando, Florida, USA, June 6 – 9, 2011.

**Dwomoh, F.K.** 2011. Training workshop on chainsaw safety. CFDS, US Forest Service Forestry Sciences Laboratory in Athens, Georgia USA, 22-23 March.

**Dwomoh, F.K.** GIS Training Workshop on Ghana Carbon Mapping. CERSGIS, University of Ghana, Legon- Accra, February 14-17.

**Oduro, A.K.** Training course on 'Improving Forest Governance' at the Centre for International Development (CIDT) of the University of Wolverhampton, UK. June 1-28, 2011.

**Obeng, E.A.** Training course on 'Improving Forest Governance', University of Wolverhampton, UK, 1st June - 28th June 2011.

## Workshops And Conferences Attended

**Addo-Danso, S.D.** Peace Corps Environment Partners meeting. Coconut Regency Hotel, Accra, 17th February, 2011.

**Addo-Danso, S.D.** Capacity Needs for REDD+ Implementation in Ghana Workshop, Kumasi, Ghana, 4th November, 2011.

**Addo-Danso, S.D.** REDD+ Project Methodology Development Workshop, Nairobi, Kenya, 20th-21st September, 2011.

**Adu-Bredu, S.** Consultative meeting on the Development of Intellectual Property Rights Policy for Council for Scientific and Industrial Research. *West African Agricultural Productivity Programme (WAAP)* CSIR-STEPRI, Accra. 24th to 25th March, 2011.

**Adu-Bredu, S. and Foli, E.G.** Proposed REDD+ Project and Forest Investment Project. *Joint Forest Investment Programme (FIP) Mission*, *Ministry of Lands and Natural Resources*. Miklin Hotel, Accra 30th May-6th June 2011.

**Adu-Bredu, S.** Seminar on Growing of Paulownia. *Paulownia Trees.Com,* Dublin, Georgia, USA. 2nd to 3rd August, 2011.

**Adu-Bredu, S.** Tree Crops Policy National Stakeholders workshop. *Ministry of Food and Agriculture.* Coconut Grove Regency Hotel, Accra. 23rd August, 2011.

**Adu-Bredu, S.** Evidence and Lessons from Latin America (ELLA) Programme workshop. *KITE* office, Accra. 8th September, 2011.

**Adu-Bredu, S.** REDD+ Methodology Development Workshop: Capacity Needs for REDD+ Implementation in Sub-Sahara Africa. African Network for Agriculture, Agroforestry and Natural Resources Education, 20th to 21st September, 2011, Nairobi, Kenya.

**Adu-Bredu, S.** Capacity needs for REDD+ implementation in Ghana at Excelsa lodge, Kumasi, 4th November, 2011.

**Ametsitsi, G.** Member of FORIG Team visit to sister research institute in Nigeria (FRIN) to identify possible areas of collaboration. 28th February - 5th March 2011

**Ametsitsi, G.** West Africa Agriculture Productivity Programme (WAAPP) Workshop on Agricultural Policies in Ghana, from 8th-9th August, at CSIR-Soil Research Institute, Kumasi

**Apetorgbor, M.M.** Study tour by selected FORIG Staff (Scientists, Administrators and Technical Staff) to Forestry Research Institute of Nigeria and University of Ibadan. 28th February to 4th March, 2011. Member

**Apetorgbor, M.M.** Consultative meeting with Board Members of Forestry Commission and Timber Industry. 25th February, 2011, FC Conference Room, Accra. Participant

**Apetorgbor, M.M.** Meeting to review Progress Reports and Workplans at Cocoa Research Institute of Ghana. June 1-3, 2011, CRIG, New Tafo-Akim.

**Apetorgbor, M.M.** West Africa Agricultural Productivity Programme (WAAP) - Ghana: West Africa Root and Tuber Crops Conference. 'The role of root and tuber crops in the socio-economic and industrial development of West Africa'. 12th-16th September, 2011, Mensvic Grand Hotel, East Legon, Accra.

**Apetorgbor, M.M.** Forum for farmers and processors on root and tuber crops. 18th October, 2011, CSIR-Crops Research Institute, Kumasi.

**Amissah, L.** Facilitation Forum for the Utilisation of Community Fire Guidelines and Manual for Ghana. Organised by the IUCN - World Conservation Body, 7th – 8th April 2011, Kumasi, Ghana.

**Appiah-Kubi, E. and Tekpetey, S.** 2011. 20th International Wood Machining Seminar (IWMS-20), Skelleftea, Sweden. Organized Lulea University of Technology Skelleftea, Sweden, June 7-10, 2011. Sponsored IUFRO-SPDC

**Appiah-Kubi, E. and Tekpetey, S.** 2011. 65th Forest Product Society International Convention / SWST Annual Convention. Doubletree Hotel, Portland, Oregon, USA. 19-22 June 2011

**Asomaning, J.M.** Consultative meeting for Research Scientists and Research Managers on the topic "Development of Effective Plant Variety Protection System: Prospects for Agricultural Research and Development". Organized by the Council for Scientific and Industrial Research, West Africa Agricultural Productivity Programme (CSIR-WAAPP). 21st to 23rd March, 2011. CSIR-STEPRI, ACCRA.

**Asomaning, J.M.** Workshop on "Agricultural Policies in Ghana". Organized by the Council for Scientific and Industrial Research, West Africa Agricultural Productivity Programme (CSIR-WAAPP). 8th to 9th August, 2011. CSIR-SRI, Kumasi.

**Bosu, P.** Training Workshop on Insect Resistance Management to Bt. Crops. South Africa; 26-29th October 2011.

**Bosu, P.** WASCAL Climate Change and Biodiversity Program Planning Workshop July 28-29 2011 Accra, Ghana.

**Bosu, P.** First Training of trainers workers on Cocoa Pollination. Global Pollinators Project. Bobiri/Kubease STEP Site. 28 & 29 June 2011 (Resource Person).

**Bosu, P.** Second Training of trainers workers on Cocoa Pollination. Global Pollinators Project. Bobiri/Kubease STEP Site. 17th – 18th November 2011 (Resource Person).

**Bosu, P.** National Partners Workshop on Global Pollinators Project. University of Cape Coast – 22-23 April 2011.

**Bosu, P.** Capacity Needs for REDD+ Implementation in Ghana Workshop, Kumasi, Ghana, 4th November, 2011

**Bosu, P.** Ghana Environmental Conventions Coordinating Authority. Capacity Building Workshop on Database Management. 10th June 2011, Koforidua.

**Derkyi, N.S.A.** Ghana Science Association Meeting, Kumasi.

**Derkyi, N.S.A.** Chemical Society Meeting, Accra.

**Duah-Gyamfi, A.** Workshop on Agricultural Policies. 8-9 August, 2011, SRI, Kumasi. Validation

**Duah-Gyamfi, A.** Workshop on Ghana Forestry Statistics Handbook. 3rd November, 2011, F.C. HQ., Accra.

**Duah-Gyamfi, A.** Workshop on REDD+ Capacity Building in Ghana. 5th November, 2011, Excelsa Lodge, Kumasi.

**Djagbletey, G.D.** Land Use and Land Use Change Modeling and Carbon Stock Mapping in Forest and Agro Ecosystems, on 16th February, 2011, at Coconut Grove Hotel, Accra.

**Djagbletey, G.D.** West Africa Agriculture Productivity Programme (WAAPP) Workshop on Agricultural Policies in Ghana, from 8th-9th August, at CSIR-Soil Research Institute, Kumasi.

**Djagbletey, G.D.** Hands-on Capacity Building Training Programme on Designing and Preparation of National Greenhouse Gas Inventory As Part of Monitoring Reporting Verification (MRV) System for NAMAs and REDD+ in Ghana, Date: 23rd – 30th October 2011 at NODA Hotel, Kumasi.

**Djagbletey, G.D.** Capacity Needs for REDD+ Implementation in Ghana Workshop, on 4th November, 2011 at Excelsa Hotel, Kumasi, Ghana.

**Djagbletey, G.D.** Science Word and PagePlayer from 12th -16th of December 2011, at CSIR-Crops Research Institute, Kumasi

**Dwomoh, F.K.** Visiting Scientist at the Center for Forest Disturbance Science, US Forest Service Southern Research Station, Athens, Georgia USA, March 2011-August 2011.

**Dumenu, W.K.** Climate Change and Disaster Risk Management, CLIMATE 2011 Hamburg, Germany. November 7-12, 2011.

**Dumenu, W.K.** International Research on Food Security, Natural Resource Management and Rural Development: Development on the margin, TROPENTAG 2011. Bonn, Germany. October 5-7, 2011.

**Dumenu, W.K.** Workshop for Managers & Contributors for Ghana's House Clearing Mechanism (HCM) of Convention for Biological Diversity (CBD) Kumasi, Ghana. February 21 - 25, 2011.

**Foli, E.G.** National Biological Diversity Clearing House Mechanism & Capacity Building Training Workshop. Excelsa Lodge, Kumasi. 21-25 February 2011.

**Foli, E.G.** ASB/IISD Workshop on REDD After Cancun: Moving from Negotiation to Implementation. Douala, Cameroon. 10-12 May 2011.

**Foli, E.G.** NCRC/FC/Katoomba Incubator for Ecosystem Services, Oxford University Workshop and Launch of the Carbon Map of Ghana. Coconut Groove Regency Hotel, Accra. 15 February, 2011.

**Foli, E.G.** EC/INBAR Project: "Bamboo as Sustainable Biomass Energy for Firewood and Charcoal in Africa" Third Project Steering Workshop. Addis Ababa, Ethiopia. 09 – 12 February 2011.

**Foli, E.G.** United Nations Framework Convention on Climate Change COP 17/ Forest Day 5 Conference. Olive Convention Centre. Durban, South Africa. 4 December 2011.

**Foli, E.G.** Ghana Environmental Conventions Coordinating Authority (GECCA) Capacity Building Workshop on Database Management. Koforidua, 09 – 10 June 2011.

**Foli, E.G.** EPA/FC/Coalition for Rainforest Nations In-Country Training Workshop on Agriculture and Land Use (ALU) National Greenhouse Gas (GHG) Inventory Software and Other Inventory Tools. Akuse, 31 July – 04 August 2011.

**Foli, E.G.** European Commission/IDL Group Accra Conference on Forest Governance. Ghana-India Kofi Annan Centre of Excellence in ICT. Ridge, Accra. 07 – 08 June 2011.

**Foli, E.G.** MLNR Symposium on Land/Tree Tenure and Benefit Sharing. Alisa Hotel, North Ridge, Accra. 04 August 2011.

**Foli, E.G.** International Tropical Timber Organization (ITTO) Project PD 431/06 "Processing and Utilization of trees on farmlands and logging residues through collaboration with local communities". Project Validation Workshop. Anita Hotel, Ejisu, Kumasi. 05 April 2011.

**Foli, E.G.** International Institute for Sustainable Development (IISD) 1st Workshop of the REDD-Development Dividend Task Force. Manilla, Philippines. 22 – 29 January 2011.

**Foli, E.G.** EU/INBAR 2nd PSC Workshop on Bamboo as Sustainable Biomass Energy in Africa. UMMA Hotel, Addis Ababa, Ethiopia. 09-12 February 2011.

**Foli, E.G.** IUFRO/FORNESSA/GIZ Scientific Workshop on "Adaptation of forests and people to climate change in Africa". IUFRO Headquarters, Vienna, Austria. 21 - 24 March

**Marfo, E.** 13th Biennial conference of the International Association for the Study of Commons. 10-14 January 2011, Hyderabad, India.

**Marfo, E.** National training workshop on Biodiversity Clearing House Mechanism. Ministry of Environment, Science and Technology. 21-25 February 2011, Kumasi.

**Marfo, E**. Development of intellectual property rights policy for Council for Scientific and Industrial Research. STEPRI. 24-25 March 2011, Accra.

**Marfo, E.** Stakeholder consultative workshop on national anti-corruption action plan (NACAP) for Ghana. Commission on Human Rights and Administrative Justice, 4 March 2011, Kumasi.

**Marfo, E.** Consultative meeting on the development of intellectual property rights policy for CSIR. Certificate obtained. 24-25 March 2011, Accra.

**Marfo, E.** National Stakeholder consultation on the development of the Forest Investment Programme, June 2011, Accra.

**Marfo, E.** Working meeting of the National Timber Procurement Policy Committee to develop public procurement policy for timber and timber products, 22-25 June, Dodowa, Accra.

**Marfo, E.** National workshop on policy proposal for the supply of legal timber to the domestic market, 30 June 2011, Kumasi.

**Marfo, E.** IUCN Dissemination and consultation workshop on potential options for the benefit sharing and gender considerations towards REDD implementation in Ghana, 6-7 July 2011, Kumasi.

**Marfo, E.** Consultative workshop on draft verification protocols of the VPA, 13-14 July 2011, Kumasi.

**Marfo, E.** Mainstreaming gender in REDD. Policy workshop organised by IUCN, 7th-8th September 2011, Accra.

**Marfo, E.** National Colloquium on illegal extension of admitted farms and settlement in forest reserves: the way out. Forestry Commission, 22nd September 2011, Akyawkrom.

**Marfo, E.** Nationl Workshop on access and use of patent information for research and academic institutions in Ghana. Registrar General Department/World Intellectual Property Organisation, 10 -12 October 2011, GIMPA, Accra.

**Marfo, E.** International Project Management Committee meeting of the EU-Chainsaw project, 21-24 November 2011, Wageningen, Netherlands.

**Marfo, E.** 13th General Assembly of the Council for the Development of Social Science Research in Africa (CODESRIA), 5-9 December 2011, Rabat, Morocco.

**Mensah, J.K.** Training workshop on two software programs (Science Word and Pageplayer). Crops Research Institute. 12th -16th of December 2011.

**Nutakor, E.** Multi-stakeholder dialogue forum on illegal chainsaw lumber production in Ghana. Ejisu June 2011.

**Oduro, A.K.** Workshop on Agricultural Policies in Ghana. Kumasi. August 8-9, 2011.

**Oduro, A.K.** Forestry Statistics Handbook Validation workshop at the Forestry Commission Office, Accra. November 3, 2011.

**Obiri, B.D.** Economic incentives for inducing adoption of mitigation practices in agriculture. Technical workshop on Climate Change Mitigation in Agriculture. 10 November, 2011. CSIR-STEPRI Conference Hall, Accra.

**Obiri, B.D.** Multi-stakeholder workshop on supply of legal lumber to the domestic market in Ghana 30th June, 2011. Miklin Hotel, Kumasi.

**Obiri, B.D.** Science communication and writing workshop. 19th-26th February, 2011. Kibo Palace Hotel, Arusha-Tanzania. Organized by the Gender and Diversity Program, World Agroforestry Centre, Kenya.

**Opuni-Frimpong, E.** Workshop on "Development and implementation of a species Identification and Timber Tracking System with DNA Fingerprints and Stable Isotopes in Africa". Organized by The Forest Trust. 23-24 March 2011, Djeuga Palace Hotel, Yaounde, Cameroon.

**Opuni-Frimpong, E.** Climate Change Sensitization Workshop for Forestry Commission Staff in Ashanti Region of Ghana 23/02/2011, Organized by the FC, Wood Industry Training Centre, Akyaakrom.

**Opuni-Frimpong, E.** National Forest Stakeholders Workshop to Define Forest for Clean Development Mechanisms Projects in Forestry. Organized by

the Forestry Commission, 10 February, 2011, FC Conference Room, Accra. Resource Person.

**Opuni-Frimpong, E.** Ghana's Participation in Afforestation and Reforestation Clean Development Mechanism. Climate Change Sensitization Workshop for Forestry Commission Staff in Ashanti Region of Ghana 23/02/2011, Organized by the FC, Wood Industry Training Centre, Akyaakrom.

**Opuni-Frimpong, E.** Land Eligibility and Selecting Baseline Methodology for Afforestation and Reforestation CDM. National Forest Stakeholders Workshop to Define Forest for CDM Projects in Forestry. Organized by the Forestry Commission, 10 February, 2011, FC Conference Room, Accra.

**Opuni-Frimpong, E.** Research on African Mahogany (*Khaya* and *Entandrophragma*) in Ghana. Guest Speaker at the Institute of Forest Genetics, Grosshansdorf, Germany. 2nd December 2011.

**Opuni-Frimpong, E.** Incidence of *Hypsipyla robusta* (Moore) on Native Mahogany trees. Guest Speaker, Series of Lectures, Free University of Bolzano, Italy. 30th November 2011

**Obeng, E.A.** REDD+ Capacity Needs Country Level Workshop, 4th November, Excelsa Lodge, Kumasi.

**Owusu-Afriyie, K.** IFPRI-SRI Technical Workshop on Climate Change Mitigation in Agriculture. November 10, 2011. CSIR-STEPRI, ACCRA. Sponsored by the International Food Policy Research Institute and organised by CSIR-Soil Research Institute.

**Owusu-Afriyie, K.** Country Level Workshop on Capacity Needs for REDD+ Implementation. November 4, 2011. Excelsa Lodge, Kumasi. Sponsored by ANAFE/AFF/ICRAF/UNEP.

**Owusu-Afriyie, K.** Facilitation Forum for the Utilisation of Community Fire Guidelines and Manual for Ghana. Organised by the IUCN - World Conservation Body, 7th – 8th April 2011, Kumasi, Ghana.

**Owusu, F.W. and Appiah-Kubi, E.** 2011. 5th National Conference of Ghana Society of Agricultural Engineering (GSAE). Theme: Agricultural engineering for commercial food production and environmental sustainability in Ghana. Held at KNUST, Kumasi from 21st – 23rd September 2011.

**Owusu, F.W.** 2011. Challenges to Promotion and marketing of Lesser Used Timber Species. 15th Annual General Meeting of Ghana Institute of Foresters. Theme: "Building Viable Wood and Forest Based Industries for Sustainable National Development- Role of the Forester". Held at Royal Lamerta Hotel, Kumasi from 10th – 11th November 2011

**Owusu, F.W.** 2011. Training course for consultants from Gamwood Ltd., Nkawkaw. June 6-13, 2011, held at CSIR-FORIG, Fumesua.

**Pentsil, S.** First Ghana Science Congress organized by the Ministry of Environment, Science and Technology (MEST) at the Accra International Conference Centre, 2nd to 5th August, 2011.

**Peprah, T.** Multi-stakeholder consultation workshop on 'How the cadbury cocoa partnership contributes to an environmental strategy for the cocoa sector'. Miklin Hotel, Kumasi. 7th February 2011

**Peprah, T.** Resource Person for Training of FORM Ghana Limited Nursery Staff in Grafting. Akumadan. 8th – 9th February 2011

**Peprah, T.** Allanblackia Technical Meeting. Anita Hotel. Kumasi. 21st – 22nd March, 2011.

**Peprah, T.** Resource Person for the Training of Forest Guards in Nursery Operations (Nursery Establishment and Management). WITC, Akyawkrom. 30th -31st March 2011.

**Peprah, T.** Annual Science Meeting Held at ICRAF, Nairobi, Kenya. 12th – 17th September 2011.

**Sparkler, S.B.** Scaling up for Food Security in Africa; Champions for Change Leadership Training Workshop 27th March to 1st April, Accra-Ghana

**Sparkler, S.B.** Social vulnerability to climate change in Ghana: a qualitative perspective. 34th Applied Geography Conference held in Orton Center, University of Redlands, CA, 19th -22nd October, 2011

**Sparkler, S.B.** Assessing Vulnerability and Adaption to Climate Variability and Change in Rural Ghana, University of Georgia, Zell B. Miller Learning Center, 24th October, 2011

# Appendix II

## Colloquium presentations

| Speaker | Title | Date |
|---|---|---|
| Mr. Edward Obiaw, Director RMSC, FSD | Integrated forest and wildlife management in Ghana | 20th January |
| Mr. F.S. Amoah, Director of Plantations, FC | Promoting sustainable development of forests | 17th February |
| Dr. J.R. Cobbinah | CSIR-FORIG's Strategic Plan Review | 24th February |
| Dr. K. Owusu-Afriyie | Recurrent fire effects on forest structure, undergrowth biomass and floristics in a dry and a moist semi-deciduous forest types in Ghana | 17th March |
| Dr. Mireku Asomaning | National Tree Seed Centres in Africa – Their functions, challenges and way forward | 17th March |
| Dr. Paul Bosu | The forgotten pollinators | 7th April |
| Mr. George Ametsitsi | Assessment of coping and adaptation strategies to the effects of climate change in Offinso North and South Districts, Ashanti Region | 7th April |
| Mr. Stephen Akpalu | Domestication of useful indigenous trees: A sure candidate for food security and environmental sustainability | 14th April |
| Dr. Degen Bernd | The use of DNA fingerprints and stable isotopes for timber tracking | 19th April |
| Mrs. Gloria Djaney Djagbletey | How selective logging affects carbon stocks in Bobiri Forest Reserve | 5th May |
| Ms. Maria del Carmen Ruiz-Jaen | The relationship between biodiversity and ecosystem functioning in tropical ecosystems | 5th May |
| Dr. Daniel Sekyere | CASSAVA: Adding value for Africa – The role of CSIR-FORIG | 26th May |

| Speaker | Title | Date |
|---|---|---|
| Dr. Marney Isaac (Assistant Professor, Agroforestry, University of Toronto, Canada) | The role of social network analysis in agroforestry management: application and methodology | 31st May |
| Mr. Shalom Addo-Danso | Survival and growth of *Nauclea diderrichii* (De Wild.) and *Pericopsis elata* (Harms) in monoculture and mixed-species plots in Ghana | 16th June |
| Dr. Marney Isaac (Assistant Professor, Agroforestry, University of Toronto, Canada) | Biophysical interactions and nutrient transfer processes in agroforestry systems | 23rd June |
| Dr. Ernest Foli | Stand dynamics in response to silvicultural interventions in Bobiri Forest Reserve | 30th June |
| Dr. Glenn Matlack (Associate Professor of Forest Ecology, Ohio University) | Structure and dynamics of a highly impacted temperate-deciduous forest in Eastern North America | 30th June |
| Dr. Victor Agyeman | CSIR can dismiss any Staff for good cause, no cause or even morally wrong cause: myths, realities and legal remedies | 7th July |
| Dr. Kerry Kriger (Executive Director and Ecologist, Save the Frogs, USA) | The wild world of frogs | 22nd September |
| Mr. John Mensah | Preliminary studies on macrofungi of Bobiri Forest Reserve | 29th September |
| Mr. Francis Wilson Owusu | Quality assessment of some timber trees from the Afram arm of the Volta lake: sawing and machining characteristics | 13th October |
| Mr. Emmanuel Appiah-Kubi | Wood for housing in Ghana: why the low interest | 13th October |

| Speaker | Title | Date |
|---|---|---|
| Mr. Kwame Oduro and Mrs. Elizabeth Obeng | Impact of development assistance on the forestry sector | 27th October |
| Dr. Mrs. Beatrice Darko-Obiri | Do forests contribute to rural livelihoods? | 27th October |
| Dr. Emmanuel Marfo | Intellectual property policy and patents | 27th October |
| Dr. Ebenezer Owusu-Sekyere | Agroforestry and sawah: A sustainable land use system for socio-economic and environmental benefits in Ghana | 17th November |
| Mr. William Bandoh | Safe biotechnology management in Ghana: The role of CSIR-FORIG | 17th November |
| Prof. Andy Burtons (Michigan Tech. University) | Carbon sequestration and sustainability considerations for tropical forest plantations | 24th November |
| Mr. Samar Sparkler | Demystifying land tenure issues and agroforestry practices among food crop farmers: A case study approach | 15th December |
| Mr. Eric Nutakor | Ethno-botanical studies and conservation status of medicinal plants in sawah ecosystem in Ahafo-Ano South District, Ghana: Influence of age structure on indigenous knowledge in endemic medicinal plants | 15th December |

## Appendix III

### List of National Service Personnel Received 2011/12

| NAME | QUALIFICATION | INSTITUTION |
|---|---|---|
| Marfo Kwadwo Nyantakyi | BA Sociology and Social Work | KNUST |
| Gifty Gyau Baffour Jnr | BSc Agric | KNUST |
| Andoh Godwin Kwarkye | BSc Forest Resources Technology | KNUST |
| Janet Owusu Gyimah | BSc Chemistry | UG, Legon |
| Oppong Bismark Jnr | BFA Painting and Sculpture | KNUST |
| Ahensan Justice Kofi | Bachelor of Arts | UCC |
| Otoo Nyankum Isaac | BSc Natural Resources Mgt. | KNUST |
| Gifty Gyau Baffour Snr | BSc Natural Resources Mgt. | KNUST |
| Daniel Afona | BA Economics | KNUST |
| Kwasi Agyarko Obeng | BA Banking and Finance | Ghana Baptist University College |
| Gifty Tenkorang Mensah Wiafe | BBA Accounting | Christian Service University College |
| Dorcas Owusu Gyimah | BSc Agriculture | UG, Legon |
| Gertrude Gyamfi | BSc Natural Resources Mgt. | KNUST |
| Winnie Kofie | BSc Natural Resources Mgt. | KNUST |

CSIR-Forestry Research Institute of Ghana
U.P.O Box 63
Kumasi, Ghana.

www.csir-forig.org.gh