



CSIR-FORESTRY RESEARCH  
INSTITUTE OF GHANA

**Annual Report 2010**

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Compiled By *Mrs. Sarah Pentsil*

## Executive Summary

This report outlines major activities undertaken in 2010 in both the core and non-core research divisions of the Institute.

By using part of its internally generated funds (IGF), the Institute initiated seven (7) core research projects, namely (i) '**Carbon Sink Potential of different Land Use Systems in the Moist Semi-Deciduous Forest Zone of Ghana**': the case of Bobiri Forest and its surroundings';(ii) 'Conservation of Mushrooms as Non-Timber Forest Product of Economic Importance and their Benefits to Communities around the Bui National Park of Ghana';(iii) 'Floristic composition of the Bobiri Forest Reserve with special reference to medicinal, mycorrhizal plants and macrofungi of economic importance';(iv) 'Increasing the Durability of Bamboos in Ghana through Chemical and Non-Chemical Methods';(v) 'Determining the Physicochemical Characteristics of Bamboo Species in Ghana'; (vi) 'Analysing the Bamboo Value Chain in Ghana'; (vii) 'Basic and Technological Properties of *Cola gigantea* and (viii) *Ficus sur*' and 'Assessment of Coping and Adaptation Strategies to the Effects of Climate Change in Offinso North and South Districts of Ashanti – Ghana.'

Furthermore, eight (8) projects were funded by donors including the International Tropical Timber Organisation and the European Union. Contributions from donors tripled during the year relative to the preceding year.

The Institute is currently, renovating its mushroom and snail facilities to start full scale training programmes as part of the on-going commercialization drive. Other commercial activities involved consultancy services, sale of seedlings, seeds, wood thinnings and prekese syrup production.

The number of publications by senior members to improved over the previous year. A total of eight (8) books were authored during the year under review, in addition to four (4) book chapter contributions, a policy brief, twenty seven (27) refereed journal papers, twenty (20) conference papers and over fifty (50) technical reports and 10 poster presentations all representing a estimated improvement of 150 per cent compared to the previous year.



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## 1.0 Introduction

CSIR-FORIG is mandated to undertake forest, forest products and related research, disseminate and commercialise research outputs and services. The Institute undertakes high quality user-focused research 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 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 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.

### 1.1 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.

### 1.2 Mission Statement

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

### 1.3 CSIR-FORIG's Activities

Research and development are key components in the creation of new knowledge and are major catalysts in the development of any nation. CSIR-FORIG's research activities address the social, environmental and economic aspects of Ghana's forest resources and how these resources can be utilized for sustainable development for the benefit of the people of Ghana. Our research projects are varied and diverse but provide a clear understanding of best practices in the forestry sector and are aimed at providing results to shape the policies affecting Ghana's forest resources. CSIR-FORIG works closely with the Ministry of Lands, Forestry and

Mines and the Forestry Commission and has extensive linkages with national and international organisations.

### 1.4 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

### 1.5 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 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.

## 1.6 Human Resource

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

### 1.6.1 List of Senior Members

#### Administration Division

Victor K. Agyeman	<i>BSc. Nat. Res. Mgt., MPhil Silviculture, PhD Forest Ecology</i> Principal Research Scientist, Director
F. Osei-Amofah	<i>BA. Secretaryship, Dip. Ed. Postgraduate Dip. Mgt. Studies</i> Administrative Officer Head of Administration
N. Obiri-Yeboah Darko	<i>BSc. (Hons) Civil Engineering</i> Maintenance Engineer
Comfort D. Konto (Ms)	<i>Dip. Education, BA. (Hons) Economics, MBA Strat. &amp; Consultancy Mgt.,</i> Administrative Officer
Georgia Coffie (Mrs)	<i>B. Ed. Secretarial &amp; Mgt, MSc E-Comm. &amp; Marketing</i> Administrative Officer

#### Forests, Livelihoods And Sustainable Development Division

Ebenezer Owusu-Sekyere	<i>BSc. Nat. Res. Mgt., MSc. Agroforestry, PhD Agroforestry</i> Senior Research Scientist Head of Division
Dominic Blay Jr.	<i>BSc. Botany, MSc. Forest Resources Mgt PhD Forest Ecology</i> Principal Research Scientist
Emmanuel Marfo	<i>BSc. Nat. Res. Mgt., MSc. Tropical Forestry, PhD Environmental Sciences</i> Research Scientist



Eric E. Nutakor <sup>ΔΔ</sup>	<i>BA. Social Science, Phil Silv. &amp; Forest Mgt.</i> Research Scientist
Elizabeth Obeng (Mrs)	<i>BSc. Agric, MSc. Sustainable Res. Mgt.</i> Research Scientist
William Dumenu	<i>BSc. Nat. Res. Mgt., MSc Forest Ecol. and Mgt.</i> Asst. Research Scientist

### Forests & Wildlife Management and Governance Division

Mary M. Apetorgbor (Mrs)	<i>BSc. (Hons) Botany PhD Plant Pathology/ Mycology</i> Senior Research Scientist Head of Division
Stephen Adu-Bredu	<i>BSc. Nat. Res. Mgt. MSc. Silv. Mgt. PhD Silv. Mgt/ Ecophysiology</i> Senior Research Scientist
Emmanuel Opuni-Frimpong	<i>BSc. Nat. Res. Mgt. MPhil. Silv. Mgt. PhD Forest Entomology</i> Research Scientist
Bright O. Kankam	<i>BSc. Nat. Res. Mgt. MPhil Wildlife and Range Mgt. PhD Primatology</i> Research Scientist
Theresa Peprah (Mrs)	<i>BSc. Nat. Res. Mgt. MSc. Tree Improvement</i> Research Scientist
Kwame Antwi Oduro <sup>ΔΔ</sup>	<i>BSc. (Hons) Nat. Res. Mgt. MSc. Forestry and Land Use</i> Research Scientist
Akwasi Duah Gyamfi	<i>BSc. Nat. Res. Mgt. MPhil. Ecology &amp; Mgt.</i> Research Scientist
John K. Mensah	<i>BSc. Botany MSc. Plant Pathology</i> Research Scientist

### Wood Industry Development and Trade Division

Joseph K. Appiah	<i>BSc. Nat. Res. Mgt MPhil. Wood Science</i> Research Scientist Head of Division
Joseph Ofori**	<i>BSc. Chemical Tech. MSc &amp; DIC Timber Tech.</i> <i>PhD Wood Technology</i> Chief Research Scientist



Daniel Sekyere**	<i>BSc. Chemistry MSc. Chemistry PhD Pulp &amp; Paper Tech.</i> Principal Research Scientist
Francis W. Owusu	<i>BSc. Agric Engineering MPhil. Wood Technology</i> Research Scientist
Lawrence Damnyag <sup>ΔΔ</sup>	<i>BA. Economics MPhil. Economics</i> Research Scientist
Charles Essien <sup>Δ</sup>	<i>BSc. Nat. Res. Mgt.</i> Asst. Research Scientist

### Forest Products and Marketing Division

Nana S.A. Derkyi <sup>ΔΔ</sup>	<i>BSc. Chemistry MSc. Organic Chemistry</i> Research Scientist Head of Division
Andrew Oteng Amoako**	<i>BSc. Wood Technology MSc. Wood Science PhD Wood Products &amp; Eng.</i> Chief Research Scientist
Beatrice Darko-Obiri (Mrs)	<i>BSc. Agric MSc. Agroforestry, PhD Agroforestry</i> Research Scientist
Emmanuel Ebanyenle <sup>ΔΔ</sup>	<i>BSc. Nat. Res. Mgt. MPhil. Wood Science</i> Research Scientist
Samar B. Sparkler	<i>BA. Arts (Econs. &amp; Geog) MA. Geog. &amp; Rural Dev.</i> Research Scientist

### Ecosystem Services and Climate Change

Paul P. Bosu	<i>BSc. Biological Science MPhil. Biological Science PhD Forest Entomology</i> Senior Research Scientist Head of Division
Joseph R. Cobbinah**	<i>BSc. Biological Science PhD Forest Entomology</i> Chief Research Scientist
Ernest G. Foli	<i>BSc. Nat. Res. Mgt. MPhil Forest Men./ Inventory PhD Silv. &amp; Mgt</i> Senior Research Scientist
Stephen E. Akpalu	<i>BSc. Agric MPhil. Env. Science Research Scientist</i>
Gloria D. Djagbletey (Mrs) <sup>ΔΔ</sup>	<i>BSc. Nat. Res. Mgt MPhil Silv. &amp; Forest Mgt.</i> 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.* Assistant Research Scientist

### Biodiversity and Land-Use Division

Daniel A. Ofori

*BSc. Agric MPhil. Tree Improvement*  
*PhD Molecular Biology*  
Prin. Research Scientist  
Deputy Director

Luke C.N. Anglaaere

*BSc. Nat. Res. Mgt. MSc. Silv. & Forest Biology*  
*PhD Agroforestry*  
Senior Research Scientist  
Head of Division

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)<sup>ΔΔ</sup>

*BSc. Nat. Res. Mgt. MPhil Silv. & Forest Mgt.* Research Scientist

Joseph Asomaning

*BSc. Agric MSc. Seed Technology*  
Research Scientist

Francis Dwomoh

*BSc. Nat. Res. Mgt. MSc. GIS & Earth Obs.*  
Research Scientist

William K. N. Bando

*BSc. Nat. Res. Mgt.* Asst. Research Scientist



## Commercialization and Information Division

Kennedy K. Asamoah	<i>BA. (Hons) Geography Post Grad. Dip. Lib. Studies MA Geog. &amp; Rural Development</i> Asst. Librarian Head of Division
Margaret Sraku-Lartey (Mrs)*	<i>BA. Social Science Post. Grad. Dip. Lib. Studies</i> <i>MA. Industrial Mgt.</i> Prin. Librarian
Stella Britwum Acquah (Mrs)	<i>BSc. Computer Science MBA. Mgt. Info. Systems</i> Computer Programmer
Sarah Pentsil (Mrs)	<i>BSc. (Hons) Nat. Res. Mgt MSc. Dev. Policy &amp; Planning</i> Scientific Secretary
Naomi Appiah (Mrs)	<i>BA. Publishing Studies MBA Marketing</i> Junior Librarian/Ass. Pub. Officer
Darimani Bukari	<i>BA Publishing Studies MPhil Art and Culture</i> Information Officer

## Finance Division

Francis Kumah	<i>BA (Hons) Accounting &amp; Econs. Asst.</i> Accountant Head of Division
Osei Yaw Agyei	<i>BSc MBA ACCA</i> Accountant
K. Agyeman Prempeh	<i>ICA</i> Accountant

\* Sabbatical Leave

△△ PhD Student

\*\* Post Retirement Contract

△ MSc/MPhil Student

## 1.6.2 List Of Senior Staff

<b>Name</b>	<b>Rank</b>
A. Mohammed Issah	Chief Technical Officer
Michael Mensah	Chief Technical Officer
Bridgette Brentuo	Chief Technical Officer
Emmanuel Zablenu	Chief Technical Officer
Leticia A. Asamoah	Chief Technical Officer
Georgina Agyeman	Chief Administrative Assistant
Victoria A. Erskine	Chief Accounting 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	Principal Technical Officer
Godzon K. Zorve	Principal Technical Officer
Elizabeth Ampah	Principal Technical Officer
Prempeh Bando	Principal Technical Officer
Philip T. Boampong	Senior Technical Officer
Sarfo Kwame Bonsu	Senior Technical Officer
Jacqueline Twintoh	Senior Technical Officer
Samuel Larbi	Senior Technical Officer
Awurama Andoh	Senior Administrative Assistant
Jane Nketiah	Senior Administrative Assistant
Eric Frimpong	Senior Technical Officer
Gabriel Lumor	Technical Officer
Wendy O. Amankwa	Accounting Assistant
Ezuame Constant	Technical Officer
Elvis Nkrumah	Technical Officer
George K. Nyantakyi	Senior Security Officer
Dickson Asmoah	Senior Acc. Assistant
Rebecca Okyere Darko	Stores Superintendent
Frank Baffour Asuming	Principal Technical Officer
John Sackey	Principal Works Superintendent
Paul Adusei	Principal Works Superintendent (Traffic)



<b>Name</b>	<b>Rank</b>
Samuel K. Appiah	Principal Works Superintendent (Traffic)
Asiamah Yeboah Konadu	Principal Admin. Assistant
J. J. Mensah	Principal Accounting Assistant
Daniel Kaiko Mankoe	Principal Accounting Assistant
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	Senior Technical Officer
Jonathan Dabo	Technical Officer
Emmanuel A. Manu	Senior Technical Officer
Samuel A. Kyei	Principal Technical Officer
Daniel Peprah	Senior Technical Officer
Sandra Owusu	Senior Technical Officer
Georgina Afriyie	Senior Technical Officer
Richard Adjei	Senior Technical Officer
Kwaku Asumadu	Senior Technical Officer
Jemima Owusu	Senior Technical Officer
E. Y. B. Imouro	Chief Accounting Assistant
Augustina Addai	Chief Technical Officer
Govina J. Kudjo	Technical Officer
Daniel K. Debrah	Senior Technical Officer
Anastasia Duah-Gyamfi	Administrative Assistant
Daniel Damte	Draughtsman
Anthony Boateng	Asst. Transport Officer







## 2.0 Research Projects

Research Projects are funded by the Institute through its internally generated funds (IGF). The research projects funded during the year under review are:

1. *Carbon Sink Potential of different Land Use Systems in the Moist Semi-Deciduous Forest Zone of Ghana: the case of Bobiri Forest and its surroundings*
2. Conservation of Mushrooms as a Non-Timber Forest Product of Economic Importance and their Benefits to Communities around the Bui National Park of Ghana
3. Floristic composition of the Bobiri Forest Reserve with special reference to medicinal, mycorrhizal plants and macrofungi of economic importance
4. Increasing the Durability of Bamboos in Ghana through Chemical and Non-Chemical Methods
5. Determining the Physicochemical Characteristics of Bamboo Species in Ghana
6. Analysing the Bamboo Value Chain in Ghana
7. Basic and Technological Properties of *Cola gigantea* and *Ficus sur*
8. Assessment of Coping and Adaptation Strategies to the Effects of Climate Change in Offinso North and South Districts of Ashanti - Ghana

## 2.1 Carbon Sink Potential of different Land Use Systems in the Moist Semi-Deciduous Forest Zone of Ghana: the case of Bobiri Forest and its surroundings

**Project Team:** Anglaaere, LC.N., Dwomoh, F., Owusu-Afriyie, K., Bandoh, W., Adam, K.A. and Mireku-Asomaning, J.

**Start Date:** January 2010

**Expected Completion Date:** December 2011

### Introduction

Quantifying carbon stocks in tropical ecosystems is crucial for understanding the global C cycle, formulation and evaluation of climate change mitigation measures, and the management of ecosystems for C sequestration. Additionally, the critical role of land use or cover as an important control of C storage in the terrestrial biosphere is undisputed. Currently, greenhouse gas emissions (GHG) from land use change continue to attract global attention. It is estimated that emissions from land use change, mostly from developing countries, constitute 20 – 25% of all anthropogenic GHG emissions hence, the considerations of land use management in international climate change agreements as an option to mitigate the build-up of atmospheric GHGs. It is envisaged that land use-based mitigation initiatives, such as Reducing Emissions from Deforestation and Forest Degradation (REDD), aside confronting deforestation and forest degradation, also has the potential to simultaneously contribute to climate change mitigation and development in local communities. This provides a new opportunity for Ghana, which hitherto has not benefited from the global carbon market, to further her developmental goals.

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 are key requirements in the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol implementation.

There is awareness about the alarming pace of forest cover change in Ghana. Estimation of 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.

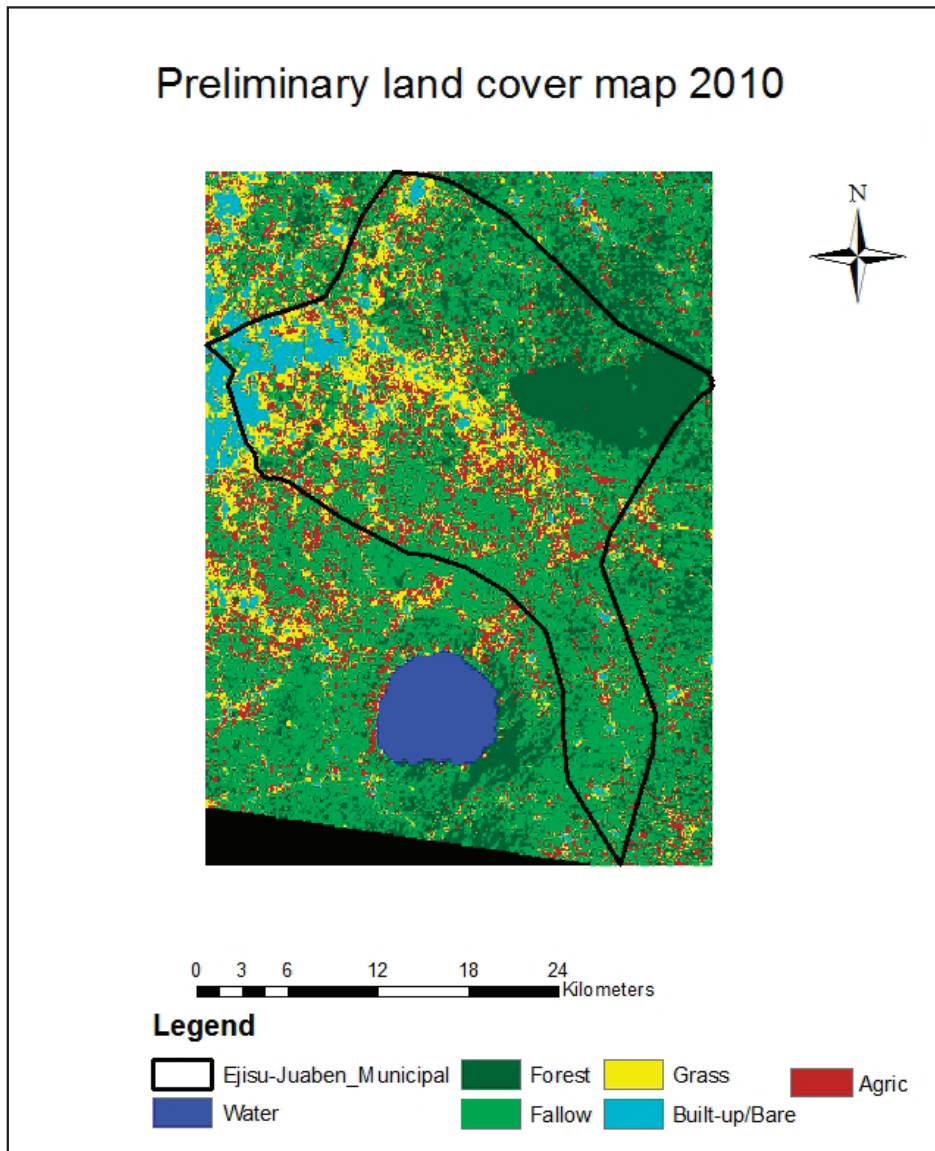
The objectives are:

- To identify and map different land use or cover systems in the moist semi-deciduous forest zone;

- To determine the C sink potential of the different land use or cover types;
- Determine changes in land cover and carbon stocks over time.

### Results achieved so far

Four (4) broad land use or cover types were sampled. These include Bobiri forest reserve, fallow lands, teak plantations and mixed crop farms. Below is a preliminary land use or cover map produced for the project area (Figure 1).



*Figure 1: Land cover map for the study area*

Soil samples collected are yet to be analysed but an assessment of carbon pools in trees (dbh  $\geq$  5 cm) showed considerable variation among land use or cover types. Table 1 shows the preliminary tree biomass and the equivalent carbon content recorded for each of the land cover types.

**Table 1:** Mean tree biomass and carbon equivalent (Mean ± SD) in different land use / cover types in Ejisu-Juaben District

Land use/cover type	Mean Tree Biomass (Mg/ha)	Carbon equivalent (Mg/ha)	Remarks
Forest reserve (n = 11)	474.54 ± 167.36	237.27 ± 83.68	
Fallow lands (n = 7)	145.09 ± 91.18	72.55 ± 45.59	
Teak plantation (n = 8)	357.70 ± 641.78	178.85 ± 320.89	A few big indigenous trees in some of the teak plantations account for the large SD
Mixed crop farm (n = 7)	18.65 ± 42.84	9.32 ± 21.42	

### Conclusion

These preliminary results suggest vast differences in above ground mean tree biomass and carbon equivalents in different land use/cover types.

## 2.2 Conservation of Mushrooms as a Non-Timber Forest Product of Economic Importance and their Benefits to Communities around the Bui National Park of Ghana

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

**Start date:** August 2010

**Expected completion date:** December 2011

### Introduction

The primary forest of Ghana is dwindling fast due to over-exploitation of timber, mining, bushfires and agricultural activities and replaced by less diverse plantations of exotic species. This affects the diversity of fungi of economic importance which impacts negatively the livelihood and food security of fringe forest communities. Scientific data on diversity and status of species of birds, primates, mammals, and insects within several protected areas have been collected with little or no data on fungi.

Knowledge on fungal genetic resource would raise awareness to biodiversity conservation in protected forests. It would also improve community adaptation to climate change by initiating alternative livelihood strategies as to the sustainable utilization of the resources.

The specific objectives of the study are to:

1. Determine diversity and distribution of fungi (edible, medicinal and mycorrhizal) in the Bui National Park;
2. Facilitate germplasm conservation of threatened economic fungi;
3. Increase awareness on biodiversity conservation by initiating alternative livelihood strategies.

## Major Findings

### *Indigenous knowledge*

Edible mushrooms collected from the wild by the local people are mainly *Volvariella volvacea* (oil palm mushrooms), *Termitomyces macrocarpus* (nkankum) and *T. schimperi* (ahimire/sibre). Others include *T. telestui* (tweaworodo), and *Coprinus* sp. (sasea). They eat these mushrooms because of their taste and availability. Mushrooms act as meat or fish substitute as well as for nutritional benefits. The respondents complained that certain mushroom species are getting scarce because of bushfires and irregular rainfall patterns.

Mushrooms are collected from termite hills, cassava peel heaps, under decaying logs or tree stumps and living trees in abandoned farms and fields under fallow at the onset of the rainy season. Decaying logs on which mushrooms are known to grow include *Afzelia africana* (papao), *Ceiba pentandra* (onyina), *Triplochiton scleroxylon* (wawa), *Antiaris toxicaria* (kyenkyen). Others include *Daniellia* species, *Adansonia digitata* (baobab), *Mangifera indica* (mango) and *Vertilaria paradoxa* (shea butter).

### *Macrofungi encountered in the off reserve*

A total of 41 macrofungal species belonging to 18 families were recorded from the off-reserve. Four (4) edible species including *Termitomyces macrocarpus* and *T. schimperi* were recorded while two (2) *Ganoderma lucidum* and *Ganoderma turbinatum* were known to be medicinal. A total of fifteen (15) ectomycorrhizal fungal species were recorded including *Russula congolena*, *Boletus edulis* and *Cantharellus* species.



**Figure 2:** Macrofungi encountered in the Bui off reserve

### ***Plant species diversity in the off reserve***

Thirty (30) different plant species were identified in the off reserve. The grasses (*Axonopus compressus*, *Elymandra androphila* and *Melinis minutiflora*) dominated the area with trees such as *Isoberlinia doka*, *Daniella oliverii*, *Azzeria africana*, *Detarium macrocarpus*, *Albizia malacophylla*, *Terminalia mollis*, *Anogueissus leicarpus* and *Parkia biglobosa* found in decreasing order of density. Ectomycorrhizal plant species in the family Caesalpinaceae were relatively high in density in the area. The most frequently occurring ectomycorrhizal tree species is *Isoberlinia doka* followed by *Azzeria africana* and grasses, *Elymandra androphila* and *Ischaemum amethystinum*.

### **Conclusion**

The Bui National Park has many edible mushrooms that serve as meat or fish substitutes. They are collected at the onset of the rainy season from various substrates but many species are disappearing because of bushfires and irregular rainfall patterns.

It is recommended that communities be trained in mushroom farming for improved livelihood because many areas where mushrooms are collected will soon be submerged by water on completion of the Bui dam.

## **2.3 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**

The role played by Bobiri Forest Reserve in education, research and recreation is unparalleled since its establishment in 1939. Though popular, it 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 the 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.

## Results

### Plant species diversity

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 dominant (65%), lianas (23.7%), herbs (8.3%) and shrubs (3.0%). Mean density of the trees was  $379 \pm 66$  stems per hectare.

### Mycorrhizal tree species

*Anthonotha macrophylla* was the only ectomycorrhizal tree species identified belonging to the family Caesalpiniaceae, however, twenty four (24) endomycorrhizal tree species in eleven (11) families were also identified.

### Medicinal plant species

Fifty-four medicinal tree species were encountered, representing twenty four families.

### Macrofungal species from the two sites

Total record from the reserve showed thirty nine (39) macrofungal species belonging to twenty (20) families. Thirty one (31) of the species were present in the intact area whereas seventeen (17) species occurred in the disturbed area. The most frequently occurring species were Polyporaceae (7) followed by Xylariaceae (5). The following families recorded one species each: Geastraceae, Sacosomataceae, Stereaceae, Coprinaceae, Boletaceae, Lycoperdaceae, Schizophyllaceae and Ramariaceae, among others. Species such as *Auricularia auricula judae*, *Auricularia polytricha*, *Calvatia longicauda*, *Ganoderma applanatum*, *Geastrum schweinitzii*, *Schizophyllum commune*, *Stereum ostrea* and *Xylaria hypoxylon* commonly occurred in the intact and degraded sites.



**Fig 3:** *Stereum ostrea*



**Fig 4:** *Microporus xanthopus*



*Fig 5: Xylaria hypoxylon*



*Fig 6: Lepiota feline*

However, agarics such as *Termitomyces macrocarpus* and *Lepiota felini* were exclusively present in the intact area whilst species such as *Cookeina sulcipes* and *Laetiporus baudonii* were restricted to the disturbed area. *Leucopaxillus albissimus*, *Bolete sp.* and *Amanita sp.* were ectomycorrhizal fungi found in the intact area of the reserve.



*Fig 7: Laetiporus baudonii*

### **Butterflies encountered**

The 25 years logged site recorded the most butterflies followed by the unlogged, 2 years logged and the 50 years logged forest area in a descending order contrary to the initial belief that butterfly diversity was highest in the unlogged forest, followed by 50 years, 25 years and 2 years logged forest. Analysis is still in progress to determine the complete species diversity and richness.

### **Conclusion**

Plant species recorded in the disturbed area are lower compared to the intact area. The intact forest had the highest medicinal tree species while the disturbed forest recorded the least number of species.



*Anthonotha macrophylla* was the only ectomycorrhizal tree species identified in the degraded area and *Anthonotha fragrans*, *Anthonotha macrophylla* and *Berlinia tomentella* occurred on only the intact area. However, twenty four (24) endomycorrhizal tree species in eleven (11) families were also identified.

The overall macrofungal diversity is higher in the intact area than the disturbed area of the reserve. The Polyporaceae accounted for the highest number of species followed by Xylariaceae. *Cookeina sulcipes* and *Laetiporus baudonii* were restricted to the disturbed area.

## 2.4 Increasing the Durability of Bamboos in Ghana through Chemical and Non-Chemical Methods

**Project Team:** Oteng-Amoako, A., Essien, C. and Derkyi, N.S.A.

**Start date:** August 2008

**Expected completion date:** December 2010

### Introduction

Bamboo is one of the oldest and most versatile building materials with many applications in the field of construction. Diminishing wood resource and restrictions imposed on felling in natural forests in the tropics have necessitated the need to identify a substitute material which is environmentally friendly, widely available and adaptable to varying climatic and edaphic conditions with properties superior to most juvenile fast growing woods. Bamboo has emerged as one of the few suitable alternatives. In order to fully exploit the potentials of bamboo, development effort should be directed to the preservation, jointing, structural design and codification. Bamboo preservation is a critical factor in the efficient utilization of this reliable and truly renewable resource which is a suitable alternative to wood. Bamboo culms contain large amount of starch and do not produce any toxic substance during their lifetime hence the whole culm tissue can be destroyed by biological organisms especially fungi, termites and borers leaving only the outer skin.

### Objective

Determine effective chemical concentrations for increasing durability of bamboo using chemical and non-chemical treatment methods

### Results

*Bambusa vulgaris vitata* proved to be tolerant to borer damage compared to *Bambusa vulgaris* at the same chemical concentration and treatment system and the middle portion of the samples was very susceptible to borer damage than the bottom and the top.

Although the manufacturer's recommended dose of 1.0% was effective, 1.5% concentration of pyrinex was the most effective for protecting bamboo against

borer deterioration and 0.5% of pyrinex was least and should not be used for bamboo preservation.

Soaking treatment at all chemical concentrations was more effective as a non-pressure treatment method than the dipping method.

## Conclusion

1.5% concentration of pyrinex chemical preservative is much more effective for the protection of bamboo against borer deterioration than 1.0% and 0.5% concentrations of the same chemical.

## 2.5 Determining the Physicochemical Characteristics of Bamboo Species in Ghana

**Project Team:** Derkyi, N.S.A., Essien, C. and Owusu, J.

**Start date:** June 2010

**Expected completion date:** February 2011

### Introduction

Bamboo is a naturally occurring composite material which grows abundantly in most tropical countries. It is considered a composite material because it consists of cellulose fibers embedded in a lignin matrix. Cellulose fibers are aligned along the length of the bamboo providing maximum tensile flexural strength and rigidity in that direction. Over 1,200 bamboo species have been identified globally.

In Asian countries, bamboo is used for household utilities such as containers, chopsticks, woven mats, fishing poles, cricket boxes, handicrafts and chairs. It also has wide applications in building such as flooring, ceiling, walls, windows, doors, fences, housing roofs, trusses, rafters and purlins. It is also used in construction as structural materials for bridges, water transportation facilities and skyscraper scaffoldings.

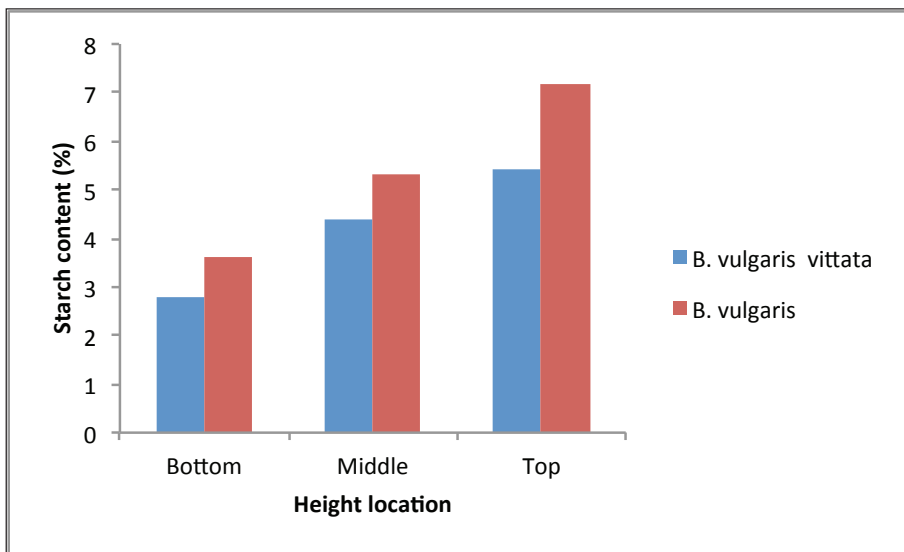
The chemical composition of bamboo is similar to that of wood. Bamboo does not contain the same chemical extractives as wood, and can therefore be glued very well. The chemistry of bamboo is important in determining its utilization potential. Several studies have investigated the chemical composition of bamboo. But systematic and thorough research on a commercially important bamboo species is needed to determine utilization potential for products such as medium density fiberboard (MDF) and in construction. Most of previous studies provide either only general information of several bamboo species or focuses on only one aspect of one species. The main constituents of bamboo culms are cellulose, hemi-cellulose and lignin, which amount to over 90% of the total mass. The minor constituents of bamboo are resins, tannins, waxes and inorganic salts. Compared with wood, however, bamboo has higher alkaline extractives, ash and silica contents.

To determine the physico-chemical causes for differences in natural durability of two bamboo species (*Bambusa vulgaris* and *Bambusa vulgaris vittata*) in Ghana.

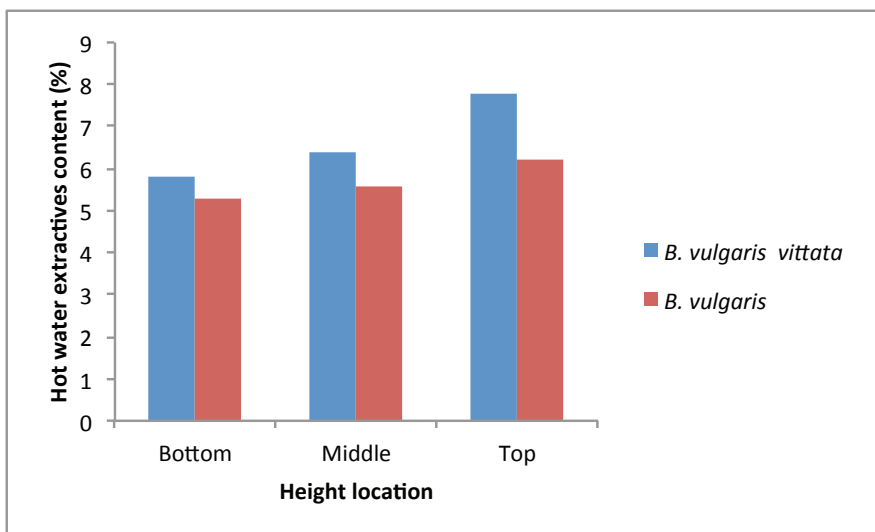
## Results

The results showed that the starch content of the yellow variety (*Bambusa vulgaris vittata*) was less than the green variety, *Bambusa vulgaris* (Figure 8), whilst the hot water extractives content of the yellow variety was more than the green variety (Figure 9).

In terms of the height-dependent fluctuation, the starch contents decreased as the sampling heights increased (Figure 8), whereas the hot water extractives content increased as the sampling heights increased (Figure 9).



**Fig. 8:** Starch contents of two bamboo species at different heights



**Fig. 9:** Hot water extractives content of two bamboo species at different heights

## Conclusion

Whereas starch content of the yellow variety (2.8-5.4%) was less than the green variety (3.6-7.2%), hot water extractives content of the yellow variety (5.8-7.8%) was more than the green variety (5.3-6.2%). Extractives serve as deterrents to termites and fungi, while starch is a source of food to them. The large proportions of hot water extractives in the yellow variety of bamboo therefore explain why it is more durable.

## 2.6 Analysing the Bamboo Value Chain in Ghana

**Project Team:** Sparkler, B.S., Darko-Obiri, B. and Adjei, R.K.

**Start date:** April 2010

**Expected completion date:** December 2010

### Introduction

Bamboo is the world's largest plant in the grass family widely used for manufacturing many products using modern technological advancement. The world bamboo market is currently worth USD 7 billion per year. The handicraft market alone is worth USD 3 billion. Bamboo shoots account for USD 1.5 billion and traditional furniture USD 1.1 billion with window blinds, panels and charcoal being the least.

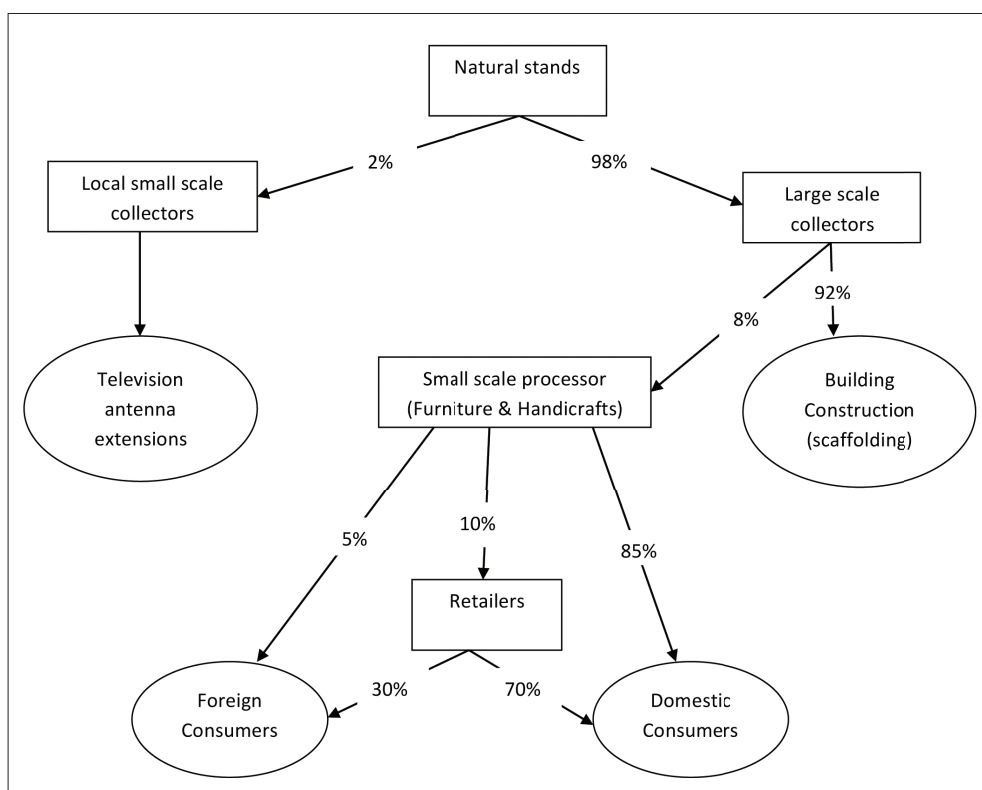
A value chain includes the full range of activities that are required to bring a product from its conception, through different phases of production, to its final customer. The value chain approach helps to improve the overall productivity of a sector mainly by identifying individual actors and the benefits they derive from the process. Thus, this approach contributes to poverty reduction. This study provides an evaluation of the potential of the bamboo enterprise sub-sector through the analysis of resources, technology processes, product markets, input markets and institutional frameworks.

### Objective

Identify opportunities, constraints and market characteristics of the bamboo enterprise and determine the viability of the bamboo enterprise in Ghana

### Results

Bamboo harvesting and processing is an occupation for men only, with women occasionally aiding in the transportation of harvested bamboo from inaccessible points to the roadside. Basic tools such as hack-saw, knives and hammers are used for harvesting. Training in sustainable harvesting of the resource is still rudimentary. The quality of the products and their durability are mostly questionable. Most people do not categorise bamboo furniture as durable products and value addition in the bamboo sector is undeveloped with low levels of technology. In bamboo growing areas, bamboo lots are in their natural stands and there is no formal management of these resources. The study revealed that the cost of the raw material was less than 5 per cent of the total input cost of the finished products.



**Figure 10:** Volume mapping in the bamboo value chain in Ghana

## Conclusion

Bamboo products' marketing is underdeveloped and exist mainly on a traditional level. The existing bamboo based enterprises are informal manufacturing set-ups, typically producing for informal markets and specialized only in making simple furniture with very limited product diversification and value addition.

## 2.7 Basic and Technological Properties of *Cola gigantea* and *Ficus sur*

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

**Start date:** January 2010

**Expected completion date:** December 2010

## Introduction

Sustainable forest management has become a priority issue in Ghana. The government through the Forestry Commission (FC) is actively pursuing the use of lesser-used species (LUS) and plantation species to reduce the pressure on major primary timber species. This has come about as a result of the dwindling volumes of the traditional species in the natural forests of Ghana, thus posing a threat to the raw material base of the timber industry, which would in the nearest future result in an increase in the unemployment level and a reduction in revenue generated from timber export.

Two LUS, *Cola gigantea* and *Ficus sur* were selected based on the results of a survey by the Timber Industry Development Division (TIDD) in collaboration with CSIR-FORIG on domestic timber consumption rates in Ghana conducted in 2009, and inventory data from the Forest Services Division of the FC. Despite the occurrence of these two species in appreciable quantities in the secondary forests of Ghana, their properties are unknown.

For their effective promotion and utilization to increase the raw material base of the wood industry or act as substitutes for some of the species that are overexploited, knowledge of their basic and technological properties and characteristics are required to provide information concerning their suitability for specific end-uses.

## Objective

To determine the basic and technological properties and develop appropriate processing techniques for the efficient utilization of two *Cola gigantea* and *Ficus sur*.

## Results



**Fig. 11:** Felling of *Cola gigantea*



**Fig. 12:** Taking data from cross-cut logs

## Sawing Characteristics of *Cola gigantea* and *Ficus sur*

Five (5) trees each of *Cola gigantea* and *Ficus sur* from Pra Anum forest reserve at Amantia in the moist-semi deciduous forest zone were felled (Figure 11) and the cross-cut and bruised surfaces were then prophylactically treated with chemicals (anti-blue 3737 and dursban) to prevent fungal stains and insect attack.

The lumber yield for *Cola gigantea* and *Ficus sur* are estimated to be 74.1% and 76.7% respectively (Table 2). The yield results show that with a constant volume of log more lumber is obtainable from *Ficus sur* than *Cola gigantea*. The production and fuel consumption rates, as shown in Table 2, are also higher for *Ficus*, an indication that its milling is quite easier than *Cola gigantea*. *Cola gigantea* is suspected to contain some inclusions as flashes of light were observed during milling.

**Table 2:** Lumber yield of *Cola gigantea* and *Ficus sur*

Species	Mean lumber volume (m <sup>3</sup> )	Mean yield (%)	Mean production rate (m <sup>3</sup> /hr)	Mean fuel consumption rate (lit/m <sup>3</sup> )
<i>Cola gigantea</i>	9.12	74.1	1.08	8.1
<i>Ficus sur</i>	4.89	76.7	1.98	5.4

### Machining Characteristics

The machining performance of the specimens increased as feed speeds and the rake/cutting angle decreased. The surface roughness was found to be affected by the feed speed and rake angle. In addition, lower surface roughness values were observed for the specimens from the top logs than those from the bottom and butt logs.

### Physical Properties and Drying Characteristics

For *Cola gigantea*, mean green moisture content was 89.36% with a standard deviation of 20.91%. However, the mean moisture content of *Ficus sur* was 155.85% with standard deviation of 23.82%. The mean basic density for *Cola gigantea* was 469.20kg/m<sup>3</sup> and 353.53kg/m<sup>3</sup> for *Ficus sur*.

Results from air drying studies on lumber showed that of *Ficus sur* took 110 days to dry from an overall average of 155.82% to 16.84% MC. The 50 mm and 25 mm boards dried from 155.62% to 20.1% and 162.43% to 16.92% MCs respectively. Lumber of *Cola gigantea* on the other hand took 110 days to dry from an overall average of 89.36% to 14.94% MC. The 50 mm and 25 mm boards dried from 87.0% to 14.74% and 91.93% to 15.14% MCs respectively.

### Chemical Composition

The main chemical components that affect the wood species quality were determined on the ground wood for each sample. The results are recorded in Table 3.

**Table 3:** Chemical Composition of *Ficus sur* and *Cola gigantea*

Wood Species	Moisture Content (%)	Cold Water (%)	1% NaOH solubles	Lignin	Cellulose	Hemi-Cellulose	Holo-Cellulose
<i>Ficus Sur</i>	13.5	3.2	12.1	28.3	48.9	13.3	61.6
<i>Cola gigantea</i>	15.2	3.3	13.1	26.0	52.6	16.5	69.5

### Mechanical Properties

The mean range of values for *Ficus sur* is as follows: bending (modulus of rupture): 25.9-34.4 N/mm<sup>2</sup>; compression parallel to grain 12.3-16.5 N/mm<sup>2</sup>; hardness 1.19 kN (radial and tangential); shear parallel to grain 5.3-6.2 N/mm<sup>2</sup> and modulus of elasticity 3,613-4,096 N/mm<sup>2</sup>.

*Cola gigantea* had relatively higher values of strength properties than Kotreamfo. Bending (modulus of rupture): 58.5-71.6 N/mm<sup>2</sup>; compression parallel to grain: 29.8-33.4 N/mm<sup>2</sup>; hardness: 1.40-1.52 kN; shear parallel to grain: 9.6-10.0 N/mm<sup>2</sup> and modulus of elasticity of 8171- 8849 N/mm<sup>2</sup>.

The strength properties of *Cola gigantea* in terms of bending (modulus of rupture and the modulus of elasticity) under green conditions compares well with *Sterculia rhinopetala* and *Petersianthus macrocarpus*.

### **Treatability**

The average air dried density of *Cola gigantea* and *Ficus sur* are 577.79 Kgm<sup>-3</sup> and 405.8 Kgm<sup>-3</sup> respectively. The sapwood of both species is denser than their respective heartwood at 95% confidence level. The average values for the sapwood and the heartwood are 409.02 Kgm<sup>-3</sup> and 402.59 Kgm<sup>-3</sup>; 596.71 Kgm<sup>-3</sup> and 558.87 Kgm<sup>-3</sup> for *Ficus sur* and *Cola gigantea* respectively. For the *Ficus sur*, as the air dried density increases from the bottom, the porosity decreases from the bottom indicating that the bottom portion of the tree may be more permeable to preservative than the middle and the top but *Cola gigantea* did not show any specific trend.

### **Anatomical Characteristics**

The mean fiber lengths, fiber lumen diameter and the double wall thickness for *Ficus sur* and *Cola gigantea* were 1.55mm, 23.88 um, & 7.47 um; and 1.99 mm, 13.89 um and 8.74 um respectively. Proportions of the vessel, fiber and parenchyma cells in *Ficus sur* and *Cola gigantea* were 9%, 42% and 49% and 8%, 49% and 43% respectively. This indicates that *Cola gigantea* may be denser and more compact than *Ficus sur* hence *Ficus sur* may absorb more preservative than *Cola gigantea*.

### **Conclusion**

Results from tests and analyses are approximately 80 per cent complete but they clearly show that *Cola gigantea* and *Ficus sur* are two lesser utilised species suitable for wide applications in construction or furniture making. Survey results indicate that the species are already being utilized by some local communities in the Brong Ahafo Region and are in considerable volumes to support the timber industry.



## 2.8 Assessment of Coping and Adaptation Strategies to the Effects of Climate Change in Offinso North and South Districts of Ashanti - Ghana

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

**Start date:** January 2010

**Expected completion date:** December 2010

### Introduction

Increasing anthropogenic greenhouse gas accumulation in the atmosphere is already having effects on the global climate system. This change is expected to continue into the coming centuries at rates projected to exceed past estimates. The Intergovernmental Panel on Climate Change (IPCC) which is responsible for assessing information relevant to climate change has noted that Africa is one of the most vulnerable continent to the impact of climate change and variability. Large parts of the continent are recognized as having climates that are among the most variable in the world in seasonal and decadal temporal scales.

In Ghana, studies show that all the ecological zones are experiencing unprecedented extreme weather conditions such as increased temperature and unpredictable rainfall patterns. The gradual but consistent changes in climatic patterns over the country is likely to impact significantly on agriculture, water resources, health, livelihoods, ecosystems and energy production.

According to the IPCC, most local communities have developed a range of indigenous-based livelihood practices and options to adapt to climate change and its impact. This study was therefore conducted to:

- Assess potential impacts of climate change and variability on communities in the Offinso North and South Districts;
- Determine the coping and adaptation strategies adopted by communities;
- Identify baseline information for future research on climate change adaptation strategies.

### Results

#### Farmers' Perception of Climate Change

Most of the farmers from the South (95.8%) are of the opinion that temperatures have increased in their lifetime, while rainfall has decreased or become less predictable (95.5%) compared to only 65.0% from the North. However, a little over half (52.5%) of the farmers from the North believe that drought periods have increased with 69.2% indicating that their farming activities/crop yields was affected in the past 10years.

Only 5.5% of farmers from the South and none (0%) from the North believe there has been increased incidence of floods.

With regards to fire, 16.7% of farmers from the South compared to 53.8% from the North are of the view that wildfire incidence has increased. This is to be expected since the South lies within the semi-deciduous Forest Zone while the North lies within the fire-prone transition zone.

According to all the respondents from the South and 92.4% from the North, many species are increasingly threatened or extinct locally but less than 20% of the respondents associated these extinctions to climate change.

### **Farmers' Coping Strategies**

For most farmers, the planting season had shifted and many were cautious with respect to their planting schedules due to unpredicted rainfall patterns. Farmers have also adapted to planting on raised ridges for food crops like maize, cassava, pepper and other vegetables which were traditionally planted on level ground.

Coping strategies against drought include: irrigating crops with water from nearby streams, use of dug out wells on farms or by conventional irrigation, which was very low in the district.

### **Perception of Climate Change by Policymakers and Administrators**

The opinions of traditional authorities, policymakers and administrators did not differ from the farmers. The general consensus was on the need to develop policies, programmes and activities to address any negative impact of climate change on the people.

### **Conclusion**

Local communities are fairly well-informed about climate change and other challenges relating to deforestation and land degradation through experience, but the implementation of national climate change policies is poor because local government administrators are not adequately informed. National programmes on climate change and related land-use issues should emphasize a strong local government participation to ensure that management interventions are effectively delivered to the door steps of the target communities.

## 3.0 Doner Funded Projects

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

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

**Start date:** May 2010

**Expected completion date:** November 2011

This project is sponsored by the West Africa Agricultural Productivity Programme (WAAP). Mushrooms are well known and contribute food nutrients in the diet of 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 these 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.

The project focuses on developing appropriate culture substrates from root and tuber for maximum production of selected edible indigenous mushrooms in rural communities. The improved technology will be disseminated to the rural communities and the unemployed through training and workshops.

Structured questionnaires were administered in six local communities in the Tano North District of the Brong Ahafo Region to obtain personal information on cassava processors on the availability and use of cassava peels. Many of the gari producers generate two to eight minibags of cassava peels a week and these are left on the farms to rot. Oil palm mushrooms were cultivated on low beds using cassava peels variously mixed with other supplements.

### 3.2 Utilization of Cassava Flour in Plywood Adhesive Mix (Cassava: Adding Value for Africa Project)

**Project Team:** Derkyi, N.S.A. and Sekyere, D.

**Start date:** 2009

**Expected completion date:** 2011

Cassava: Adding Value for Africa (C:AVA) is funded by Bill and Melinda Gates Foundation. C:AVA-GHANA seeks to develop value chains for high quality cassava flour (HQCF) in Ghana, to improve the livelihoods and incomes of at least 20,000 smallholder households as direct beneficiaries including women and disadvantaged groups. It seeks to achieve this by promoting the use of HQCF as a versatile raw material for which diverse markets have been identified in pilot studies. This project aims to encourage the utilization of HQCF as urea-formaldehyde glue extender in selected plywood mills in Ghana.

Five (5) regions of Ghana namely; Eastern, Western, Ashanti, Brong Ahafo and Volta were surveyed to identify plywood manufacturing industries.

The technical feasibility of using HQCF as a raw material in the plywood industry was demonstrated in twelve (12) plywood mills. Twenty eight (28) glue mixers (from the 12 plywood mills) have been trained in using HQCF as extender in plywood glue mix and three (3) HQCF processors have been linked with four (4) plywood mills.

### 3.3 Tropical forests for poverty alleviation: from household data to global analysis

**Project Team:** Obiri, B.D., Marfo, E., Nutakor, E.,  
Cobbinah, J.R. and Treue, T.

**Start date:** 2007

**Expected completion date:** 2010

This project is sponsored by the Danish International Development Agency (DANIDA). The key focus of this project is to estimate the magnitude of dependency on forests in the wet evergreen and transition zones and its implications on policy. One significant achievement is the submission and approval of the Ghana country databases on rural household income patterns in forest communities in the wet and transition zones of Ghana to CUFO-PEN in Indonesia. The databases will be used in global analysis for economic estimation of the extent of forest dependency by rural people in tropical countries and to inform policy debate and pro-poor forest sector interventions.

Highlights of findings from preliminary analysis are as follows:

- Agriculture is the predominant livelihood activity contributing up to 50% of total annual household income in both the wet and dry forest zones. It is also the key contributor to cash income of the farm household.
- The non-forest environment (fallow, farmlands, etc.) is the key source of environmental products.
- Forests contribute up to 10% of total household income. However, environmental income (i.e. non-forest environment and forests) is the second largest contributor to household income (i.e. 30% and 25% for wet and dry respectively).
- Households rely on environmental resources mainly for subsistence.
- Forest and other environmental products are harvested throughout the year. Collection peaks in the first quarter of the year when there is less agricultural activity. There is higher reliance on game, poles and fuelwood.
- Environmental creaming at the non-forest area (fallow, farmlands) for poles and fuelwood provides an opportunity for developing this area with short rotation tree species for these products for cash and subsistence purposes, particularly in the dry area. These could be developed essentially as supplementary viable cash income sources in the short-medium term for agrarian economies in the forest and savannah transition zones.
- At the wet forest site, small scale gold mining influences non-forest income which calls for pragmatic steps to effectively control these activities that have significant destructive impact on water and land resources.

### 3.4 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 studies concluded 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 confirmed that chainsaw milling under an illegal regime is very wasteful and has the lowest recovery efficiency. It was recommended that dealing with legal supply of timber to the domestic timber market is an important prerequisite to curb illegal chainsaw milling. The recommendations were taken up by a multi-stakeholder technical group and informed the proposition of three (3) policy directions. These policy directions are currently under discussion by a national multi-stakeholder dialogue process (MSD) to negotiate specific policy options.

### 3.5 Conservation and Utilization of Medicinal Plants in Ghanaian Forest Fringe Communities

**Project Team Leader:** Owusu-Sekyere, E.

**Start date:** 2008

**Expected completion date:** 2012

This project funded by the International Tropical Timber Organisation (ITTO) and focuses on documenting the distribution and availability of medicinal plants (endangered, common). Over 60 per cent of the population in Ghana depends on plant parts for health delivery. This is because medicinal plants are of critical importance in poor communities where even relatively inexpensive western medicines remain prohibitively expensive. The continued availability of many of these plants is in jeopardy. A workshop organized to solicit views on the state of medicinal plants in Ghana revealed that in several forest fringe communities, the loss of medicinal plants mean not only an immediate loss of livelihood but also rapid erosion on the knowledge and efficacy of their use. Again, there is no attempt whatsoever to conserve medicinal plants as both timber and non-timber forest products (NTFPs). Therefore, habitat destruction and over-exploitation means sources of medicinal plants are becoming increasingly scarce. In recent times, herbalists and collectors travel long hours over long distances in search for specific medicinal plants. Sometimes they travel to other ecological areas for suitable plant species.

The project also focuses on conservation methods and sustainability of supply of medicinal plants from three different ecological zones. Another aspect of this project is training of forest fringe communities in conservation (both timber and non-timber forest products (NTFPs), propagation and management techniques, sustainable harvesting and utilization of medicinal plant species.

### 3.6 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 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.

Some of 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 engage in *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 genebanks 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.

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.

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

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

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.

The specific objective 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 project aims to develop, among others; methods for measurement, assessment reporting and verification and in addition determine the financial value of environmental services. 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 of the project.

### 3.8 Plant Resources of Tropical Africa - Timbers of Tropical Africa Part II

**Project Team Leader:** Cobbinah, J.R.

**Start date:** 2006

**Expected completion date:** 2010

Plant Resources of Tropical Africa (PROTA) is an international programme sponsored by ITTO concerned with making scientific information about utility plants accessible in Africa and supporting their sustainable use to reduce poverty. As part of the programme, PROTA is synthesizing all existing but dispersed knowledge on about 1,070 Timbers of Tropical Africa. PROTA 7(2): 'Timbers 2' will deal with about 570 species in 300 review articles. It complements PROTA 7(1): 'Timbers 1' (2008) in making the overview of the timbers of tropical Africa complete. So far



151 articles on 324 species have been completed and 83 have been incorporated in the PROTA web database in both English and French and fully illustrated. Also, 133 Standardized wood-anatomical descriptions were generated in a production and training workshop held from 13-23 September in Kumasi, Ghana. Twelve trainees from nine African countries were guided by five experienced wood anatomists.

### 3.9 Towards Sustainable Indigenous Mahogany Timber Production in Ghana: Phase II, Refining the Silvicultural 'Tool Kit' and Practical Training for Industrial Foresters and Community Farmers (Ghana)

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

**Start date:** 2010

**Expected completion date:** 2014

Funding for this project is provided ITTO. Mahogany (Meliaceae: Swietenidae) is a valuable tropical timber, but continued supply is threatened by overexploitation of natural forest reserves and the prevention of successful plantation culture by a single pest species, the shoot boring moth *Hypsipyla robusta*, that devastates young stands by killing main stems, causing excessive forking and branching, and, in worst cases, contributing to mortality. This project demonstrates an integrated management strategy for plantation establishment incorporating a number of pest management measures based on sound experimental evaluation.

This second phase will refine the silvicultural “tool kit” to optimized planting in mixed stands with an aim to reducing economic losses from *Hypsipyla*, and will promote the establishment of additional industry and community plantations through the development of a “How to” cultivate indigenous mahogany practical handbook and a series of field workshops for industry foresters and community farmers. Also comparable information on wood quality and lumber characteristics of plantation-grown mahogany and natural forest mahogany will be made available.

## 4.0 Commercialisation And Information Division

The Commercialisation and Information Division is made up of three (3) sections; the Information and Publications, Computer, Public Relations and Special Services.

### 4.1 Commercialisation Activities

The Division is responsible for the coordination of all commercial activities of the Institute. The actual commercialisation activities are however, undertaken by the special services section. The income generation activities are centred 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, all the technologies developed as output from research continued to be commercialized, though at a relatively slow rate.

#### **4.1.1 Sale of Seeds and Seedlings**

CSIR-FORIG has over the years collected various species of tree seeds for sale to prospective plantation developers in the country. Seeds from CSIR-FORIG are usually of a high quality since they are collected from plus trees, processed and tested before they are sold. This activity is however, confronted with many challenges including unavailability of parent trees for seed collection due to illegal logging and competition from the private sector. To reduce this problem, CSIR-FORIG has established seed orchards for some tree species that would serve as reliable sources of seed supply but this requires a large capital outlay. As at December 2010, the Institute had established four (4) orchards of different tree species at various ecological zones of the country.

The production of seedlings for sale is also facing a similar problem with respect to competition from the private sector. Notwithstanding the challenge, the Institute continued to produce various tree seedlings for sale to plantation developers in the country. Quality seedlings of various tree species are available at the Institute's main nurseries at Fumesua and Mesewam. Plans are underway to establish other nursery sites at the various outstations. The quality of our seedlings is high since the seeds used are usually scientifically processed and tested for quality. Exotic and indigenous tree seedlings as well as some ornamentals are available for sale at CSIR-FORIG.

#### **4.1.2 Sale of Wood Thinnings**

CSIR-FORIG periodically thins wood from its research plots at Amantia and Afram Headwaters research stations and sells it as wood to generate income for the Institute. The sale of wood, however, is not sustainable since thinning is done periodically. As a result, the Institute has intensified its plantation development programme. In 2010, its 33 hectare forest plantation was expanded substantially to over 100 hectares to serve as a future source of wood supply. This activity on the other hand, requires huge capital investment to maintain the stand.

#### **4.1.3 Consultancies, Contract Research and Training**

On contract research and consultancies, CSIR-FORIG has performed creditably over the years. Yet in the year under review, there was no significant improvement in performance as far as consultancies and contract research were concerned. No training was organised in snail farming or mushroom cultivation, the main pillars



of our training programme. Training facilities such as the mushroom house, snail pens and sterilization equipment were under renovation. Currently, the Institute has started renovating these facilities and has acquired a new autoclave to launch new training programmes in 2011.

#### **4.1.4 Production of Prekese Syrup and Honey**

The production of prekese syrup for sale has been ongoing for several years even though production is at the laboratory level. Its popularity as a food condiment makes it a possible commercial enterprise for CSIR-FORIG. In view of this, due consideration is being given to moving it from the laboratory stage to the pilot stage. A new structure is under construction to process the syrup. Preparation of a business plan is in progress for the effective management of the product and its implementation will begin very soon.

### **4.2 Information and Publications**

The library added to its stock a total of twenty-five (25) new books that were received on gratis. Most of the publications received, however, did not have any bearing on forest management which is the focus of research at the Institute. The library was not able to purchase new books or subscribe to new journal titles on its own due to lack of funding. However, due to the magnanimity of some online publishers, the Institute was given access to e-resources from AGORA, JSTOR and EBSCOHOST that make full text information available to scientists. Notwithstanding the above challenge, the library in 2010 provided essential information services to support ongoing research activities. It also provided useful forestry-related information to the general public for professional development.

Currently, the library, through the support of FAO, has established an Institutional Repository that seeks to electronically capture all local publications. This is for the purpose of sharing information among CSIR Institutes. As at December 2010, the library had captured over five hundred (500) records in the Institutional Repository. The library conducted over two hundred (200) literature searches for students and researchers using various databases. In addition, the section published two (2) volumes of the Ghana Journal of Forestry, two (2) Technical Notes and four (4) issues of the CSIR-FORIG newsletter.

### **4.3 Computer Section**

The computer section of the Commercialisation and Information Division has the responsibility of managing CSIR-FORIG's Local Area Network (LAN) as well as servicing of computers at the premises. It is also in charge of the development and maintenance of the Institute's website for both the Internet and Intranet.

Activities that were undertaken in 2010 include the following:

- Maintenance of the Institute's website for both the Internet and Intranet



- Management of the Local Area Network to support research
- Servicing of computers for maximum output

All the activities of the section were performed satisfactorily during the year.

## 5.0 Administration

The objectives of this Division are to:

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

### 5.1 Staff Strength and Structure

The current staff strength of the Institute is 257 made up of 55 Senior Members, 67 Senior Staff and 135 Junior Staff as against the approved 2005 manpower ceiling of 296.

### 5.2 Administrative Matters

#### 5.2.1 Promotions/Upgrading

Applications for promotion from seven (7) senior members were sent to Head Office and are receiving attention.

#### Upgrading

The following officers were upgraded:

- Mrs. Georgia Marfo Coffie has been upgraded to Administrative Officer with effect from 9<sup>th</sup> June 2009.
- Mr. Osei Yaw Adjei upgraded to Accountant effective 3<sup>rd</sup> August 2009
- Mr. Kwasi Agyeman-Prempeh upgraded to Accountant effective 23<sup>rd</sup> December 2009

#### Promotions

Fourteen (14) Senior Staff were promoted by the Council. They are:

- Mrs. Magdalene A. Prempeh - PTO<sup>1</sup> - 1st January, 2010
- Mr. Albert K. Nyeha - PTO<sup>1</sup> - 1st January, 2010
- Mr. Daniel Peprah - STO<sup>2</sup> - 1st January, 2010
- Mrs. Jemima Owusu - STO<sup>2</sup> - 1st January, 2010



- Mr. Daniel Debrah - STO<sup>2</sup> - 1st January, 2010
- Mr. Kwaku Bonsu - STO<sup>2</sup> - 1st January, 2010
- Ms. Esther Amponsah - STO<sup>2</sup> - 1st January, 2010
- Mr. Elvis Nkrumah - TO<sup>3</sup> - 1st December, 2008
- Miss Mavis S. Kwarteng - CAA<sup>4</sup> - 1st January, 2010
- Mr. Samuel Atusong - PAA<sup>5</sup> - 29th May, 2009
- Mr. Kwaku Asumadu - SMA<sup>6</sup> - 1st January, 2010
- Miss Margaret Adugbire - SAA<sup>7</sup> - 1st January, 2010
- Miss Jane Nketiah - SAA<sup>7</sup> - 1st January, 2010
- Mrs. Ewurama Andoh - SAA<sup>7</sup> - 1st January, 2010

1 Principal Technical Officer

2 Senior Technical Officer

3 Technical Officer

4 Chief Accounting Assistant

5 Principal Accounting Assistant

6 Senior Marketing Assistant

7 Senior Administrative Assistant

### 5.2.2 New Appointments

The following are new appointments to fill vacancies in the Institute during the year:

- Mr. Emmanuel Appiah Kubi - Research Scientist
- Mr. Albert Ansah-Akuffo - Principal Technical Officer
- Mr. Markfred Mensah - Principal Technical Officer
- Mr. Ernest Osei Boakye - Principal Technical Officer
- Mr. Caleb Ofori Boateng - Principal Technical Officer
- Mr. Stephen Tekpetey Lartey - Principal Technical Officer
- Mr. Francis Asare Abetia - Principal Administrative Assistant
- Mr. Mark Debra Marfo - Technical Officer

### 5.2.3 Resignations

The following officers resigned from the Institute during the year. They are:

- Mr. Maxwell Osae Bekoe - Senior Technical Officer
- Mr. Kwaku Bonsu - Senior Technical Officer
- Miss Esther Amponsah - Senior Technical Officer

### **5.2.4 Training**

Presently, eight (8) staff are in school offering BSc, MSc or PhD Programmes.

1. Mrs. Lucy Amissah, PhD Programme, Sandwich, Wageningen University, Netherlands
2. Mr. Lawrence Damnyag, PhD Programme, the University of Joensuu, Finland
3. Mr. Emmanuel Ebenyenle, PhD Programme, Michigan Technology, University, USA
4. Ms. Bridgette Brentuo, MPhil Programme, Wood Science, KNUST, Kumasi
5. Mr. Charles Essien, MPhil Programme Wood Science, KNUST, Kumasi
6. Mr. Govina J. Kudjo, BSc. Programme, KNUST, Kumasi
7. Mr. Kwame Debrah, BSc. Programme, KNUST, Sunyani Campus
8. Miss Sandra Owusu, BSc. Programme, KNUST, Sunyani Campus

### **Back from Training**

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

1. Dr. Kennedy Owusu Afriyie, PhD. Plant Science, University of Aberdeen, UK
2. Mrs. Naomi Appiah, MBA Marketing, KNUST, Kumasi
3. Mr. William Kwadjo Dumenu, MSc Forest Ecology and Management, University of Freiburg, Germany
4. Mr. Shalom Daniel Addo-Danso, MSc Forest Ecology and Management, University of Freiburg, Germany
5. Dr. Bright Obeng Kankam, PhD in Primatology at University of Calgary, Canada

### **5.2.5 Sabbatical Leave**

#### **On Sabbatical Leave**

Mrs. Margaret Sraku-Lartey, Principal Librarian of CID Division is still on a 2-year sabbatical leave at the Presbyterian University College, Abetifi.

#### **Back from Sabbatical Leave**

Dr. Kwame Asamoah Adam resumed from sabbatical leave effective 1st August, 2010 after 22 months tenable at WWF-West Africa Regional Forest Programme, Accra.



### 5.3 Retirements

In 2010, two (2) Senior Members, three (3) Senior Staff and seven (7) Junior Staff Members retired from the Institute at the compulsory retirement age of 60 years.

The names of the retired senior members and the three (3) senior staff members are presented below:

- |    |                               |   |                              |
|----|-------------------------------|---|------------------------------|
| 1. | Dr. Joseph Ofori              | - | Chief Research Scientist     |
| 2. | Dr. Dominic Blay Jnr.         | - | Principal Research Scientist |
| 3. | Miss Augustina Addae          | - | Chief Technical Officer      |
| 4. | Miss Alberta Victoria Erskine | - | Chief Accounting Assistant   |
| 5. | Mr. Dickson K. Asamoah        | - | Senior Accounting Assistant  |

#### Post Retirement Contract

- Dr. Joseph Ofori, Chief Research Scientist was granted a two (2) year post retirement contract effective September, 2010.
- Dr. Dominic Blay Jnr. Principal Research Scientist was also granted a two (2) year post retirement contract effective September, 2010.

#### New Office for CSIR Kumasi Branch Pensioners Association

The Kumasi branch of CSIR Pensioners' Secretariat was commissioned on CSIR-FORIG Campus on 1<sup>st</sup> December, 2010. The commissioning was done by Dr. Victor Agyeman, Director of CSIR-FORIG.

### 5.4 Official visits by distinguished Personalities

The following distinguished personalities visited the Institute during the year:

1. Dr. Ekharad Roger, German Forest Service, 19<sup>th</sup> February, 2010
2. Prof. Eugene H. Amonoo-Neizer Chairman, CSIR Council, 17<sup>th</sup> March, 2010
3. Rev. Father Augustine Owusu, Duayaw Nkwanta Catholic Church, 22<sup>nd</sup> March, 2010.
4. Prof. Dr. Elizabeth Wheeler, United States of America
5. Dr. Felix Kamala, Malawi
6. Dr. Lawrence Awoyemi, University of ADO EKITI, Nigeria
7. Dr. Paul Mugabi, Makerere University, Uganda
8. Mr. Edi Kouassi Achi, SODEFOR, Cote d'Ivoire
9. Dr. Peter Gasson, Royal Botanic Gardens, Kew, United Kingdom
10. Dr. Ernesto Uetimane Jnr., Forestry Department, Mozambique

11. Prof. Peter Baes, Holland
12. Dr. Keuben Shanda, Kenya Forestry Research Institute
13. Ms. Neduvoto, Forestry Research Institute, National Herbarium, Tanzania
14. Dr. Sognigbe N'Danikou, INRAB, Benin
15. Mr. Ezekiel Mwakalukwa, University of Copenhagen and SUA Tanzania
16. Dr. Hans Beckman, Belgium

## 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.

Below is the cash flow statement for the period January to December 2010

Government of Ghana	Inflows(GHc)	Outflows(GHc)	Variance(GHc)
Personnel Emoluments	3,141,692.00	3,084,626.00	57,066.00
Administrative Expenditure	146,926.67	282,618.00	(135,691.33)
Service Expenditure (Note 1)	-	37,400.00	(37,400.00)
IGF (Note 1)	180,675.00	160,766.00	19,909.00
Guest Houses	124,670.00	71,871.00	52,799.00
Production Unit	50,840.00	38,488.00	12,352.00
<b>Total</b>	<b>3,644,803.67</b>	<b>3,675,769.00</b>	<b>(30,965.33)</b>
Donor (Note 2)	<b>Inflows(\$)</b>	<b>Outflows(\$)</b>	<b>Variance(\$)</b>
<b>Total</b>	<b>615,000</b>	<b>570,000</b>	<b>45,000</b>

**Note 1:** In the year under review, no service or investment grant was received. The IGF outflow includes GH¢37,400.00 released by the Institute to the various units for their research activities.

**Note 2:** Donor inflows in various currencies are all converted to US dollars.



## 7.0 APPENDICES

### Publications/Training Programmes/Conferences Attended

#### Books

**Agyeman, V.K., Senaya, J., Anglaaere, L.C.N., Dedjoe, C.D, Foli, E.G. & Britwum Acquah, S.** 2010. Soils of Degraded Forest Reserves and Key Species for Plantation Development in Ghana, CSIR-Forestry Research Institute of Ghana, Kumasi, Ghana x+ 84pp.

**Bosu, P.P. Cobbinah, J.R., Darko-Obiri, B., Nkrumah, E.E., Stephens, S.S. and Wagner, M.R.,** 2010. Hand Book on Mixed Indigenous Species Plantations in Ghana. FORIG Publication, Kumasi 37pp.

**Derkyi, M., Insaidoo, T.F.G., Afriyie, M.A., Baffoe, N.S., Pentsil, S., Derkyi, N.S.A., Nassah, V.F., Gyan, G.O. and Pentsil, M.** 2010. Micro-Enterprise Development Skills: A Community Training Manual. CDF, Kumasi, Ghana. 46pp.

**Derkyi, M., Afriyie, M.A., Insaidoo, T.F.G., Pentsil, S., Derkyi, N.S.A., Baffoe, S.N., Nassah, V.F. and Pentsil, M.** 2010. Livelihood Micro-Enterprises and Advisory Services: A Community Training Manual. CDF, Kumasi, Ghana, 72pp.

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**Marfo, E.** 2010. Chainsaw Milling in Ghana, Context, Drivers and Impacts. Tropenbos International, Wageningen, the Netherlands. xii + 64pp.

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**Domingues, T.F., Meir, P., Feldpausch, T.R., Saiz, G., Veenendaal, E.M., Schrodt, F., Bird, M., Djangbletey, G., Hien, F., Compaore, H., Diallo, A., Grace, J. and Lloyd, J.** 2010. Co-limitation of Photosynthetic Capacity by Nitrogen and Phosphorus in West Africa Woodlands. *Plant, Cell and Environment* 33, 959–980. Blackwell Publishing Ltd.

**Oteng-Amoako, A.A. and Essien, C.** 2010. *Celtis zenkeri, Cynometra ananta, Guibourtia ehie*. In **Plant Resources of Tropical Africa 7(2). Timbers 2 Book**

**Obeng, E.A. and Acquah, S.B.** 2010. *Bikinia coriacea*. In **Plant Resources of Tropical Africa 7(2). Timbers 2 Book.**

**Owusu, F.W. and Derkyi, N.S.A. 2009.** *Sterculia africana* (Lour.). **Plant Resources of Tropical Africa 16 Fibres: PROTA Foundation/Backhuys Publishers/CTA Wageningen, Netherlands.**

### Refereed Journal Papers

**Abraham, J., Angeli, S., Schuetz, S., Weissbecker, B. and Opuni-Frimpong, E. 2010.** Olfactory cues of female *Hypsipyla robusta* (Moore) (Lepidoptera: Pyralidae) to Mahoganies of the genera, *Entandrophragma* and *Khaya*. *International Forestry Review* 12(5): 111.

**Agyeman, V.K., Swaine, M.D., Thompson, J. Kyereh, B., Duah-Gyamfi, A, Foli, E.G. and Adu-Bredu, S. 2010.** A Comparison of Tree Seedling Growth in Artificial Gaps of Different Sizes in two Contrasting Forest Types. *Ghana Journal of Forestry*, 26: 14 - 40.

**Ameyaw, L.K., Obiri, B.D., Acheampong, E. and Opuni-Frimpong, E. 2010.** Farm Forestry: A Viable Option to Poverty Alleviation and Climate Change Amelioration in Ghana. *International Forestry Review* 12 (5): 192.

**Asomaning, J.M., Sacande, M. and Olympio, N.S. 2010.** Germination Responses of *Khaya anthotheca* seeds to a range of alternating and constant temperatures provided by the 2-way grant's thermogradient plate. *Ghana Journal of Forestry* (26): 74 – 88.

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**Wagner, M.R., Bosu, P.P. and Stephens, S.S. 2010.** Impact of Plantation Species Diversity on the Growth and Survival of selected Tropical Tree Species in a mixed native. *The International Forestry Review* page 118.

**Britwum Acquah, S. 2010.** Analysis of Students' Dissertation: A Case for Promotion of Lesser-used Vegetables in Ghana. *Agricultural and Food Science Journal of Ghana* Vol. 8: pp 617-630

**Britwum Acquah, S., Mikkola, E., Kleine, M. and McCracken, R. 2010.** FORNIS: Building online Network of Forestry information of Sub-Saharan Africa. *The International Forestry Review* Vol. 12(5), 344

**Derkyi, N.S.A, Sekyere, D., Okyere, Y.Y., Darkwa, N.A. and Nketiah, K.S. 2010.** Development of Bioenergy Conversion Alternatives for Climate Change Mitigation". *International Journal of Energy and Environment*, Volume 2, ISSN 2076-2895 (In Print) ISSN 2076-2909 (Online).

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**Henry, M., Besnard, A., Asante, W.A., Eshun, J., Adu-Bredu, S., Valentini, R., Bernoux, M. and Saint-André, L.** 2010. Wood Density, Phytomass Variations within and among Trees, and Allometric Equations in a Tropical Rainforest of Africa. *Forest Ecology and Management* 260: 1375-1388.

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### Poster Presentations

**Apetorgbor, M., Bosu, P.P., Ofori, J. Foli, E.G., Appiah, J.K., Owusu, F.W., Brentuo, B. and Mensah, M.** 2010. Development of Technologies for the establishment and management of forest plantations, I: Initiation of Research Protocols on Protection and Development of Methods for the Control of *Broussonetia papyrifera*. Poster presented at the MLNR/CFMP End of Project Exhibition. Asempaneye, 20 December, 2010.

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## Workshops And Conferences Attended

**Adu-Bredu, S.** National Stakeholder Workshop on Greenhouse Gas Data Collection and Processing. Crystal Palm Hotel, Accra, 19<sup>th</sup> May, 2010.

**Adu-Bredu, S.** Training Workshop: Measuring and Assessing Carbon Stocks in Forest and Agro Ecosystems. 31<sup>st</sup> May to 5<sup>th</sup> June, 2010 at Asumura Training Camp, Goaso (Resource Personnel)

**Adu-Bredu, S.** Natural Resources and Environment Summit 2010 - Mining, Forestry & Environment Sectors (Theme: Promoting Good Governance in Mining, Forestry and Environmental Management) Anyinam Lodge, Obuasi. 26<sup>th</sup> to 28<sup>th</sup> July, 2010.

**Adu-Bredu, S.** "Changing Ghana's forest definition" stakeholder group meeting. Organised by Forestry Commission on 1<sup>st</sup> September, 2010.

**Adu-Bredu, S.** "Making the revised forest and wildlife policy responsive to livelihood challenges in Ghana" Symposium. Organised by Tropenbos International. WITC, Akyaakrom, 9<sup>th</sup> September, 2010.

**Adu-Bredu, S.** *Ecosystem Services and Poverty Alleviation* (ESPA) Grant Proposal Writing Workshop. Calabar, Cross-River State, Nigeria. 18<sup>th</sup> to 24<sup>th</sup> September, 2010.



**Ametsitsi, G.K.D.** Technical Committee member “Review of Ghana Standard GS 198: 2003: Specification for Plywood for General Use Manufactured from Ghana Hardwood. Ghana Standards Board, Accra, 10<sup>th</sup> November, 2010.

**Ametsitsi, G.K.D.** Participant, Ceremonial Handing over of assets and achievements of Community Forest Management Project to stakeholders in 3 forest districts. Worobong South, Yaya and Offinso. December 2010

**Ametsitsi, G.K.D.** Participant, Workshop to consolidate reviewed Documents “Guidelines on Formation and Operations of Modified Taungya Groups and constitution for the taungya farmers groups (TAFAG) (modified taungya plantation establishment)” WITC, Akyawkrom, August, 2010

**Ametsitsi, G.K.D.** Technical Sub-Committee member: Validation and publication of Ghana Standards GS 980, GS981, GS982, GS983, GS, 984 in 2010 by Ghana Standards Board.

**Apetorgbor, M.M.** ATO/ITTO Stakeholders Workshop on Principles, Criteria and Indicators for Ghana. Working Group on Forest Certification Ghana. 17<sup>th</sup> September, 2010. Miklin Hotel, Kumasi

**Apetorgbor, M.M.** ATO/ITTO Stakeholders Workshop on Principles, Criteria and Indicators for Ghana. Working Group on Forest Certification Ghana. 17<sup>th</sup> September, 2010. Miklin Hotel, Kumasi

**Apetorgbor, M.M.** Workshop of the Ghana Taxonomy Needs Assessment (TNA) organized by UK Natural Museum, BioNET-International, CSIR and WAFRINET-Ghana and funded by the World Summit Sustainable Development Implementation Fund (WSSD-WIF) of the UK Department for Environment, Food and Rural Affairs (Defra). 15th to 17th April, 2010. Accra, Ghana.

**Apetorgbor, M.M.** Workshop of the Ghana Taxonomy Needs Assessment (TNA) organized by UK Natural Museum, BioNET-International, CSIR and WAFRINET-Ghana and funded by the World Summit Sustainable Development Implementation Fund (WSSD-WIF) of the UK Department for Environment, Food and Rural Affairs (Defra). 15th to 17th April, 2010. Accra, Ghana.

**Appiah, N.** Regional Workshop on Editorial and Online Peer-Review, Erata Hotel, Accra, 2-5 November 2010

**Asomaning, J.M.** Training workshop in Seed Conservation Techniques. By the Millenium Seed Bank Project, Royal Botanical Gardens, Kew, from 20<sup>th</sup> Sept to 1<sup>st</sup> Oct 2010 at the Tanzania Tree Seed Centre, Morogoro, Tanzania.

**Ametsitsi, G.K.D.** Participant, PIT meeting of CFMP held at Royal Lamerta Hotel Hotel Kumasi, 4<sup>th</sup> August 2010



**Appiah, J.K.** Participated in the Second Pan African Competitiveness Forum (PACF conference) titled “Cluster Development and management in Africa,” Elmina Beach resort, Elmina, 15<sup>th</sup> – 17<sup>th</sup> February, 2010

**Bosu, P.P.** Workshop on Ecosystem Services and Poverty Alleviation. Hosted by South African National Biodiversity Institute (SANBI), 14-21 August 2010. Mopani Camp, Kruger National Park, South Africa

**Bosu, P.P.** Southern African Development Commission (SADC) Workshop on REDD, Arusha, Tanzania. 23-25 March, 2010.

**Bosu, P.P.** 17<sup>th</sup> Session of the African Forest and Wildlife Commission meeting and First African Forest and Wildlife Week celebration. Brazzaville, Congo. 22-27 February, 2010.

**Bosu, P.P.** Forest Plantation Development in Ghana: Strategies, Challenges and Way Forward Colloquium held at the Wood Industry Training Center, Achiawkrom near Kumasi. 10 June 2010.

**Britwum Acquah, S.** XXIII IUFRO World Congress, CEOX Seoul, Republic of Korea, 23-28 August 2010

**Britwum Acquah, S.** XXIII IUFRO World Congress: SPDC Pre-Congress Training Workshop on “Managing Forest Information” Namyangju City, Republic of Korea, 16-20 August 2010

**Britwum Acquah, S.** ITOCA Facilitators Information Literacy Training Workshop, Nairobi, Kenya 23-25<sup>th</sup> June 2010

**Djagbletey, G.D.,** Measuring and Assessing Carbon Stocks in Forest and Agro Ecosystems from 31<sup>st</sup> May – 5<sup>th</sup> June, 2010 at Asumura Training Camp, Goaso.

**Djagbletey, G.D.,** Forest Plantation Development in Ghana: Strategies, Challenges and Way Forward’ Colloquium held at the Wood Industry Training Center, Achiawkrom near Kumasi. 10 June 2010.

**Dwomoh, F.K.** Refresher course: Preparing for Adaptations to Climate Change in West-Africa. Organized by Faculty ITC - University of Twente (Netherlands) and IDR.-UPB. Bobodioulasso, Burkina Faso, 1<sup>st</sup> - 12<sup>th</sup> November, 2010

**Dwomoh, F.K.** AFORNET Workshop on Review of AFORNET. January, 2010

**Darko Obiri, B.** United Nations Forest Forum. Accra, July, 2010

**Darko Obiri, B.** IUFRO Forestry Congress. Korea. August, 2010.

**Derkyi, N.S.A.** Workshop on Change Management Process. CSIR-CRI, Kumasi. 19<sup>th</sup> August 2010.



**Derkyi, N.S.A.** Workshop on Development of Second Generation Biofuels. KNUST, Kumasi. 29<sup>th</sup> June – 1<sup>st</sup> July 2010.

**Derkyi, N.S.A.** Pyrolysis of Wood Biomass for Energy. Workshop on Development of Second Generation Biofuels. KNUST, Kumasi. 29<sup>th</sup> June – 1<sup>st</sup> July 2010.

**Derkyi, N.S.A. and Sekyere, D.** Wood Biomass for Energy Security and Climate Change Mitigation. Workshop on Production of Non-Food Bio-oil Supply Chains for Renewable Energy in Ghana: Needs, Challenges and Opportunities. Erata Hotel, Accra. 7<sup>th</sup> – 9<sup>th</sup> October 2010.

**Essien, C.** JICA Training Programme on Research on Forest Environment and Resources (Forestry and Forest Products Research). Hosted by JICA Tsukuba and Forestry and Forest Products Research Institute, Japan. 26<sup>th</sup> August – 21<sup>st</sup> November, 2009

**Essien, C.** International Wood Anatomy Training Workshop organized by Plant Resources of Tropical Africa (PROTA) at the Excelsa Lodge Kumasi-Ghana, from 13-23<sup>rd</sup> September, 2010.

**Essien, C.** Treatability of two tropical timber species using vacuum – pressure impregnation method and Copper Chrome Arsenate Type C (CCA-C), presented at FRNR conference room, Kumasi on the 26<sup>th</sup> February, 2010

**Essien, C.** JICA training programme on research on forest environment and resources (forestry and forest products research) hosted by JICA Tsukuba and Forestry and Forest Products Research Institute, Japan. from 26<sup>th</sup> August- 21<sup>st</sup> November, 2009

**Essien, C.** Bamboo and non-timber forest products study tour to Zhejiang province, China, 19<sup>th</sup> - 29<sup>th</sup> April, 2009. EU/INBAR/ CSIR-FORIG bamboo project

**Foli, E.G.** INASP/KNUST Regional Training Workshop on “Editorial and Online Peer-Review. Erata Hotel, Accra. 02 – 05 November 2010.

**Foli, E.G.** ERA Working Group Orientation Workshop. 19 January 2010, Cicero Hotel, Kumasi.

**Foli, E.G.** EU/INBAR Project: Bamboo as sustainable Biomass Energy – A Suitable alternative for Firewood and Charcoal Production in Africa. 01 – 02 February 2010, Crystal Palm Hotel, Accra.

**Foli, E.G.** Clean Climate Heritage Workshop on Providing Solutions for Climate Change in Ghana. 10 February 2010, Coconut Grove Hotel, Accra.

**Foli, E.G.** CSIR Seminar on “Achieving Organisational Performance at the CSIR: Some ideas”. 10 March 2010.

**Foli, E.G.** 14<sup>th</sup> Ghana International Trade Fair. (Theme: Promoting Industrialisation-led Economy for Ghana’s economic independence). 03 March 2010, Accra.





**Foli, E.G.** 1<sup>st</sup> Symposium on Forest Management in the Brazilian Amazon and Seminar Celebrating 30 years of Forest Research in Tapajós National Forest by EMBRAPA at Eastern Amazonia/ 67 km. 18 - 21 May 2010, Santarém-PA, Brazil.

**Foli, E.G.** The Ghana Climate Change Science Policy Dialogue. Policy Framework Roundtable. Coconut Grove Hotel, Accra. 9 June 2010.

**Foli, E.G.** The Prince's Rainforest Workshop: Increasing agricultural production without further deforestation. Hotel Fiesta Royale, Accra. 22 June 2010.

**Foli, E.G.** XXIII IUFRO World Congress – SPDC Pre-Congress Training Workshop on Forests and Climate Change. Namyangju City, Republic of Korea. 16 - 20 August 2010.

**Foli, E.G.** XXIII IUFRO World Congress. COEX Convention Centre, Seoul, Korea. 23 – 28 August, 2010.

**Foli, E.G.** INASP/KNUST Regional Training Workshop on “Editorial and Online Peer-Review. Erata Hotel, Accra. 02 – 05 November 2010.

**Nuako Bandoh, W.K.** Training course on Good Laboratory Practices Organised by CDM Training Solutions of South Africa at the Royal Dutch Hotel. May 2010.

**Ofori, D.A.** Research and Development Management Training Programme for High Level Policy Makers, Intercontinental City Stars Hotel, Cairo, Egypt, 7<sup>th</sup> – 12<sup>th</sup> November, 2010

**Ofori, D.A.** Biosafety Training Workshop to Strengthen Capacity for Application Review, Compliance, Inspection and Communication in Ghana. Elking Hotel, East Legon, Ghana, 17-19 November 2010.

**Opuni Frimpong, E.** Develop Potential Carbon Financing Options for the National Forest Plantation Development Programme. 20<sup>th</sup> April, 2010. Forestry Commission, Accra

**Opuni-Frimpong, E.** REDD after Copenhagen – The Way Forward. Organized by the International Institute for Sustainable Development. 1<sup>st</sup>-3<sup>rd</sup> March, 2010. Intercontinental Hotel – Nairobi, Kenya

**Opuni-Frimpong, E.** “Changing Ghana’s Forest Definition” Stakeholders group meeting. Organized by the Forestry Commission. Forestry Commission Conference Room Accra. September 1, 2010. Lead Resource Person

**Opuni-Frimpong, E.** IUFRO-SPDC Pre-Congress Training Workshops. Organized by IUFRO SPDC, 16<sup>th</sup> -21<sup>st</sup> August, 2010.

**Opuni-Frimpong, E.** XXIII IUFRO World Congress. Organized by IUFRO 23-28 August 2010, Seoul, Korea.



**Opuni-Frimpong, E.** Workshop to Review Options for National REDD+ Architecture in Ghana. Organized by Nature Conservation Research Centre, 27<sup>th</sup> October, 2010.

**Opuni-Frimpong, E.** Towards the Ghana National Climate Change Policy Framework. Organized by the National Climate Change Committee. Coconut Grove Hotel, Thursday 10<sup>th</sup> June, 2010.

**Opuni-Frimpong, E.** Workshop of National Committee for the Establishment of Public Two Universities. Organized by Policy Coordination and Implementation Wing of the Presidency. Ghana Telecom University 8<sup>th</sup> January, 2010.

**Oduro, K.A.** IUFRO-SPDC Pre-Congress Training Workshops. Organized by IUFRO SPDC, 16<sup>th</sup> - 21<sup>st</sup> August, 2010.

**Opuni-Frimpong, E.** Developing Potential Carbon Financing Options for the National Forest Plantation Development Programme. 20<sup>th</sup> April, 2010. Forestry Commission, Accra

**Opuni-Frimpong, E.** REDD after Copenhagen – The Way Forward. Organized by the International Institute for Sustainable development. 1<sup>st</sup> -3<sup>rd</sup> March 2010. Intercontinental Hotel – Nairobi, Kenya

**Opuni-Frimpong, E.** “Changing Ghana’s Forest Definition” Stakeholders group meeting. Organized by the Forestry Commission. Forestry Commission Conference room Accra. September 1, 2010. Lead Resource Person

**Opuni-Frimpong, E.** IUFRO-SPDC Pre-Congress Training Workshops. Organized by IUFRO SPDC, 16<sup>th</sup> - 21<sup>st</sup> August 2010.

**Opuni-Frimpong, E.** XXIII IUFRO World Congress. Organized by IUFRO 23-28 August 2010, Seoul, Korea.

**Opuni-Frimpong, E.** Workshop to Review Options for National REDD+ Architecture in Ghana. Organized by Nature Conservation Research Centre, 27<sup>th</sup> October 2010.

**Opuni-Frimpong, E.** Towards the Ghana National Climate Change Policy Framework. Organized by the National Climate Change Committee. Coconut Grove Hotel, Thursday 10<sup>th</sup> June 2010.

**Opuni-Frimpong, E.** Workshop of National Committee for the Establishment of Public Two Universities. Organized by Policy Coordination and Implementation Wing of the Presidency. Ghana Telecom University January 8, 2010.

**Oduro, K.A.** IUFRO-SPDC Pre-Congress Training Workshops. Organized by IUFRO SPDC, 16<sup>th</sup> - 21<sup>st</sup> August, 2010.

**Oteng-Amoako, A.A.** IUFRO Forestry Congress. Korea. August, 2010.



**Oteng-Amoako, A.A.** PROTA International Workshop on Wood Anatomy. September, 2010.

**Owusu-Afriyie, K.** “Writing to be published and read: tips for writing scientific articles” Organised by University of Amsterdam and Tropenbos International Ghana, at the Tropenbos International Ghana, Kumasi. 10<sup>th</sup> July, 2010.

**Pentsil, S.** Workshop on Change Management Process. CSIR-CRI, Kumasi. 19 August 2010.

**Pentsil, S.** CSIR Seminar on “Achieving Organisational Performance at the CSIR: Some ideas”, Accra. 10 March 2010.

**Peprah, T.** Regional Workshop on country Reporting for the state of the World’s Forestry Genetic Resources in Brazzaville Republic of Congo 25<sup>th</sup>-26<sup>th</sup> March 2010

**Peprah, T.** ICRAF Science Meeting 6<sup>th</sup>-8<sup>th</sup> September, 2010

**Peprah, T.** Annual General Meeting of Gender and Energy Network Ghana. 8<sup>th</sup> to 9<sup>th</sup> July, 2010. Forest Hotel, Dodowa

**Sparkler, S.B.** Workshop on Writing to be Heard. Tropenbos Ghana, CSIR-FORIG, Kumasi. August, 2010.

## Appendix ii

### COLLOQUIUM PRESENTATIONS

Date	Speaker	Title
11/02/10	Dr. J.R. Cobbinah	Communicating Science
18/02/10	Dr. Opuni Frimpong	Diversity and abundance of fruit-feeding butterflies species in relic forest and forest reserves of Ghana
04/03/10	Mrs. Lucy Amissah	Effects of climate change on regeneration of tree species in tropical forest of Ghana
18/03/10	Dr. Kennedy Owusu Afriyie	Spatial and temporal distribution of fires in Ghana
18/03/10	Mr. William Dumenu	Management of on-farm timber resources: the role of stakeholders (Graduate Student, University of Freiburg, Germany)
15/04/10	Mr. Shalom D. Addo Danso	Restoration and sustainable production of indigenous timber species in the moist semi-deciduous forest zone of Ghana: The case of Goaso forest district.
13/05/10	Dr. E. Owusu-Sekyere	Techniques for writing a good proposal
10/06/10	Mr. Eric Nutakor	Utilisation and Conservation Status of Medicinal Plants in Sawah Farming Systems; Case Ethnobotany Study in Ahafo-Ano South District
17/06/10	Dr. Paul Bosu	Ecological and economic impacts of alien invasive species in forests and woodlands of Africa
08/07/10	Dr. Stephen Adu-Bredu	Carbon stock under different land-use systems in some sites in Ghana
08/07/10	Mrs. Gloria Djagbletey	Vegetation carbon stock recovery after selective Logging
9/09/10	Dr. Mrs. Apetorgbor	Diseases in <i>Cedrela odorata</i> and <i>Tectona grandis</i> plantations: Hindrance to successful reforestation programme in Ghana



9/09/10	Mr. J.K. Appiah	Seasoning characteristics of two cordia timber species in Ghana
9/09/10	Mr. Francis W. Owusu	Milling characteristics of teak ( <i>Tectona grandis</i> ) logs from six different localities in Ghana
30/09/10	Mr. N.S.A. Derkyi	Bio energy for energy security and climate change mitigation
10/11/10	Mrs. Theresa Peprah	Improving the collection and germination of West African <i>Garcinia kola</i> seeds
10/11/10	Mr. A. Duah Gyamfi	Logged versus unlogged forest: comparison of some soil properties eight years after logging
9/12/10	Mr. Francis Dwomoh	Participatory carbon measurement and monitoring: The case study of two districts in Ghana
9/12/10	Mr. George Ametsitsi	Application of photo monitoring as a monitoring protocol to evaluate anthropogenic effects of vegetation management



## Appendix iii

### Composition of CSIR-FORIG Management Board

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

## Appendix iv

### List of National Service Personnel Received 2010/11

Name	Qualification	Institution
Charles Prince Asante	BSc Chemistry	UCC
Ben Frederick Selormey	BSc For. Res. Tech	KNUST, FFRT
Isaac Dery	BSc Mathematics	KNUST
Ernestina Gyinae	BSc Forest Resources Technology	KNUST, FFRT
Austin Gyimah Acheampong	BA Publishing Studies	KNUST
Emmanuel Owusu-Mensah	BSc Biological Science	KNUST
Sampong Emmanuel Agyare	BSc Nat. Res. Mgt.	KNUST
Adjei Mensah	BSc Biological Science	KNUST
William Hagan Brown	BSc Nat. Res. Mgt.	KNUST
Lily Naa Adamah	BA Publishing Studies	KNUST
Abigail Sekyere	BSc Physics	KNUST
George Gyamerah Afriyie	BSc Mathematics	University of Mines and Technology
Abubakari Tahiru	BSc Nat. Res. Mgt.	KNUST
Anita Dwomoh	BSc Agric	UCC
Akosua Akubea Agyapong	BA Integrated Art	KNUST
Suleman Shariff Din	BSc Nat. Res. Mgt	KNUST
Godfred Sarpong Boakye	BSc Nat. Res. Mgt.	KNUST
Annabella Boadi Misa	BA Integrated Rural Art and Industry	KNUST
Doreen Amedior	BA Social Sciences	UCC
Stephen Ankamah	HND Marketing	Sunyani Polytechnic
Abigail Kusi	BSc Agric Tech (Animal Science)	UDS



Name	Qualification	Institution
Prince Manu	Bed Education	University of Education, Winneba-Mampong
Frank Owusu Boateng	BSc Agric	KNUST
Collins Gyimah Gyamfi	BSc Business Administration	KNUST
Isaac Rahaman Iddrisu	HND Entrepreneurship and Finance	Kumasi Polytechnic
Collins Baah Darko	BSc Nat. Res. Mgt.	KNUST
Mickey Boakye	BSc Nat. Res. Mgt.	KNUST