

**CSIR-FORESTRY RESEARCH INSTITUTE OF
GHANA**

ANNUAL REPORT 2009

CSIR-FORIG

For more information please contact:

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

Telephone:

Director: 233-3220-60122

Offices: 233-3220-60123/60373

Fax:

233-3220-60121

E-mail:

director@csir-forig.org.gh

© Copyright CSIR-FORIG 2010

EXECUTIVE SUMMARY

This report contains an overview of research and commercialisation activities undertaken by the Forestry Research Institute of Ghana of the Council for Scientific and Industrial Research (CSIR-FORIG) in 2009.

Five (5) research projects were funded through internally generated funds specifically; 'Floristic Composition of the Bobiri Forest Reserve with Special Reference to Medicinal, Mycorrhizal Plants and Macrofungi of Economic Importance', 'Impact of selective Logging on Vegetation Carbon Stock, Regeneration, Diversity of Species, Soil Carbon Stock and Carbon Dioxide flux: The case of Bobiri Forest Reserve', 'Framework for Improved Land Use in the Degraded Watersheds of the Coastal Water System Zone of Ghana', 'Evaluation of Natural Borer Resistance variation between *Bambusa vulgaris cv vitata* (yellow) and *Bambusa vulgaris* (green)' and 'Basic and Technological Properties of *Borassus* Palm and *Broussonetia papyrifera* in Ghana'. These projects cover Ghana Government's priority areas and the millennium development goals (MDGs) such as climate change, biodiversity conservation and poverty reduction.

In addition, the Institute undertook twelve (12) research projects through funds from international donors including International Tropical Timber Organisation (ITTO), Danish International Development Agency (DANIDA) and African Forestry Research Network (AFORNET).

Commercialisation activities were primarily centred on the sale of seeds, seedlings, wood, prekese syrup production and consultancy services.

A total of twenty seven (27) technical reports, twenty one (21) journal articles and twenty four (24) conference papers were authored by scientists of the Institute in collaboration with scholars worldwide.

There were twenty (20) colloquium presentations during the year under review and nineteen (19) distinguished personalities visited the Institute.

Contents	Page
1.0 INTRODUCTION.....	1
1.1 VISION STATEMENT.....	1
1.2 MISSION STATEMENT.....	1
1.3 CSIR-FORIG's ACTIVITIES.....	2
1.4 DIVISIONS.....	2
1.6 RESEARCH CENTRES AND LABORATORY FACILITIES.....	2
1.5 HUMAN RESOURCE CAPACITY.....	3
1.5.1 LIST OF SENIOR MEMBERS.....	3
1.5.2 LIST OF SENIOR STAFF.....	6
1.6 Organizational Structure of CSIR-FORIG.....	6
2.0 RESEARCH PROJECTS.....	7
2.1 Floristic Composition of the Bobiri Forest Reserve with Special Reference to Medicinal, Mycorrhizal Plants and Macrofungi of Economic Importance.....	8
2.2 Impact of selective Logging on Vegetation Carbon Stock, Regeneration, Diversity of Species, Soil Carbon Stock and Carbon Dioxide flux: The case of Bobiri Forest Reserve.....	11
2.3 Framework for Improved Land Use in the Degraded Watersheds of the Coastal Water System Zone of Ghana.....	16
2.4 Evaluation of Natural Borer Resistance Variation between <i>Bambusa vulgaris cv vitata</i> (yellow) and <i>Bambusa vulgaris</i> (green).....	19
2.5 Basic and Technological Properties of <i>Borassus Palm</i> and <i>Broussonetia papyrifera</i> in Ghana.....	22
3.0 DONOR FUNDED PROJECTS.....	25
4.0 COMMERCIALISATION AND INFORMATION DIVISION.....	34
4.1 Commercialisation Activities.....	34
4.1.1 Sale of Seeds and Seedlings.....	34
4.1.2 Sale of Wood.....	34
4.1.3 Consultancy, Contract Research and Training.....	35
4.1.4 Production of Prekese Syrup and Honey.....	35
4.2 Information and Publication Section.....	35
4.3 Computer and Biometrics Section.....	35
5.0 ADMINISTRATION.....	37
5.1 Staff Strength and Structure.....	37
5.2 Administrative Matters.....	37
5.2.1 Promotions/Upgrading.....	37
5.2.3 New Appointments.....	37

5.2.4 Resignations	38
5.2.5 Training	38
5.2.6 Sabbatical Leave	38
5.2.7 Post Retirement Contract.....	39
5.3 Retirements.....	39
5.4 Official Visits by Distinguished Personalities	39
6.0 FINANCE DIVISION	41
APPENDICES	42
LIST OF PUBLICATIONS	42
SCHEDULE FOR INTERNAL COLLOQUIA FOR 2009	55
COMPOSITION OF CSIR-FORIG MANAGEMENT BOARD.....	57

LIST OF TABLES	PAGE
-----------------------	-------------

Table 1: Characteristics of the selected compartments with their sizes (ha), felling series and dates of last entry for logging	11
Table 2: Summary of star categories of conservation priority for species	14

LIST OF FIGURES	PAGE
------------------------	-------------

Figure 1: An intact area at Bobiri Forest Reserve	9
Figure 2: A disturbed area at Bobiri Forest Reserve	9
Figure 3: Wild mushroom on forest floor	10
Figure 4: Stump at freshly logged site	12
Figure 5: Stump at 50 year old post logged site	12
Figure 6: Assessing under storey vegetation and forest floor litter	13
Figure 7: Collection of soil sample	13
Figure 8: Vegetation cover map along River Densu between 1990 – 2000	17
Figure 9: Changes in vegetation cover along Densu River between 1990 – 2000	18
Figure 10: Mean borer-holes between the green and yellow types of bamboo	20
Figure 11: Mean number of borer holes and exposure dates	20
Figure 12: Meat cage produced from coconut wood	23
Figure 13: Meat cage produced from Borassus palm	23
Figure 14: Lab stools produced from Borassus palm	23
Figure 15: Entertainment unit produced from Borassus palm	23

1.0 INTRODUCTION

CSIR-FORIG is mandated to undertake forestry and forest products research to ensure sustainable management and utilisation of Ghana's forest resources and to engage in the commercialization of the research results and services. During the year under review, the Institute undertook high quality user focused research with the following objectives:

- Develop technologies for sustainable management of natural forests and biodiversity conservation
- Develop technologies fundamental to the success of plantation forestry
- Generate technological properties and develop appropriate processing techniques for the efficient utilization of forest resources
- Enhance sustainable management and utilization of non timber forest products (NTFPs)
- Mobilize, process and disseminate information critical to the management of Ghana forest resources
- Strengthen capacity and use same for optimum research and commercialised services
- Establish mechanism for attracting financial assistance from donors, private and public institutions for research.

1.1 VISION STATEMENT

The vision of CSIR-FORIG is to be the centre of excellence in forestry research in the humid tropics. CSIR-FORIG is to be recognized as one of the institutions in the tropics making substantial contribution towards sustainable development of tropical forests.

1.2 MISSION STATEMENT

Our mission is to conduct user-focused research that generates scientific knowledge and appropriate technologies which enhance the sustainable development, conservation and utilization of Ghana's forest resources for the improvement of social, economic and environmental well-being of the people of Ghana.

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. Research in CSIR-FORIG addresses the social, environmental, economic and sustainability of Ghana's forest resources and goes on to investigate how these resources can be utilized 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 that can be used to shape the policy affecting Ghana's forest resources. CSIR-FORIG works closely with the Ministry of Lands, Forestry and Mines, 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:

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

1.6 RESEARCH CENTRES AND LABORATORY FACILITIES

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

Location	Region	Name of Research Station
Benso	Western	Wet/Moist Evergreen
Kubease	Ashanti	Moist Semi-Deciduous N/E
Amantia	Ashanti	Moist Semi-Deciduous S/E
Abofour	Ashanti	Dry Semi-Deciduous
Bolgatanga	Upper East	Northern Savanna

An irrigated research nursery is maintained at Mesewam, near Kumasi. In addition, the Institute maintains a herbarium and an insectary. The Bobiri research centre has been developed as an ecotourism site.

The laboratories of the Institute have a wide range of equipment for research and development. They include impregnation plants, seasoning kilns, furniture testing machines, "INSTRON" strength testing machine, wood-working machines, steam generators, microscopes, growth chamber and UV spectrophotometer.

1.5 HUMAN RESOURCE CAPACITY

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

1.5.1 LIST OF SENIOR MEMBERS

Administration Division

Victor K. Agyeman
BSc. Nat. Res. Mgt.
MPhil Silviculture
PhD Forest Ecology
Principal Research Scientist
Director

N. Obiri-Yeboah Darko
BSc. (Hons) Civil Engineering
Head of Administration

F. Osei-Amofah
BA. Secretaryship, Dip. Ed.
Postgraduate Dip. Mgt. Studies
Administrative Officer

Comfort D. Konto (Ms)
BA. (Hons) Economics
MBA Strategic Consulting Mgt.
Administrative Officer

Georgia Marfo (Mrs)
B. Ed. Secretarial & Mgt
Asst. Administrative Officer

Forests, Livelihoods and Sustainable Development Division

Dominic Blay Jr.
BSc. Botany
MSc. Forest Resources Mgt
PhD Forest Ecology
Principal Research Scientist
Head of Division

Ebenezer Owusu-Sekyere
BSc. Nat. Res. Mgt.
MSc. Agroforestry
PhD Agroforestry
Senior Research Scientist

Emmanuel Marfo
BSc. Nat. Res. Mgt.
MSc. Tropical Forestry
PhD Environmental Sciences
Research Scientist

Eric E. Nutakor^{△△}
BA. Social Science
MPhil Sil. & Forest Mgt.
Research Scientist

Elizabeth Obeng (Mrs)
BSc. Agric
M.Sc. Env/Nat. Res. Econs.
Research Scientist

William Dumenu[△]
BSc. Nat. Res. Mgt.
Asst. Research Scientist

Forests & Wildlife Management and Governance Division

Stephen Adu-Bredu
BSc. Nat. Res. Mgt.
MSc. Sil. Mgt.
PhD Sil. Mgt/Ecophysiology
Senior Research Scientist
Head of Division

Mary M. Apertogbor (Mrs)
BSc. (Hons) Botany
MSc. Plant Pathology/Mycology
PhD Plant Pathology/Mycology
Senior Research Scientist

Emmanuel Opuni-Frimpong
BSc. Nat. Res. Mgt.
MPhil. Sil. Mgt.
PhD Forest Entomology
Research Scientist

Bright O. Kankam^{△△}
BSc. Nat. Res. Mgt.
MPhil Wildlife and Range Mgt.
Research Scientist

Theresa Peprah (Mrs)
BSc. Nat. Res. Mgt.
MSc. Tree Improvement
Research Scientist

Kwame Antwi Oduro^{△△}
BSc. (Hons) Nat. Res. Mgt.
MSc. Forestry and Land Use
Research Scientist

Akwasi Duah Gyamfi
BSc. Nat. Res. Mgt.
MPhil. Ecology & Mgt.
Research Scientist

John K. Mensah
BSc. Botany
MSc. Plant Pathology
Research Scientist

Wood Industry Development and Trade Division

Joseph Ofori
BSc. Chemical Tech.
MSc. & D.I.C. Timber Tech.
PhD. Wood Technology
Chief Research Scientist
Head of Division

Joseph K. Appiah
BSc. Nat. Res. Mgt
MPhil. Wood Science
Research Scientist

Daniel Sekyere**
BSc. Chemistry
MSc. Chemistry
PhD Pulp & Paper Tech.
Principal Research Scientist

Francis W. Owusu
BSc. Agric Engineering
MPhil. Wood Technology
Research Scientist

Lawrence Damnyag^{Δ Δ}
BA. Economics
MPhil. Economics
Research Scientist

Charles Essien^Δ
BSc. Nat. Res. Mgt.
Asst. Research Scientist

Forest Products and Marketing Division

Beatrice Darko-Obiri (Mrs)
BSc. Agric Econs.
MSc. Agroforestry
PhD Agroforestry
Research Scientist
Head of Division

Andrew Oteng Amoako**
BSc. Wood Technology
MSc. Wood Science
PhD Wood Products & Eng.
Chief Research Scientist

Nana S.A. Derkyi^{Δ Δ}
BSc. Chemistry
MSc. Organic Chemistry
Research Scientist

Emmanuel Ebanyenle^{Δ Δ}
BSc. Nat. Res. Mgt.
MPhil. Wood Science
Research Scientist

Samar B. Sparkler
BA. Arts (Econs. & Geog)
MA. Geog. & Rural Dev.
Research Scientist

Ecosystem Services and Climate Change

Ernest G. Foli
BSc. Nat. Res. Mgt.
MPhil Forest Men./Inventory
PhD Sil. & Mgt
Senior Research Scientist
Head of Division

Joseph R. Cobbinah**
BSc. Biological Science
PhD Forest Entomology
Chief Research Scientist

Paul P. Bosu
BSc. Biological Science
MPhil. Biological Science
PhD Forest Entomology
Senior Research Scientist

Stephen E. Akpalu
BSc. Agric
MPhil. Env. Science
Research Scientist

Gloria D. Djagbletey (Mrs)^{Δ Δ}
BSc. Nat. Res. Mgt
MPhil Sil. & Forest Mgt.
Research Scientist

George K. Ametsitsi
BSc. Nat. Res. Mgt
MSc. Env. Res. Mgt.
Research Scientist

Daniel Shalom Addo-Danso^Δ
BSc. Nat. Res. 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. Sil. & Forest Biology
PhD Agroforestry
Senior Research Scientist

Kwame Asamoah Adam
BSc. Nat. Res. Mgt.
MSc. Forest Mgt. & Planning
PhD Forest Management
Senior Research Scientist

K. Owusu-Afriyie
BSc. Nat. Res. Mgt
MSc. Forest Mgt
Research Scientist

Lucy Amissah (Mrs) ^{Δ Δ}
BSc. Nat. Res. Mgt
MPhil Sil. & Forest Mgt.
Research Scientist

Joseph Asomaning ^{Δ Δ}
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

Margaret Sraku-Lartey (Mrs)*
BA. Social Science
Post. Grad. Dip. Lib. Studies
MA. Industrial Mgt.
Prin. Librarian
Head of Division

Kennedy K. Asamoah
BA. (Hons) Geography
Post Grad. Dip. Lib. Studies
MA Geog. & Rural Development
Librarian

Stella Britwum Acquah (Mrs)
BSc. Computer Science
MBA. Mgt. Info. Systems
Computer Analyst

Sarah Pentsil (Mrs)
BSc. (Hons) Nat. Res. Mgt
MSc. Dev. Policy & Planning
Scientific Secretary

Naomi Appiah (Mrs) ^Δ
BA. Publishing Studies
Junior Librarian

Darimani Bukari
BA Publishing Studies
MA Art and Culture
Information Officer

Finance Division

Francis Kumah
BA (Hons) Accounting & Econs.
Accountant
Head of Division

Osei Yaw Agyei
BSc
MBA
ACCA
Accountant

K. Agyeman Prempeh
ICA
Accountant

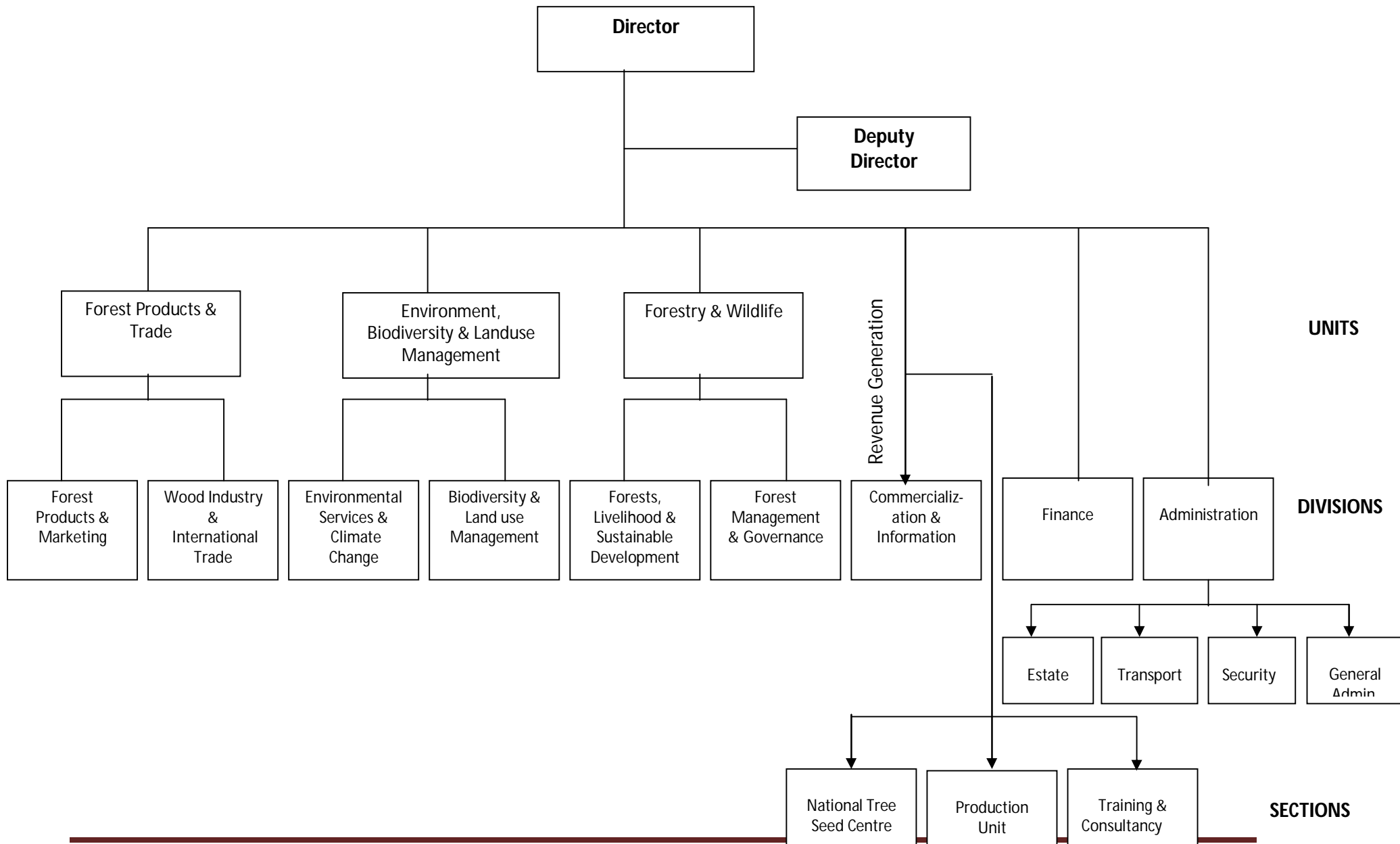
- * Sabbatical Leave
- ** Post Retirement Contract
- Δ Δ PhD Student
- Δ MSc/MPhil Student

1.5.2 LIST OF SENIOR STAFF

NAME	RANK	NAME	RANK
A. Mohammed Issah	Chief Technical Officer	Frank Baffour Asuming	Principal Technical Officer
Michael Mensah	Chief Technical Officer	John Sackey	Principal Works Superintendent
Brentuo Bridgette	Chief Technical Officer	Paul Adusei	Principal Works Superintendent (Traffic)
Zablenku Emmanuel	Chief Technical Officer	Samuel K. Appiah	Principal Works Superintendent (Traffic)
Leticia A. Asamoah	Chief Technical Officer	Asiamah Yeboah Konadu	Principal Admin. Assistant
Georgina Agyeman	Chief Administrative Assistant	J. J. Mensah	Principal Accounting Assistant
Victoria A. Erskine	Chief Accounting Assistant	Daniel Kaiko Mankoe	Principal Accounting Assistant
Mensah Bonsu Isaac	Chief Accounting Assistant	Isaac Boahen	Principal Accounting Assistant
Mavis Serwaah Kwarteng	Chief Accounting Assistant	C. C. Acheampong	Principal Accounting Assistant
Evelyn Owusu Agyeman	Chief Accounting Assistant	Samuel Atusong	Principal Accounting Assistant
John Agbozo	Chief Technical Officer	Maud M. Prempeh	Principal Technical Officer
Philip T. Boampong	Senior Technical Officer	Albert K. Nyeha	Principal Technical Officer
Paul Kankam	Principal Technical Officer	Peter L. Arthur	Senior Technical Officer
Godzon K. Zorve	Principal Technical Officer	Jonathan Dabo	Technical Officer
Elizabeth Ampah	Principal Technical Officer	Emmanuel A. Manu	Senior Technical Officer
Prempeh Bando	Principal Technical Officer	Samuel A. Kyei	Principal Technical Officer
Sarfo Kwame Bonsu	Senior Technical Officer	Daniel Peprah	Senior Technical Officer
Jacqueline Twintoh	Senior Technical Officer	Sandra Owusu	Senior Technical Officer
Samuel Larbi	Senior Technical Officer	Georgina Afriyie	Senior Technical Officer
Awurama Andoh	Senior Administrative Assistant	Richard Adjei	Senior Technical Officer
Jane Nketiah	Senior Administrative Assistant	Kwaku Asumadu	Senior Technical Officer
Eric Frimpong	Senior Technical Officer	Jemima Owusu	Senior Technical Officer
Gabriel Lumor	Technical Officer	Kwaku Bonsu	Senior Technical Officer
Margaret Adubigire	Senior Administrative Assistant	Felix Boakye	Technical Officer
Wendy O. Amankwa	Accounting Assistant	E. Y. B. Imouro	Chief Accounting

NAME	RANK	NAME	RANK
Ezuame Constant	Technical Officer	Augustina Addai	Chief Technical Officer
Elvis Nkrumah	Technical Officer	Govina J. Kudjo	Technical Officer
George K. Nyantakyi	Senior Security Officer	Daniel K. Debrah	Senior Technical Officer
Dickson Asmoah	Senior Acc. Assistant	Anastasia Duah-Gyamfi	Administrative Assistant
Rebecca Okyere Darko	Stores Superintendent	Daniel Damte	Draughtsman
Anthony Boateng	Asst. Transport Officer		

1.6 Organizational Structure of CSIR-FORIG



2.0 RESEARCH PROJECTS

The research projects are funded by the Institute through its internally generated funds (IGF). In the year under review, CSIR-FORIG carried out five (5) IGF sponsored research projects namely:

- Floristic Composition of the Bobiri Forest Reserve with Special Reference to Medicinal, Mycorrhizal Plants and Macrofungi of Economic Importance;
- Impact of selective Logging on Vegetation Carbon Stock, Regeneration, Diversity of Species, Soil Carbon Stock and Carbon Dioxide flux: The case of Bobiri Forest Reserve;
- Framework for Improved Land Use in the Degraded Watersheds of the Coastal Water System Zone of Ghana;
- Evaluation of Natural Borer Resistance variation between *Bambusa vulgaris cv vitata* (yellow) and *Bambusa vulgaris* (green);
- Basic and Technological Properties of *Borassus* Palm and *Broussonetia papyrifera* in Ghana

Details on the above projects are presented below;

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

Project Team: Apertorgbor, M.M., Adu Bredu, S., Dabo, J. and Mensah, J.K.

Introduction

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

The rapid disappearance of genetic resources, particularly from the wild, has clearly made forest reserves important centres for *ex-situ* conservation of the world's biological diversity. 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.

The objective of this project is 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.

Work done

Seven (7) one-hectare sample plots were estimated for the study within the reserve. Four (4) of the sample plots were located in unlogged forest area, two (2) plots in swampy area and one (1) plot in degraded area of the forest. The plots were demarcated with the aid of a field compass and the edges marked with pegs. The sample plots were systematically surveyed for all trees with diameter at breast height (dbh) greater than 5cm and the tree densities determined.

Eight (8) nested plots within a sample plot were set up to assess shrubs, herbs, seedlings and climbers. The various plant functional types were identified and counted. When definitive field identification was not possible plant samples were collected and pressed for proper identification.

The data were quantitatively analyzed for basal area, relative density, relative frequency and relative dominance. The Importance Value Index (IVI) for tree species was determined as the sum of the relative frequency, relative density and relative dominance.

Results

Plant species diversity

A total of 328 plant species were identified within the seven (7) sampled plots in the reserve.

The trees were the most diverse among the plant life forms enumerated accounting for 62% of all plant species, followed by climbers 23.5%, herbs/grasses 7.3%, shrubs 5.8% and ferns 1.5% being the least. In general, tree species diversity (Shannon diversity index (H') in the unlogged forest did not differ from that of the swampy area. The degraded area had a relatively lower diversity of tree species (Figure 1&2).



Fig. 1: An intact area at Bobiri Forest Reserve



Fig. 2: A disturbed area at Bobiri Forest Reserve

Funtumia elastica emerged as the most dominant tree species followed by *Cleidon gabonicum* and *Sterculia rhinopetella*. These plant species were found in all the three (3) areas in the forest reserve.

The families Euphorbiaceae and Rubiaceae were the most abundant plant species (16 each), followed by the Meliaceae, Moraceae and Sterculiaceae with 14, 12 and 12 species, respectively. With respect to number of individuals, Sterculiaceae was the highest in importance/dominance followed by Euphorbiaceae and Meliaceae.

Mycorrhizal tree species

The ectomycorrhizal plant species within the sampled plots were relatively low and scarce. The ectomycorrhizal tree species are all in the family Caesapinaceae accounting for 1.2% while endomycorrhizal tree species were 15.1%. The most frequently occurring ectomycorrhizal tree species is *Berlinia tormentella* followed by *Gilbertiodendron splendidum*; *Anthonotha fragrans* was the least. *Gilbertiodendron splendidum* was restricted to the swampy area while *Anthonotha macrophylla* and *Berlinia tomentella* were found in all the areas studied. *Gilbertiodendron splendidum* has been categorized as a black star species while the other genera of ectomycorrhizal tree species are in the green star category group.



Figure 3: Wild mushroom on forest floor

Medicinal tree species

The medicinal plant species used by herbal practitioners in Ghana identified in the intact, swampy and degraded areas were 85, 79 and 51, respectively. Thirty nine (39) medicinal plant species were common to all the three sites. The most abundant were *Funtumia elastica* followed by *Carapa procera* and *Hymenostegia afzelii*. *Funtumia elastica* is in the category of green star while *Entandrophragma angolense* and *Nesogordonia papaverifera* are in the red and pink star categories respectively.

Conclusion

Medicinal plants accounted for 32.0% of the flora in the reserve while known ectomycorrhizal and endomycorrhizal plant species within the sampled plots were 1.2%, and 15.1%, respectively. Ectomycorrhizal plant species population within the sampled plots was relatively low and scarce.

2.2 Impact of selective Logging on Vegetation Carbon Stock, Regeneration, Diversity of Species, Soil Carbon Stock and Carbon Dioxide flux: The case of Bobiri Forest Reserve

Project Team: Adu-Bredu, S., & Djabletey G.D.

Introduction

The living tree biomass, under-storey vegetation, litter, woody debris and soil organic matter have been specified as the main carbon pools in tropical forest ecosystems. The carbon stored in the aboveground living biomass of trees is typically the largest pool and the most directly impacted by deforestation and degradation.

A chunk of carbon is often removed in the form of wood from natural forest during logging under the selective logging system, as practiced in Ghana. The questions that need to be answered are: Is the forest able to naturally recover with respect to floristic composition and carbon stock (vegetation and soil)? Is there a build up or a decline in carbon stock with time? Is the forest resilient enough without any intervention?

The Bobiri forest reserve was chosen for the study because it is being managed as protective, productive and research forests. It therefore has both primary and secondary forests. The study is looking at natural recovery, biodiversity and soil carbon trend over time with the objective to:

- Assess the impact of logging on plant diversity and natural recovery
- Determine carbon and nutrient status of the forest floor litter
- Determine the effects of logging on soil carbon stock and nutrient dynamics

Work Done

Seven compartments or sites were selected for the study. The selection was carried out to reflect in a chrono-sequential manner intact forest (not logged before), 50, 42, 29, 21, 10 and 1year post logging sites. Data collection has been completed in three sites namely 50, 21 and 1year post logging sites (Table 1).

Table 1: Characteristics of the selected compartments with their sizes (ha), felling series and dates of last entry for logging

Compartment	Size (ha)	Last year of Entry	No. of Entries	Felling Series	Years since Last entry	Status
19B	32.09	Intact Forest	Nil	Bobiri	Unlogged	Not Yet
8	62.54	1959	1	Bobiri	50	Completed
72	48.30	1967	2	Bobiri	42	Not Yet
62	88.98	1980	4	Bobiri	29	Not Yet
24B	47.24	1987	4	Juabenaka	21	Completed
52	98.42	1998	2*	Bobiri	10	Not Yet
61	147.80	2007	3	Bobiri	1	Completed

Ten (10) sample plots were established in each of the selected compartments. Nested plot design was used in the assessment of the plots. Stumps of logged trees in the selected compartments were located. With the stump as the centre, a 50 x 50 m (0.25 ha) temporary sample plots (TSPs) were established as the main plots (Figures 4 and 5).



Fig.4: Stump at freshly logged site



Fig. 5: Stump at 50 year old post logged site

The main plot was used for the assessment of bigger trees larger than 20 cm in diameter at breast height (dbh), as well as standing dead trees of similar size. A sub-plot of size 25 x 25 m was used for the assessment of trees between 10 and 20 cm in dbh, as well as downed dead trees, a smaller sub-sub-plot of size 12.5 x 12.5 m was used to assess trees and other plant forms smaller than 10 cm dbh but with height not less than 2.0 m. Five (5) quadrates of size 1.0 x 1.0 m were laid in one of the 25 x 25 m sub-plots for the assessment of under storey vegetation, forest floor litter and the collection of soil samples for nutrient and bulk density analyses (Figure 6)



Fig. 6: Assessing under storey vegetation and forest floor litter



Fig. 7: Collection of soil samples

Results

Abundance

Analysis of the results in terms of species abundance indicated a vegetation shift on the state of the forest. Commercial species like *Khaya* species, *Entandrophrama* species and *Triplochiton scleroxylon*, were not present in the top most abundant 20 species. The forest is dominated by smaller-sized trees like *Baphia nitida*, *Cleidon gabonicum*, and *Microdesmis puberula*, and lianas like *Calycobolus africanus*, *Motandra guineensis*, *Alafia baterii* and *Griffonia simplicifolia*. For the 1-year post logged site (Y_1), only four (4) commercial species namely *Turraeanthus africanus*, *Celtis mildbraedii*, *Nesogordonia papaverifera* and *Blighia sapida* were captured in the top 20 most abundant tree species. For the 21-years post logged site (Y_{21}) also, four (4) commercial species found are; *Celtis mildbraedii*, *Celtis zenkeri*, *Strombosia glaucescens* and *Nesogordonia papaverifera*. However, the 50-years post logged site (Y_{50}) captured seven (7) commercial species in the 20 most abundant species namely; *Sterculia rhinopetala*, *Nesogordonia papaverifera*, *Celtis mildbraedii*, *Celtis zenkeri*, *Sterculia oblonga*, *Guarea cedrata* and *Pterygota macrocarpa*.

Diversity

Plant diversity based on importance value index (IV) decreased with the passage of time. Importance value (IV) gives the structural role of a species in a stand. It is useful in making comparisons with respect to species composition and stand structure (Robert-Pichette and Gillespie, 1999). The openness of the canopy due to the logging activities resulted in the recruitment of species, leading to high diversity of plant species. The closing of the canopy with the passage of time and competition among the plants resulted in the mortality of certain species, especially shade intolerant species.

Conservation Status

Species were categorised under star rating system based on their rarity internationally and in Ghana (Hawthorne, 1995). The most dominant star rated species in all the sites was Green Star (very common) followed by Pink Star (Table 2). The Green and Pink Star species were more abundant in the Y₁ site than in both Y₂₁ and Y₅₀ sites. The Black and Gold Star rated (Table 2) species were very scarce in all the sites. Although the number of Blue Star rated species was low, it was higher in both Y₂₁ and Y₅₀ site than in Y₁ site. The Scarlet Star species was more abundant in the Y₅₀ sites than in the other two sites.

Table 2. Summary of star categories of conservation priority for species

STAR	COMMENT
BLACK	Urgent attention to conservation of population needed. Rare internationally and at least uncommon in Ghana. Ghana must take particular care of these species
GOLD	Fairly rare internationally and/or locally. Ghana has some inescapable responsibility for maintaining these species.
BLUE	Widespread internationally but rare in Ghana or vice-versa. It may be in Ghana's interest to pay attention to protecting some of these species
SCARLET	Common but under serious pressure from heavy exploitation. Exploitation needs to be curtailed if usage is to be sustainable. Protection on all scale vital
RED	Common but under pressure from exploitation. Needs some control and tree by tree area protection
PINK	Common and moderately exploited. Also non-abundant species of high potential value
GREEN	No particular conservation concern
OTHERS	Non forest species, excluded from the analysis for other reasons

Source: Hawthorne, 1995

Commercial Status

The species were categorized into commercial status Class I, II, III and IV according to the classification of Parren & de Graft (1995). The basal area of Class I species decreased from Y₅₀, Y₂₁ to Y₁. Exploitation has just been carried out in Y₁ resulting in the removal of the Class I species, Y₂₁ was still recovering, whilst Y₅₀ contains a lot of matured trees.

Basal Area

Tree basal area, which is a surrogate of biomass, was assessed for the different sites. It increased from Y_1 , Y_{21} to Y_{50} . The highest basal area exhibited by the Y_{50} indicates that it is almost at climax and may harbour many larger diameter trees. Y_{21} being almost at par in terms of basal area may be attributed to the fact that Y_{21} is gradually building up and Y_1 had just undergone exploitation through selective logging.

Conclusion

- ◆ Natural recovery in terms of commercial species abundance after selective logging is slow
- ◆ There is high species diversity after selective logging, which reduces with time
- ◆ The build up in basal area, a surrogate of biomass, after selective logging is sluggish
- ◆ Species abundance, commercial and conservation status of the forest indicated a vegetation shift which calls for a quick silvicultural intervention, such as enrichment planting.

2.3 Framework for Improved Land Use in the Degraded Watersheds of the Coastal Water System Zone of Ghana

Project Team: Ofori, D.A., Anglaaere, L.C.N., Bandoh, W., Amissah, L., Dwomoh, F., & Mireku, J.

Introduction

Work on this project commenced in January 2008 and was completed in December 2009. The Densu River is one of the four (4) major rivers within the coastal water system of Ghana and it supplies water to over 2 million people in its catchments located in the most densely populated districts in Ghana.

Over the past 30 years, Ghana has been experiencing gradual but constant decline of water flow and water quality in its major water systems. This situation has been attributed mainly to unsustainable agriculture and forestry practices that have led to the degradation of the watershed ecosystem.

The trends in environmental degradation and the associated water supply situation are seen as a result of combination of factors including the absence of an Integrated Water Resource Management (IWRM) policy framework. However, it is only recent that attempts are being made in Ghana to coordinate efforts through the water and sanitation project (at institutional, local government, traditional council or community levels) to address water management problems.

While exploring the depth of traditional knowledge in water resource management within the Densu River basin the project sought to use available secondary data in addition to field surveys to develop a framework for future studies that will lead to a watershed-based land use prioritization model for sustainable water supply within the coastal water system zone of Ghana.

The overall objective of this project is to establish a sound scientific and socio-cultural basis for integrated land use system that will improve the general ecology of the watersheds for sustainable supply of quality water in the coastal river system using River Densu basin as a case study.

The methodology used was a desk study which reviewed papers and reports over 30 years, from the CSIR-Water Research Institute of Ghana, Water Resources Commission, Hydrological Services Division and Ghana Water Company (Weija Water Works). It also involved visits to the various Institutes.

Results

Using Water Quality Index, the CSIR-WRI determined the mid points of Mangoase and Nsawam as the areas with the poorest water quality (WQI=25-50). The total coliforms and faecal coliforms in the Densu basin were very high as compared to the other basins. This is due to the high anthropogenic activities in the basin.

The total and faecal coliform values were also higher in the rainy season, than in the dry season as a result of the increased runoff in the rainy season coupled with the indiscriminate dumping of waste along the river.

Nsawam also recorded the highest level of micro-organic pollutants, the highest derivative of DDT with concentrations of 0.431 mg/L in March and 0.460 mg/L in July in excess of the WHO guideline value of 0.001 mg/L (WHO, 2004).

With respect to vegetation, the following satellite imageries show vegetation cover maps indicating changes in forest cover between 1990 and 2000 (Figure 8).

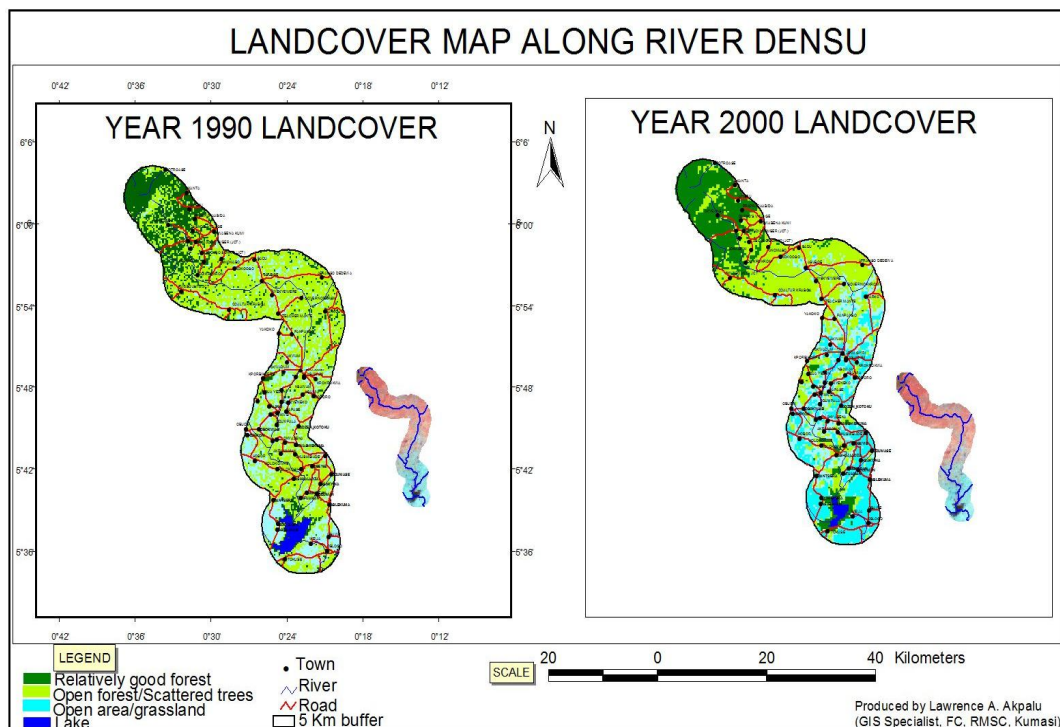


Figure 8: Vegetation cover map along River Densu between 1990 and 2000

The maps show that there has been extensive forest degradation along the River Densu between 1990 and 2000. Relatively good forest gained a total of 2018 ha in certain areas of the catchment while open forest/open vegetation lost a total of 17464.50 ha in certain areas of the catchment. At the same time degraded areas have expanded by a total of 16529.04 ha over the 10 year period. The size of the water body has shrunk by 1083.29 ha over the 10 year period. This reduction might not be due to the reduction of the water content itself but could be attributed to the grass/vegetation covering the surface or along Weija dam and other water bodies therefore raising the value gained in forest cover. Reforestation programme undertaken round the Weija Lake has also shown improved forest cover over what existed as at 1990.

The figure below shows actual scale of forest degradation over the 10 year period. However, an afforestation programme has improved the vegetation cover round the dam.

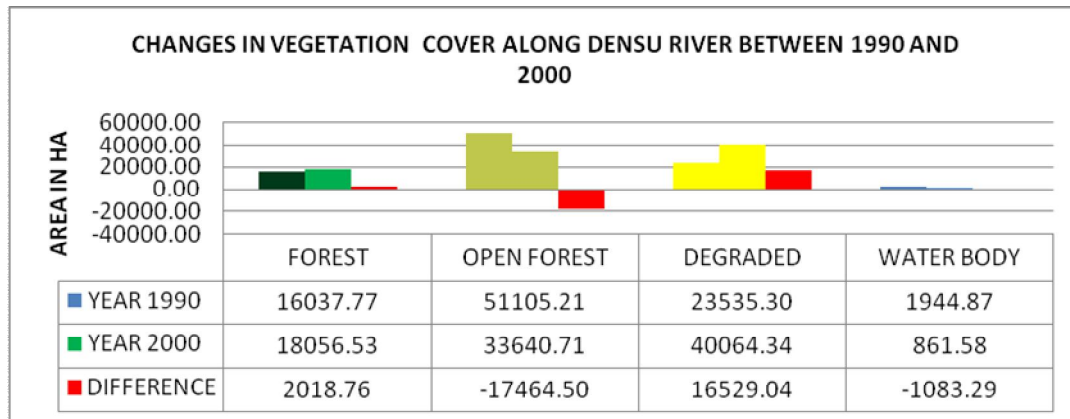


Figure 9: Changes in vegetation cover along Densu River between 1990 and 2000

Conclusion

An evaluation of current economic activities in the Densu basin will be beneficial. This will identify activities in the catchment area that have adverse impacts and which can be replaced with more environmentally friendly alternatives. However, it must take into cognizance the social and or traditional values of those activities.

2.4 Evaluation of Natural Borer Resistance Variation between *Bambusa vulgaris cv vitata* (yellow) and *Bambusa vulgaris* (green)

Project Team: Oteng Amoako, A. & Essien, C.

Introduction

Bamboo is one of the oldest and most versatile building materials with many applications in the field of construction. Diminishing wood resources 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 emerged as the most suitable alternative.

Its acceptance as a suitable alternative to wood is however hindered by its liability to biological degradation of the construction components as well as the finished products. Bamboo culms do not produce any toxic substance during their lifetime hence the whole culm tissue can be destroyed by biological organisms leaving only the harder outer skin. Bamboo culms contain large amount of starch which determines mainly its susceptibility against borers and blue-stain fungi. The objective of the project is to evaluate variation in powder-post beetles' susceptibility between the *Bambusa vulgaris cv vitata* (yellow) and *Bambusa vulgaris* (green)

Workdone

Matured yellow and green bamboo culms were harvested from Mesewam nursery near Kumasi in a moist semi-deciduous forest. The culms were cross cut into three (3) portions namely the top, middle and bottom. The mean internode length and the wall thickness were 34.2cm and 7.3mm, 34cm and 10.3mm, 27cm and 15.8mm for the top, middle and bottom of the green type respectively whilst 31.6cm and 8.4mm, 32.7cm and 10.5mm, 24.4cm and 15.6mm for the top, middle and the bottom of the yellow type respectively. The samples were subjected to borer attack under-shed and the number of borer-holes was counted monthly.

Results

There was significant statistical difference among the two varieties of *Bambusa vulgaris* studies with respect to their susceptibility to powder-post beetle attack ($\alpha= 95\%$ and 99%) with the green being very susceptible to powder-post beetle degradation than the yellow type (Figure 10).

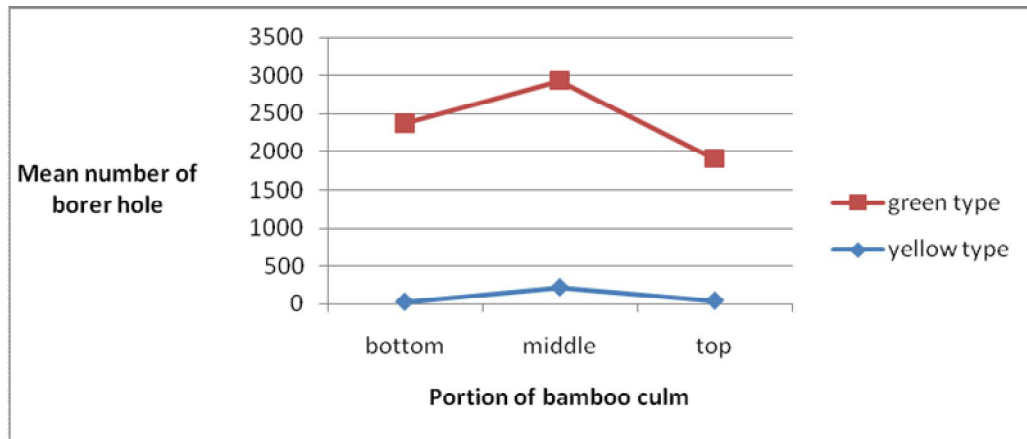


Figure 10: Mean borer-holes between the green and yellow types of bamboo

Previous reports have indicated that the beetle damage has a positive correlations with the starch content of the bamboo therefore it can be inferred that the green variety has higher starch content than the yellow type.

However, in both varieties, the damage was confined to the inner portions of the culms with the outer parts intact.

The middle portions of both the yellow and the green varieties were very susceptible to powder-post beetle degradation than the bottom and the top portions ($\alpha= 95\%$ and 99%). This conforms to the recent investigations on starch distributions in *Phyllostachys pubescens* which indicated that the starch content is higher in the middle portion, followed by the top and the bottom ends. Hence the higher susceptibility of the middle portion to powder-post beetle may be due to higher starch content in that portion than the bottom and the top portions.

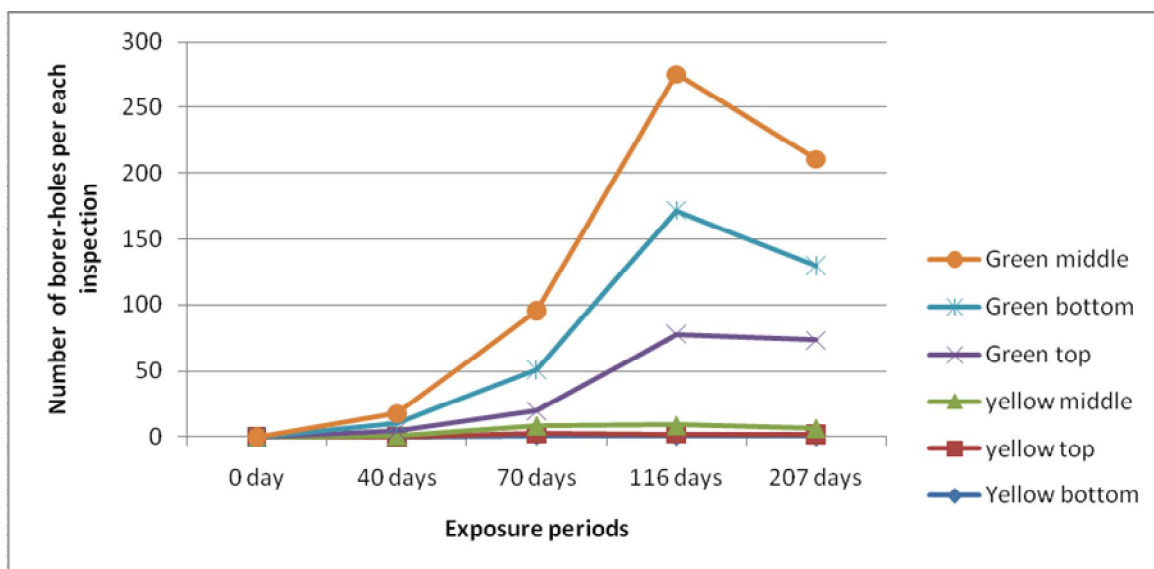


Figure 11: Mean number of borer holes and exposure dates

Conclusion

On the same site in Ghana, powder-post beetle susceptibility varies between the two varieties of *B. vulgaris* with the green type being more prone to beetle attack than the yellow type. Also, the middle portions of both varieties were very susceptible to beetle attack than the bottom and the top. However, both varieties must be treated with appropriate preservative in order to prolong their service life.

2.5 Basic and Technological Properties of *Borassus Palm* and *Broussonetia papyrifera* in Ghana

Project Team: Appiah, J.K., Ofori, J., Wilson Owusu, F. and Essien C.

Introduction

Most of the primary timber species in Ghana are dwindling in numbers and facing possible extinction from the Ghanaian forests due to over-exploitation. Some lesser-used species have therefore been promoted to replace those species that are being over-exploited. In the forests of Ghana, wood from non-traditional sources like the palmae species including *Borassus palm* and *Broussonetia papyrifera* are in abundance but unutilized. It is therefore important that *Borassus palm* and *Broussonetia papyrifera* be effectively promoted and utilised as raw materials in Ghana's wood industry. This requires knowledge of their physical and drying characteristics to provide information concerning their suitability for specific end-uses.

Borassus palm (*Borassus aethiopum*) is a monocotyledonous palmae species of economic importance that serves as a potential source of raw material for the furniture and construction industries. It is also used in areas like medicine, food, beverage and for industrial products. *Broussonetia papyrifera* (Paper mulberry), regarded as an aggressive, invasive weed, is used for household energy production while its leaves are used as feed for domestic ruminants. Processing and utilisation of these species would help reduce pressure on the traditional tree species and again promote conservation of Ghana's dwindling forest estate.

The objective is to determine the basic and technological properties and develop appropriate processing techniques for the efficient utilization of Ghana's wood resources.

The specific objectives of this study are:

- To determine shrinkage, basic density, and moisture content distribution for the wood of *Borassus aethiopum* (from Nkoranza) and *Broussonetia papyrifera* (from Pra-Anum);
- To monitor drying behaviour of the wood of *Borassus aethiopum* and *Broussonetia papyrifera*;
- To propose kiln schedules for *Borassus aethiopum* and *Broussonetia papyrifera*.

Key Results/Achievements

Physical properties and drying characteristics

Moisture content of lumber of the two species were monitored, drying defects evaluated and kiln schedules proposed. Mean green moisture content and basic density of 64.8% and 483.3 kg/m³ respectively were obtained for *Broussonetia* which took 63 days to move from 70.2% to 19.4% moisture content. Level of shrinkage was small for the two species indicative of their dimensional stability. Some drying defects in *Broussonetia* included checking, cupping and

crook. Proposed schedules for both species indicated that wood of both *Borassus* and *Broussonetia* could withstand high drying temperatures.

Mechanical properties

The modulus of rupture, compression parallel to grain and shear parallel to grain of *Broussonetia* from Amantia in the Pra-Anum Forest Reserve is slightly lower than that from the Afram Headwaters Forest Reserve; while the other strength parameters (Modulus of elasticity and Hardness) seem to be slightly higher.

Machining properties

Planing: For feed speeds of 6, 9 and 14 m/min the percentage defect-free (surface quality) ranged between 70 – 80%, 66 – 76% and 60 – 72% for cutting angles of 15⁰, 20⁰ and 30⁰ respectively for *Broussonetia papyrifera*. The range of surface quality for *Borassus aethiopum* was obtained to be 90 – 96% and 80 – 92% for cutting angles of 15⁰ and 20⁰ respectively.

Shaping: The percentage good to excellent shaping qualities for spindle speeds of 4,500, 6,000 and 8,000 rpm were determined to range from 58 – 82%.

Turning: Using spindle speeds of 1,000, 1,850 and 2,500 rpm the percentage fair to excellent (turning quality) ranged between 60 – 88%

Sanding: Sandpaper with grit sizes of 100, 120 and 150 used in sanding the samples generated percentage defect-free samples of between 80 – 100%

Prototypes

Meat cages, laboratory stools and entertainment unit were produced from Coconut wood and *Borassus* palm as shown below.



Fig. 12: Meat cages produced from Coconut wood

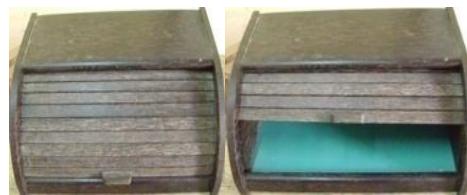


Fig. 13: Meat cages produced from *Borassus palm*



Fig. 14: Lab stools produced from *Borassus palm*



Fig. 15: TV/Computer stands produced from *Borassus palm*

Recommendations/Conclusion

The physical, mechanical and machining properties of *Borassus* and *Broussonetia* show that these species can be adopted for furniture and construction purposes. With the two species studied, *Broussonetia papyrifera* is recommended for indoor furniture while *Borassus aethiopum* is recommended for construction (bridges, canoes, roofing, posts, door/window frames), industrial flooring, tool handles, meat cages, laboratory stools and deck boards.

3.0 DONOR FUNDED PROJECTS

In 2009, donor funds' contribution to the Institute's research activities was more than three times the total inflows from IGF and continues to be a major source of funding for research. Some of the international donors include; International Tropical Timber Organisation (ITTO), European Union (EU) and Danish International Development Agency (DANIDA) and the details are presented below;

3.1 Plant Resources of Tropical Africa - Timbers of Tropical Africa Part II

(Project Team Leader: Dr. J.R. Cobbinah)

As part of a programme to improve access to information on the 8000 useful plants of Tropical Africa and to promote their use in a sustainable manner, Plant Resources of Tropical Africa (PROTA) is synthesizing all existing but dispersed knowledge on the estimated 1070 Timbers of Tropical Africa. This second part of the project started in January 2009. The project will lead to the publication of approximately **300** review articles (English and French) dealing with about **570** timber species of tropical Africa. As of December 2009, completed TEXTFILE review articles reached 87 articles on 161 species. The translation process of TEXTFILE review articles from English into French started in July 2009 and 62 articles have been translated, of which 40 have been validated. The information will be made widely available electronically and in books. One of the important elements in the project is capacity building (author/editorial training) of personnel from key African institutions. Two candidates underwent editorial training at the PROTA Network Office Europe in Wageningen. This project is sponsored by International Tropical Timber Organisation and PROTA Foundation.

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

(Project Team Leader: Dr. Dominic Blay)

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; participatory methods for measurement, assessment reporting and verification and in addition determine the financial value of environmental

services. The output of the project will be: a developed participatory management system; provision of financial value of the environmental services by the conservation area; good governance mechanisms and benefit sharing arrangements; and 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 and this will ensure sustainability of the project.

3.3 Conservation and Utilization of Medicinal Plants in Ghanaian Forests Fringe Communities

(Project Team Leader: Dr. E. Owusu-Sekyere)

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 cheap 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 means 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 the medicinal plants as both timber and the 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 their suitable plant species.

This project funded by the International Tropical Timber Organisation (ITTO) focuses on documenting the distribution and availability of medicinal plants (endangered, common). It also looks at conservation methods and sustainability of supply of medicinal plant 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 harvest and utilization of medicinal plant species.

3.4 Silvicultural Strategies to Mitigate *Hypsipyla* Shoot Borer Impact on African Mahogany: Effect of Pruning and Companion Species

(Project Team Leader: Dr. Paul Bosu)

African mahoganies belonging to the genera *Khaya* and *Entandrophragma* are extremely valuable timber species of the family Meliaceae. However, the species suffer severely from damage caused by *Hypsipyla robusta* (Lepidoptera: Pyralidae) shoot borer. Attacks result in profuse branching of the stem which significantly reduces the timber value of the tree.

The impact of shoot borer damage to *Khaya ivorensis* was evaluated in mixtures with three (3) companion species (*Azadirachta indica*, *Triplochiton scleroxylon* and *Cedrela odorata*). Two (2) of the companion species (*Azadirachta indica* and *Cedrela odorata*) were evaluated for their efficacy as insect repellent plants.

Shoot borer activity was not observed in the plantation until after 20 months, but when it occurred it was massive and instantaneous, affecting 53 per cent of the host species (*K.*

ivorensis) during the initial colonization. Generally, *K. ivorensis* mixtures in which *Cedrela odorata* was the companion species showed higher prospect to mitigate shoot borer damage than those with *A. indica* or *T. scleroxylon*. Studies have shown that overhead shade minimizes shoot borer impact on mahogany. *Cedrela odorata* was the fastest growing of all the species in the plantation, and its bushy habit could provide greater canopy shade for the host species than the other two companion species.

The outcome of the mixed species trials show that it is possible to minimize mahogany shoot borer damage to African mahogany if planted in low-density mixtures with *Cedrela odorata*. A ratio of 25% Mahogany to 75% *Cedrela* (1:3 ratio) or lower is recommended. This study was implemented under an International Foundation for Science (IFS) Fellowship.

3.5 Alternative Mixed Plantation Systems and Restoration Strategies for Conservation and Sustainable Production of Native Timber Species in Ghana (Project Team Leader: Dr. Paul P. Bosu)

Decades ago, Ghana's efforts to establish forest plantations using native species were thwarted by a variety of technical and managerial bottlenecks. The problem of pests was among the highest on the list of factors causing failure. To overcome this problem exotic species were targeted. Species like teak (*Tectona grandis*), *Cedrela odorata*, and *Gmelina arborea* which were found to be relatively stable to pest ravages and fast growing were planted at the expense of native tropical hardwood species. By year 2000, Ghana's 75,000ha forest plantation estate was at least 70% exotic. A national forest inventory programme (FIP) completed in 1989 revealed very vividly that most of our high value tropical hardwood species were over-exploited; to the point of resource extinction. Investigations soon indicated that species such as Iroko (*Milicia excelsa* and *M. regia*), African mahogany (*Khaya* and *Entandrophragma* spp), and other native species of high vulnerability to endemic pests could be established in plantations with reasonable degree of success if planted in mixtures.

Conceptual models of mixed indigenous species plantations involving three (3) threatened high value species, namely *Milicia* spp (Iroko), *Khaya* spp (Mahogany) and *Pericopsis elata* (Afromosia) were planted in various combinations and ratios with seven (7) other timber species in several ecological zones. In addition, small-holder community mixed specie plantations were established with the cooperation of volunteer farmers.

Generally, pest damage in the mixed plantations was lower than in the monocultures. The level of damage reduction achieved was in many instances enough to sustain the vulnerable species through critical growth stages. The study showed that the impact of pests on plantations depended on factors such as nurse or companion species used, density of host in mixture, site factors, pest species in question, and season of attack. Also, mixed species plantation required more care and attention, especially during the early stages of development, than monoculture plantations. This study is sponsored by ITTO.

3.6 Domestication of *Allanblackia parviflora* in Ghana (Project Team Leader: Dr. D. A. Ofori)

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 5per 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/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 the 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 study of the behavior of different propagule types of *Allanblackia* (seedlings, cuttings and grafts) in farming systems are in progress.

3.7 Developing alternatives to illegal chainsaw milling through multi-stakeholder dialogue in Ghana and Guyana an EU Chainsaw Project (Project Team Leader: Dr. E. Marfo)

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.

The various studies were completed in 2009 leading to the preparation of thirteen (13) technical reports which were compiled into a publication. Following this, a synthesis of all major chainsaw related studies over the years was carried out and published.

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 studies confirmed that chainsaw milling under an illegal regime is very wasteful and has the lowest recovery efficiency. The study recommended that dealing with legal supply of timber to the domestic timber market is key to dealing with illegal chainsaw milling. The recommendations of the studies 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.

3.8 The Biology, Impact and Integrated Management of the Opepe Shoot Borer, *Orygmophora mediofoveata* in West Africa (Project Team Leader: Dr. Paul P. Bosu)

Nauclea diderrichii (local name: Opepe, Kusia) is a valuable timber species found in tropical Africa. Its distribution extends from Sierra Leone through Central Africa to Uganda and some parts of East Africa. In Ghana, the species is found in both the deciduous and evergreen forest zones. The wood is resistant to decay, marine borers and termites and is used extensively in heavy construction, furniture, veneer, as well as many other domestic uses. In 2001 *N. diderrichii* was selected as one of the five (5) priority indigenous species for forest plantation development in Ghana. The topmost criteria for selection of the five indigenous species (together with five other exotic species) were fire tolerance and resiliency to pests. However, the impact of opepe shoot borer (OSB) *Orygmophora mediofoveata* (Lepidoptera: Noctuidae) as a pest on *Nauclea* was under-estimated due to lack of knowledge on its pest status. Initial attempts to set up *Nauclea* plantations in Ghana in the last several years had limited success as a result of the pest.

The objective of the project was to develop integrated pest management strategies towards the establishment of sustainable *Nauclea* plantations in West Africa. The studies undertaken included provenance and genotype assessments; evaluation of OSB impact on *Nauclea* seedlings in field exclusion cages studies; evaluation of factors affecting seed germination; and an evaluation of the potential of insecticides to protect *Nauclea* seedlings against shoot borer damage.

Fifteen (15) *N. diderrichii* genotypes from five (5) ecological zones in Ghana and Togo, including Amantia, Begoro, Benso, Berekum and the Plateau Region of the Republic of Togo were established at wet, moist and dry forest zones in Ghana and assessed for growth and OSB damage.

The results of the cage exclusion studies indicate that in the absence of attack by OSB, *Nauclea* can achieve growth at a rate more than double its current growth rate in plantations. It is recommended that integrated management for *Nauclea* should begin with the use of tolerant genotypes established on suitable sites. As a result of this study *N. diderrichii* has been included on the national list of indigenous species for plantation development in Togo. Prospects are also high for increased planting of the species in Ghana. African Forest Research Network (AFORNET) provided sponsorship for this project (Grant number 25/2005).

3.9 The Impact of *Broussonetia papyrifera* on Community Characteristics in the Forest Transition Zone in Ghana

(Project Team Leader: Dr. Paul P. Bosu)

Broussonetia papyrifera (paper mulberry, PM) is a non-native invasive woody plant which was deliberately introduced into Ghana in the late 1960's in an attempt to utilize it for industrial scale production of pulp and paper. After a lag period of about 25 years *B. papyrifera* emerged as a serious woody invasive species in the landscape of Ghana. Current estimates put distribution at between 50,000 - 60,000 km² of the closed forest region. It seriously threatens the regeneration of native species and succession processes in degraded forest areas wherever is found. It is also a weed of significant proportion in farms, tree and cash crop plantations throughout the forest regions of Ghana. The species is also gradually becoming established as a dominant vegetation in the transition forest zone. The transition zone is a unique ecosystem in Ghana and forms a corridor between the deciduous forest regions of the south and the savannah woodland ecosystems of the north. Additionally, a small stand of *B. papyrifera* was recently discovered along the bank of the Red Volta near Bolgatanga in the Guinea Savannah zone. This stand is believed to have survived from previous abortive attempts to introduce the species in the north. The objective of the study was to assess the effect of *B. papyrifera* invasion on community characteristics in the forest transition ecosystem.

The study was carried out in and around the Afram Headwaters Forest Reserve (AHFR) from March 2008 to April 2009. This location was chosen because of the high density of PM stands in and around the reserve. The studies included comparative and removal experiments. In each plot, the relative percent cover of PM, *Chromolaena odorata*, grasses and shrub or herbaceous species was estimated to the nearest 5 percent.

At the transition site, removal of PM resulted in a doubling of cover by the vegetation guilds, with *C. odorata* becoming the dominant vegetation in the absence of PM. However, in the forest site PM removal increased the regeneration of indigenous herbaceous species at the expense of *C. odorata* or grasses. Furthermore, relatively more indigenous species were lost than recruited in the removal plots at the transition site compared to the forest site.

The results suggest that control of paper mulberry in invaded forest stands may be justified to promote natural regeneration in the forest zone. On the other hand, the presence of PM may actually lead to increased regeneration in the transition forest zone and this observation supports previous observations. This study was executed under a British Ecological Society Overseas Bursary Fellowship (OBF1428/1798).

3.10 Tropical Forests for Poverty Alleviation: from household data to global analysis *(Project Team Leader: Dr. Mrs. Beatrice Darko Obiri)*

The Danish International Development Agency (DANIDA) Poverty and Environmental Network (PEN) study is funded by the Danish Government and executed in collaboration with the Danish Centre for Forest and Landscape Planning of the University of Copenhagen (coordinating institution), CSIR-FORIG, University of Burkina Faso and the Cambodian Resources Research Institute under the guidance of the Poverty and Environmental Network Programme of the CIFOR, Indonesia. The study is one of the 26 country studies of CIFOR-PEN being conducted in tropical forest countries across the continents of Africa, Asia and Latin America

The key objective of the Ghana PEN study is to estimate the economic importance of forests to rural households to ultimately inform policy debate on the magnitude and trends in forest dependency. It is also to guide the development and use of forest resources for sustainable rural livelihoods. The study basically explores the magnitude of forests contribution to rural livelihoods in relation to non-forest or other productive aspects of the rural economy of forest fringe communities in the wet and transitional forest zones of Ghana. The wet forest area is typically within the resource basket of the nation where key agricultural cash crops, forest products and minerals such as gold and others abound. Conversely, production of agricultural staples is the predominant livelihood activity in the transition drier forest area.

Preliminary results indicate that households at the wet forest area use 48 cultivated crops, 50 forest products and 58 non-forest environmental products while those recorded at the dry forest area were 46 cultivated crops, 41 forest products and 56 non-forest environmental products. Results also confirm that agriculture is the predominant livelihood activity for both cash and subsistence purposes contributing up to 50% of household income. However, 13% of household income is derived from forests. Forest and other environmental products are harvested throughout the year. Collection peaks in the first quarter when there is less agricultural activity. There is a higher reliance on fuel wood, poles and game for subsistence. Dependency is more pronounced in the transition zone where forests are much degraded, with less restriction on access and limited opportunities for alternative incomes.

As part of its poverty reduction strategies, the government is promoting tree (timber) plantations to restore degraded forest landscapes in collaboration with forest fringe communities. These plantations have longer gestation periods. Thus although communities are entitled to 40% of the proceeds in the long term, there are a number of challenges. However, this study shows that game, fuel wood, poles and medicines are key commodities collected particularly from the forest. Charcoal is also the most frequently processed forest product (62%) mainly for commercial purposes particularly in the transition area. Short rotation forest plantations for fuel wood and poles may be viable alternatives that could be promoted and developed on farmlands for both cash and subsistence. This system can also be managed for charcoal and timber production to reduce pressure on the forests especially in degraded ecological zones.

3.11 Towards sustainable Timber Production in Ghana: Stage 1. Improving Shoot Borer Resistance and Developing Silvicultural Systems to maximize Mahogany Plantation success (Project Team Leader: Dr. Opuni-Frimpong)

Native mahoganies contribute significantly to timber exports in Ghana and are part of the most economically important timber tree family (Meliaceae) worldwide. Continued supply of mahoganies is however threatened by overexploitation of natural forest reserves necessitating their establishment in plantations, which are also hampered by the ubiquitous insect pest species, the shoot boring moth, *Hypsipyla robusta*.

This project directly addressed the mahogany shoot borer pest problem by identifying resistance/tolerance in *Khaya* and *Entandrophragma* species across their range of distribution. Provenance selection for tolerance to the shoot borer pest were conducted by establishing genetic and environmental interaction plots across the three (3) major ecological forest zones in Ghana to investigate how individual families will respond to *Hypsipyla* attack in the different ecological zones. The plantations established for the provenance studies have been set aside as biodiversity conservation plots for the various mahogany species investigated.

Vegetative propagation technologies (by cuttings and in-vitro tissue culture) were developed with the aim of using them to propagate resistant/tolerant genotypes of mahoganies that will be identified. The project also developed protocol for mass propagation of African mahoganies through *in vitro* tissue culture technology which could be used to clone and conserve cultures of the elite mahoganies that will be identified in the provenance/genotype selection.

Silvicultural options used in this project included spacing trials, mixed plantings (planting in association with other species) and companion plantings (planting in association with legumes and insect repellent trees) and combining these in an integrated management strategy. Some of the mixed plantation studies under the project were established with community farmers and industries which ensured the acceptance of the project techniques and findings as well as the continued planting of the mahoganies using the techniques developed by the project. Studies were also conducted to assess the socio-economic aspects of the project in the various communities where farmers were involved in the implementation of the project.

The project initiated the process of understanding wood properties and qualities of plantation grown mahogany by conducting anatomical studies to investigate differences and similarities between natural forest and plantation grown *K. ivorensis*.

The demands and expectations of project participants and stakeholders especially community tree growers has been overwhelming, stimulating the project team and the steering committee to recommend the development of a second phase of the project. This second phase aims to refine the silvicultural “tool kit” to optimize planting in mixed stands to reduce economic losses from *Hypsipyla* and 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 farmers.

The successful implementation of this project could be attributed to the active participation of stakeholders in the project identification, design, implementation, monitoring and evaluation. ITTO Project PD 105/01 Rev.3 (F).

3.12 Development of an Integrated Strategy for Control of Stem Dieback of *Ceiba pentandra* **(Project Team Leader: Dr. D.A. Ofori)**

Ceiba pentandra is among the most valuable timber species in Ghana and Benin. In Ghana, it ranks second in volume of export and revenue generated. Continual supply of this species is threatened by exploitation from the natural forest and difficulties in the establishment of plantations of *C. pentandra* due to dieback of the shoot at the nursery and in the field. The project sought to develop and demonstrate an integrated management strategy for reduction of dieback. It also addressed the urgent need for genetic screening and identification of best sources of seeds and conservation of *Ceiba* germplasm.

Specific objectives are: identification of less susceptible genotypes for plantation establishment; identification of the causal agents of dieback and their control measures and evaluation of the most promising nursery techniques for reduction of dieback. Genetic screening showed large variability in growth and susceptibility of individual accessions and provenances to the stem dieback. The dieback problem was more prominent in the nursery than after planting in the field. Silvicultural management practices showed that the dieback disease could be controlled in the nursery when overhead water is avoided in the nursery. No intermediate insect vector was found to aid the transmission of the disease but the major predisposing factor is high humidity. It was therefore concluded that if genetically resistant genotypes are nursed during the dry season for at least six (6) months before field planting, the incidence of dieback disease would be very minimal.

4.0 COMMERCIALISATION AND INFORMATION DIVISION

The Commercialisation and Information Division has three (3) sections; made up of the Information and Publications, Computer and Biometrics 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 by the special services section and for the period under review focused on the following:

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

Additionally, technologies developed as output from research continued to be commercialized though at a relatively slow rate. Some activities registered an increase in revenue over that of the previous year, while others registered a decline.

4.1.1 Sale of Seeds and Seedlings

CSIR-FORIG has over the years been collecting various species of tree seeds for sale to prospective plantation developers in the country. Our seeds are usually of high quality since they are always tested and treated for higher percentage germination. The activity is however, confronted with many challenges including unavailability of parent trees for seed collection. Many of the superior trees have been felled by illegal chain saw operators. To reduce this problem, CSIR-FORIG has started establishing seed orchards for some tree species that would serve as a reliable source of supply but this requires a huge capital outlay. The other difficulty encountered is the active participation of the private sector in the seed collection exercise and relatively lower cost of their seeds.

The production of seedlings for sale is also engulfed with a similar problem. Currently, the Institute is competing with private nursery developers for market. Notwithstanding, 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. There are exotic and indigenous tree seedlings as well as some ornamentals available for sale.

4.1.2 Sale of Wood

CSIR-FORIG periodically thins wood from its research plots at Amantia and Afram Headwaters research stations and sells it to generate income for the Institute but the sale of wood is not sustainable since thinning is only done periodically. As a result, CSIR-FORIG has intensified its plantation development programme. In 2009, its 33 hectare forest plantation was expanded

substantially to serve as future source of wood supply. The activity however, requires huge capital investment to maintain the stand.

4.1.3 Consultancy, Contract Research and Training

On contract research and consultancies, CSIR-FORIG has performed creditably over the years. However, the year under review did not show any significant improvement in performance as far as consultancies and contract research were concerned. No training was organised due to the absence of the two resource persons responsible for the snail farming and mushroom cultivation training which are the main thrust of our training programme.

4.1.4 Production of Prekese Syrup and Honey

The production of prekese syrup for sale has been ongoing for several years at CSIR-FORIG even though, production is undertaken 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 business plan has been developed to that effect and it is hoped that its implementation will begin very soon.

4.2 Information and Publication Section

The library added to its stock a total of forty three (43) new books that were received on gratis. The library was neither able to purchase new books nor subscribe to new Journal titles due to lack of funding. However, due to the magnanimity of some publishers, the Institute was given access to e-resources from AGORA, JSTOR and EBSCOHOST that makes full text information available to Scientists. Notwithstanding the above challenge, the library in 2009 provided essential information services to support ongoing research activities. The library also provided useful forestry related information to the general public for professional development.

Currently, the library is participating as a member of the Ghana Agricultural Agris Project that was initiated by CSIR-INSTI and FAO. The project aims at assisting participating Institutes to create Institutional Repositories for the purpose of sharing information. The library has been able to capture over four hundred (400) records in the Institutional Repository. The library conducted over two hundred (200) literature searches for students and researchers using various databases at the library. In addition, the section published two (2) volumes of the Ghana Journal of Forestry, four (4) issues of the CSIR-FORIG newsletter and one (1) technical note.

4.3 Computer and Biometrics Section

The Computer and Biometrics section of the Commercialisation and Information division has the responsibility of managing CSIR-FORIG's Local Area Network (LAN) and computers, development and maintenance of website for both the Internet and Intranet and analysing data for research scientists.

Activities that were undertaken in 2009 included 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
- Analysis of data

All the above activities were performed satisfactorily, though the section was confronted with few challenges which included the continuous breakdown of the radio equipment for internet access.

Analysis of Data

The section continued to analyse data for scientists and management using Microsoft Excel and other application software.

Problems and Way Forward

- The shared bandwidth of 64K is not enough for CSIR-FORIG. This has resulted in slow Internet Connectivity. A bandwidth of at least 128k is needed and every effort is being made to improve the bandwidth. The frequency of breakdown of the radio equipment is quite high due to the sensitivity of the radio equipment to power fluctuations and severe weather conditions. Work is in progress to install thunder arresters and power boosters to stabilize the situation.
- Difficulty in obtaining information from staff to update the website. A system of information exchange whereby Scientists could provide summaries of their activities including projects, policy briefs, news, events etc to the Scientific Secretary or the library for easy access is being developed to facilitate communication.

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 Institute level and undertake human resource management and development activities.

5.1 Staff Strength and Structure

The current staff strength of the Institute is 256 made up of 53 Senior Members, 61 Senior Staff and 142 Junior Staff as against the approved 2005 manpower ceiling of 296.

The breakdown of Senior Members on the basis of qualification are as follows; 18PhD, 6PhD students, 16 MPhil/MSc/MA, 8 MPhil/MSc Students and 3 BSc/BA.

5.2 Administrative Matters

5.2.1 Promotions/Upgrading

Three (3) Senior Members' application for promotion was sent to Head office and are receiving attention.

Four (4) Senior Staff were interviewed and promoted by the Council. They are;

- Ms. Georgina Agyeman - Chief Administrative Assistant - 1st January 2009
- Mr. Isaac Mensah-Bonsu - Chief Accounting Assistant - 1st January 2009
- Mr. Dickson Asamoah - Senior Accounting Assistant - 1st January 2009
- Ms. Georgina Afriyie - Senior Technical Assistant - 1st January 2009

The following were upgraded during the year;

- Mr. Francis Kwabena Dwomoh - Research Scientist
- Mr. Bukari Dramani - Information Officer
- Mr. Kwasi Duah-Gyamfi - Research Scientist
- Ms. Comfort Darkwaah Konto - Administrative Officer

5.2.3 New Appointments

The following new appointments were made during the year;

- | | | |
|------------------------------|---|--------------------------------|
| • Mr. George K. D. Ametsitsi | - | Research Scientist |
| • Mr. J. K. Mensah | - | Research Scientist |
| • Mrs. Elizabeth Obeng | - | Research Scientist |
| • Mrs. Sarah Pentsil | - | Scientific Secretary |
| • Mr. Samar Brefo Sparkler | - | Research Scientist |
| • Mr. Frank Assuming Bafour | - | Principal Technical Officer |
| • Mr. Isaac Boahen | - | Principal Accounting Assistant |

5.2.4 Resignations

Messrs Samuel Owusu Yeboah, Scientific Secretary and Kofi Sarpong, Research Scientist resigned from the Institute effective September 2009.

5.2.5 Training

The following Staff are in school offering BSc, MSc or PhD;

1. Mrs. Lucy Amissah, PhD Programme, Sandwich, Wageningen Univ. The Netherlands
2. Mr. Lawrence Damnyag, PhD Programme, The University of Joensuu, Finland
3. Mr. Emmanuel Ebanyenle, PhD Programme, Michigan Technology, University, USA
4. Mr. William Dumenu, MSc. Programme, Freiburg University, Germany
5. Mr. Shalom Addo-Danso, MSc. Programme, Freiburg, University, Germany
6. Mr. Charles Essien, MPhil Wood Science, KNUST, Kumasi
7. Ms. Bridgette Brentuo, MPhil Wood Science, KNUST, Kumasi
8. Mr. Govina J. Kudjo, BSc. Programme, KNUST, Kumasi
9. Mr. Kwame Debrah, BSc Programme, KNUST, Sunyani Campus
10. Ms. Sandra Owusu, BSc. Programme, KNUST, Sunyani Campus

5.2.6 Sabbatical Leave

On Sabbatical Leave

- Mrs. Margaret Sraku-Lartey, Principal Librarian and Head of Division, CID started a 2 year sabbatical leave effective September 2009 at the Presbyterian University College, Abetifi, Kwaku.

Back from Sabbatical Leave

- Mrs. Mary Mamle Apetorgbor, Senior Research Scientist reported to work after a two (2) year Sabbatical Leave from the College of Renewable Natural Resource, KNUST, Sunyani Campus in August 2009,
- Mr. Kennedy Asamoah, Assistant Librarian also reported to work after a one (1) year sabbatical leave on September 2009.

5.2.7 Post Retirement Contract

- Dr. Sekyere was granted a two (2) year post retirement contract effective September, 2009
- Dr. Oteng Amoako was granted a two (2) year renewal of his post retirement contract effective September 2009.
- Mrs. Gyimah ended her four (4) year post retirement contract on 31st October 2009.

5.3 Retirements

In 2009, one (1) Senior Member, Four (4) Senior Staff and Six (6) Junior Staff Members retired from the Institute at the compulsory retirement age of 60 years. The names of the retired Senior Member and the Four (4) Senior Staff Members are presented below.

- | | | |
|--------------------------|---|---|
| 1. Dr. Daniel Sekyere | - | Principal Research Scientist and Former Deputy Director |
| 2. Mr. Opong Yaw Duah | - | Chief Technical Officer |
| 3. Mr. Richard B. Tawiah | - | Chief Technical Officer |
| 4. Mr. Edwin Y. Imouro | - | Chief Accounting Assistant |
| 5. Mr. Samuel Obuo Anti | - | Senior Accounting Assistant |

5.4 Official Visits by Distinguished Personalities

1. Dr. Tou Vander Zou from the Royal Netherlands Embassy, Accra on 29th May, 2009.
2. Dr. Cassandra Johnson, Dr. John Stanturf and Dr. Stephanie Otis, all from the US Forest Service on 11th August, 2009
3. Nana Boakye Amponsah Okofroban III, Parkosohene paid a courtesy call on the Director and Management on 16th November, 2009.
4. Dr. Edward Omani Boamah, Deputy Minister of the Ministry of Environment, Science and Technology visited CSIR-FORIG on the 30th of June 2009 during the celebration of the Day of Scientific Renaissance held at CSIR-FORIG.
5. Mrs. Sherry Ayittey, Minister of the Ministry of Environment, Science and Technology paid a familiarization visit to the CSIR Institutes based in Kumasi on the 20th October, 2009.
6. Dr. G.K.C. Nyiranda from Bunda College of Forestry in Lilongwe, Malawi on 26th February, 2009.
7. Mr. Mushougahande from the Forestry Commission, Harare, Zimbabwe, 26th February, 2009.
8. Dr. Ginus Mwanli from Forestry Research Institute of Kenya, 26th February, 2009
9. Fifteen (15) Students from the Northern Arizona University, together with Professor Michael Wagner on 7th August, 2009
10. Pragnish Mishra from Alullou Timber Company in India on the 11th September, 2009.
11. Dr. Jolan Roux from FABI University in Pretoria, South Africa on 26th February, 2009

12. Dr. Ephila Olarij and Mr. Peter Kiwuso from the Forestry Research Institute of Uganda on 26th February, 2009.
13. Mr. Sluf Mandoffe from SUA in Tanzania on 26th February, 2009
14. Mr. Benjamin Kanyi from Tree Biotech (NGO) Nairobi, Kenya, 26th February, 2009.
15. Dr. K.E. Mutity and Dr. John Richard from Kenya Forestry Research Institute on 26th February, 2009.
16. Dr. Panlos Mwale from the Forestry Research Institute of Malawi, 26th February, 2009.

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 2009

Government of Ghana	INFLOWS GH¢	OUTFLOWS GH¢	VARIANCE GH¢
Personnel Emoluments	2,564,931.00	1,994,407.00	570,524.00
Administrative Expenditure (Note 1)	117,760.00	159,961.00	- 42,201.00
Service Expenditure (Note 2)	-	25,500	- 25,500.00
IGF (Note 3)	123,063.00	69,630.00	53,433.00
Guest Houses	34,127.00	12,987.00	21,140.00
Total	2,839,881	2,267,485	577,396

Donor	Inflows (\$)	Outflows	Variance
Total	269,114.00	216,568.01	52,545.99

Note 1: Administrative grants of GH¢23,550 per month were received up to May 2009.

Note 2: No Service or Investment Grant was received in 2009. The expenditure of GH¢25,500 is the total amount released by the Institute from IGF to the various units for research activities.

Note 3: Wood sales contributed about 77% of Gross IGF inflows, while seed and seedlings contributed 16% and 6% respectively. Contributions from other items were less than 1%. Outflows from IGF include GH¢51,000.00 reserves from wood sales for plantation regeneration.

APPENDICES

APPENDIX I

LIST OF PUBLICATIONS

TECHNICAL REPORTS

1. **Adu-Bredu, S.** & Derkyi, N.S.A. (2009). Feasibility of a gold standard project promoting efficient use of firewood and charcoal in West Africa to reduce deforestation and carbon emission. *Consultancy Service Report for World Wide Fund for Nature (WWF) By CSIR-Forestry Research Institute of Ghana.*
2. **Abebrese, I.K.** and Addai, A. (2009). “Gum Arabic development in Ghana” (Submitted for publication).
3. **Adam, K.A.** and Duah-Gyamfi, A. (2009). A comparative analysis of chainsaw and sawmilled lumber production to the domestic market in Ghana. In Marfo, E., K.A. Adam and B.D. Obiri (eds.). Ghana case study of illegal chainsaw milling. Developing alternatives to illegal chainsaw milling through multi-stakeholder dialogue in Ghana and Guyana project. CSIR-FORIG Research Report (CSIR-FORIG/TR/EM; KAA; BDO/2009/18).
4. **Adam, K.A.** and Duah-Gyamfi, A. (2009). Environmental impacts of chainsaw milling. In Marfo, E., K.A. Adam and B.D. Obiri (eds.). Ghana case study of illegal chainsaw milling. Developing alternatives to illegal chainsaw milling through multi-stakeholder dialogue in Ghana and Guyana project. CSIR-FORIG Research Report (CSIR-FORIG/TR/EM; KAA; BDO/2009/18).
5. **Appiah, J.K.,** Brentuo, B., & Mensah, M. (2009): Physical properties and drying characteristics of *Broussonetia papyrifera* from two forest reserves in Ghana (Draft).
6. **Appiah, J.K.,** Brentuo, B. & Owusu, F.W. (2009). The design, construction and operation of a solar kiln dryer at Aburi. Consultancy report for WWF-WAFPO on the construction of a 20 – 25m³ greenhouse type solar kiln dryer for wood artisans of the Aburi Industrial Centre, May 2009.
7. **Bosu, P.P.** (2009). Silvicultural Strategies to Mitigate Hypsipyla Shoot Borer Impact on African mahogany: Effect of Pruning and Companion Species. IFS (International Foundation for Science) Fellowship Report. Submitted December 2009.
8. **Bosu, P.P.,** Adu-Bredu, S., Nuto, Y. and Koukou, K. (2009). The Biology, Impact and Integrated Management of the Opepe Shoot Borer, *Orygmophora mediofoveata*, in West Africa. Final Project Report submitted to African Forestry Research Network (AFORNET). December 2009.

9. **Bosu, P.P.** (2009). The Impact of *Broussonetia papyrifera* Invasion on Community Characteristics and Ecosystem Properties of the Dry Forest Zone of Ghana. Final Fellowship Report submitted to British Ecological Society. August 2009.
10. **Darko Obiri, B.,** Marfo, E., Damnyag, L. Nutakor, E., Agyeman, V.K. and Ofori, J. (2009). Supply and demand for lumber on the Ghanaian domestic market
11. **Darko Obiri, B.,** Marfo, E. & Nutakor, E. (2009). Estimating Rural Forest Incomes. Narrative of the Ghana country case study submitted to PEN-CIFOR, Indonesia
12. **Darko Obiri, B.,** & Owusu-Sekyere, E. (2009). A survey of medicinal plant use among traditional herbal practitioners in the Ashanti and Brong Ahafo Regions of Ghana. To be Submitted to ITTO November 2009.
13. **Derkyi, N.S.A.** and Sekyere, D. (2009). Converting sawn waste into briquettes. Submitted to Benneh Foundation.
14. **Darko Obiri, B.,** Nutakor, E. and Marfo, E. (2009). Tropical forests for Poverty alleviation: from household data to global Analysis: Ghana PEN project narrative
15. **Foli, E.G.,** Duah-Gyamfi, A., Dwomoh, F.K. and Agyeman, V.K. (2009). Feasibility Study for Assisted Natural Regeneration in Forest Reserves in Ghana. A Consultancy report prepared for FORM International, Netherlands. November, 2009. 50pp.
16. **Foli, E.G.,** Duah-Gyamfi, A., Dwomoh, F.K. & Agyeman, V.K. (2009). Feasibility Study of FORM International for Assisted Natural Regeneration in Forest Reserves in Ghana: Literature Review on Enrichment Planting in Ghana. Consultancy report prepared for FORM International, the Netherlands.
17. **Foli, E.G.,** Duah-Gyamfi, A. and Dwomoh, F. (2009). Contribution of CSSIR-FORIG to Feasibility Study of FORM International for Assisted Natural Regeneration in Forest Reserves in Ghana. Consultancy Report for FORM International, the Netherlands.
18. **Marfo, E.** and Nutakor, E. (2009). Social and Political environment: effectiveness of the enforcement of the chainsaw milling law
19. **Marfo, E.** and Nutakor, E. (2009). Communication at the science-policy interface in the Forestry sector of Ghana
20. **Marfo, E.,** Adam, K.A., Darko Obiri, B., Damnyag, L., Nutakor, E., Wilson, F. & others (2009). EU chainsaw Ghana country case study report
21. **Nutakor, E.** and Marfo, E. (2009). Chainsaw conflicts and their impact on Communities and officials.

22. **Obiri, B.D.**, Marfo, E., Damnyag, L., Nutakor, E., Agyeman, V.K. and Ofori, J. (2009). Demand and Supply of Lumber on the Ghanaian Domestic Timber Market. Consultancy report for TIDD, FC. Takoradi.
23. **Owusu, F.W.**, Damnyag, L., Appiah, J.K. & Blay, D. (2009). Processing efficiency of different milling techniques: A comparative analysis. Ghana case study of illegal chainsaw milling. EU-project “Developing alternatives to illegal chainsaw milling through multi-stakeholder dialogue Ghana and Guyana project. FORIG Research Report (CSIR-FORIG/TR/EM;KAA;BDO/2009/18
24. **Ofori, D.A.**, Peprah, T. and Assuming, F (2009). Domestication of *Allanblackia parviflora* in Ghana. Report for January – December 2009 to ICRAF.
25. **Owusu-Sekyere, E.**, Peprah, T. and Twintoh, J. (2009). APSD Project Report on the Production of *Eucalyptus* and *Acacia* species seedlings.
26. **Ofori, D.A.**, Obiri B.D., Gyimah A, Adam, A. and Addai, A. (2009). Ethnobotany and conservation of some collected medicinal plants in West Africa. Report submitted to (AFORNET).
27. **Ofori, D.A.** and Addai, A. (2009). Vegetative propagation of some selected medicinal plants in Ghana. Final report submitted to project Leader.

BOOK CHAPTERS

Bosu, P. P., Apetorgbor, M. M. and Refera, A. (2009). Ecology and Management of Tropical Africa’s Forest Invaders. In: R. K. Kohli, S. Jose. H. P. Singh and D. R. Batish (Editors). Invasive plants and Forest ecosystems. Taylor and Francis Group, CRC Press, LLC, USA. Pp 355-376.

REFEREED PAPERS

1. **Appiah, M.**, Blay, D., Damnyag, L., Dwomoh, F.K., Pappinen, A., & Luukkanen, O. (2009). Dependence on forest resources and tropical deforestation in Ghana. *Environment, Development and Sustainability*, 11(3), 471-487. Springer Netherlands. DOI: <http://dx.doi.org/10.1007/s10668-007-9125-0>
2. **Blay, D.**, Dwomoh, F. K. and Damnyag L. (2009). Assessment of Forest Degradation by Local Communities: The Case Study of Ghana. Forest Resources Assessment Working Paper 160. Food and Agriculture Organization of the United Nations, Rome, Italy <http://www.fao.org/docrep/012/k7179e/k7179e00.pdf>
3. **Bombelli, A.**, Henry, M., Castaldi, S., Adu-Bredu, S., Arneth, A., Grieco, E., Lehsten, V., Rasile, A., Reichstein, M., Tansey, K., Weber, U. & Valentini, R. (2009). An outlook on the Sub-Saharan Africa carbon balance. *Biogeosciences* 6: 2193-2205.

4. **Bosu, P.P.** and Chilima, C.Z. (2009). Networking for Forest Health in Sub-Saharan Africa: the Forest Invasive Species Network for Africa (FISNA) fights against invasive species. *Nature and Faune* Vol. 23 (2): 64-66.
5. **Cheteu, L.B.**, Cobbinah, J.R., Dwomoh, F.K., Foaham, B., Foli, E.G., Idinoba, M., Makungwa, S., Nkem, J., Oballa, P., Utila, H. (2009). In: Eastaugh, C. (Ed.) Making African forests fit for climate change. A Policy Brief for the Copenhagen Climate Talks. 27pp.
6. **Derkyi, N.S.A.** and Derkyi, M.A.A. (2009). Traditional knowledge on conservation of seed oil, medicinal and dyes and tannin plants. In: Traditional Forest-Related Knowledge and Sustainable Forest Management in Africa. IUFRO World Series Volume 23.
7. **Derkyi, N.S.A.**, Bailleres H., Chaix G., Thevanon, M.F., Oteng-Amoako, A.A. and Adu-Bredu S. (2009). Colour Variation in Teak (*Tectona grandis*). Wood from Plantations Across the Ecological Zones of Ghana. *Ghana Journal of Forestry*.
8. **Derkyi, N.S.A.**, Acquah, S.O. and Owusu-Akyaw, M. (2009). Bioactivity-Directed Isolation of Pesticidal Compound in *Cassia alata* Linn against *Sitophilus zeamais* and *Callosobruchus maculatus*. *International Journal of Pure and Applied Chemistry*. Volume 4 No. 2.
9. **Derkyi, N.S.A.**, Acquah, S.O, and Owusu-Akyaw, M. (2009). Use of some indigenous plant products to control the maize storage weevil, *Sitophilus zeamais* Motsch *Journal of Natural Sciences*. (Accepted).
10. **Derkyi, N.S.A.**, Acquah, S.O, and Owusu-Akyaw, M. (2009). Bioactivity of some natural products against the cowpea storage beetle *Callosobruchus maculatus* L. in the laboratory. *International Journal of Biological and Chemical Sciences*. (Accepted).
11. **Foli, E.G.**, Agyeman, V.K. and Pentsil, M. (2009). Ensuring sustainable timber supply in Ghana: A case for plantations of indigenous timber species. *CSIR-FORIG Technical Bull.*, Vol 1, 2009.
12. **Fofana, I.J.**, Ofori, D.A., Poitel, M. and Verhaegen, D. (2009). Diversity and genetic structure of teak (*Tectona grandis* L.f) in its natural area using DNA microsatellite markers. *New Forests* 37:175-195
13. **Foli, E.G.** and Pinard, M.A. (2009). Liana distribution and abundance in moist tropical forest in Ghana 40 years following silvicultural interventions. *Ghana Journal of Forestry* (In print).
14. **Meir, P.**, Gustavo S., Feldpaush, T., Veenendaal, E., Schrodte, F., Bird, M., Djabletey, G., Hien, F., Compaore, H., Diallo, A., Grace, J. and Lloyd, J. (2009). Co-limitation of photosynthetic capacity by nitrogen and phosphorus along a precipitation gradient in West Africa. *Plant, Cell and Environment*. Accepted.

15. **Ofori, D.A.**, Peprah, T., Henneh, S., Von Berg, J.B., Tchoundjeu, Z., Jamnadass, R. and Simons, A.J., (2008). Utility of grafting in tree domestication programme with special reference to *Allanblackia parviflora* A. Chev., *Ghana Journal of Forestry* 23&24, 42-48
16. **Obiri, B.D.**, Marfo, E., Nutakor, E., Cobbinah J.R. and Treue, T. (2009). Do forests contribute to rural livelihoods in Ghana? Draft paper for Forest Policy and Economics journal
17. **Ofori, J.**, Brentuo, B., Mensah, M., Mohammed, A.I., and Boamah-Tawiah, R. (2009a). Properties of 10 Ghanaian high density Lesser-Used-Species of potential importance to bridge construction – Part 1: Green Moisture Content, Basic Density and Shrinkage Characteristics [*Ghana Journal of Forestry* - Vol. 25 & 26 -In Press].
18. **Ofori, J.**, Mohammed, A.I., Brentuo, B., Mensah, M., and Boamah-Tawiah, R. (2009b) Properties of 10 Ghanaian high density Lesser-Used-Species of potential importance to bridge construction – Part 2: Mechanical strength. [*Ghana Journal of Forestry* - Vol. 25 & 26 - In Press].
19. **Peprah, T.**, Kyereh, B., Owusu, K.A. & Adu-Bredu, S. (2009). Drought tolerance of *Garcinia kola* and *garcinia afzelii* at the seedling stage. *Ghana Journal of Forestry (In Press)*
20. **Peprah, T.**, Ofori, D.A., Siaw, D.E.K.A., Addo-Danso, S.D., Cobbinah, J.R., Simons, A.J. and Jamnadass, R. (2009). Reproductive biology and characterization of *Allanblackia parviflora* A. Chev. in Ghana. *Genetic Resources and Crop Evolution* 56(7): 1037-1044
21. **Roux, J.** and Apetorgbor, M.M. (2009). First Report of *Chrysoporthe cubensis* from *Eucalyptus* in Ghana. *New Disease Reports* 20

REFEREED PAPERS (IN REVIEW)

1. **Anglaaere, L.C.N.**, McDonald, M.A., Sinclair, F.L. and Cobbinah, J.R. Competitive potential of some native forest tree species planted as shade for cocoa in Ghana. *Agriculture, Ecosystem and Environment (in Review)*.
2. **Anglaaere, L.C.N.**, McDonald, M.A., Sinclair, F.L. and Cobbinah, J.R. Tree diversity on cocoa farms and different land use systems in the Atwima district of Ghana. *Agroforestry Systems (in Review)*.
3. **Anglaaere, L.C.N.**, McDonald, M.A., Sinclair, F.L. and Cobbinah, J.R. Survival and early growth performance of some native forest tree species planted as shade for cocoa in Ghana *Forest Ecology and Management (in Review)*

4. **Anglaere, L.C.N.**, McDonald, M.A., Sinclair, F.L. and Cobbinah, J.R. Domestication of an indigenous tropical forest tree: Improving the germination of *Tetrapleura tetraptera* (Schum & Thonn.) Taub for the rehabilitation of degraded cocoa lands in Ghana. *Agroforestry Systems* (in review).
5. **Ofori, D.A.**, Peprah, T., Henneh, S., Von Berg, J.B., Simons, A.J., and Jamnadass, R. Utility of grafting in tree domestication programme with special reference to *Allanblackia parviflora* A. Chev. Ghana Journal of Forestry (in review).
6. **Ofori, J.**, Foli, E.G., Mohammed, A.I., Brentuo, B., & Mensah, M. (2010). Mechanical Strength Properties of *Broussonetia papyrifera* (Linn.) L'Hert. Ex Vent. from Afram Headwaters Forest Reserve [Draft]
7. **Ofori, D.A.**, Peprah, T., Cobbinah, J.R; Atchwerebour, H.A., Asuming, F., Osabutey, F., Tchoundjeu, Z., Jamnadass, R. and Simons A.J. (In Review). Germination of *Allanblackia parviflora* seeds and seedling management. (Submitted to New Forest)
8. **Owusu, F.W.** & Ayarkwa, J. (2009). Milling characteristics of some Ghanaian timber species for the production of wooden dowels for the furniture industry. [Submitted - JUST Journal of Forestry].
9. **Owusu, F.W.**, Ayarkwa, J. & Frimpong-Mensah, K. (2009). The sanding properties of seven Ghanaian lesser-used timber species [Submitted - Ghana Journal of Forestry].
10. **Owusu, F.W.**, Ayarkwa, J. (2009). Some machining characteristics of *Khaya senegalensis* and *Anogeisus leiocarpus*. [Submitted - Ghana Journal of Forestry].
11. **Owusu, F.W.**, Appiah, J.K., Damnyag, L. & Blay, D. (2009). Comparative review of recovery efficiencies of some milling techniques in Ghana. A case study of illegal chainsaw milling in Ghana. EU-project "Developing alternatives to illegal chainsaw milling through multi-stakeholder dialogue Ghana and Guyana project. [Submitted-Ghana Journal of Forestry]
12. **Peprah, T.**, Boateng, K.,Owusu, Appiah, K. and Adu Bredu, S. (2009). Drought tolerance of *Garcinia kola* and *Garcinia afzelii* at the seedling stage. Ghana Journal of Forestry. (Accepted for publication)
13. **Peprah T.**, Ofori, D.A., Siaw, D.E.K.A, Oduro, K.A., Cobbinah, J.R, Tchoundjeu, Z., Jamnadass, R. and Simons, A.J. (In Review). Conservation and use of genetic resources of *Allanblackia parviflora* A. Chev. in Ghana. (Submitted to New Forest)
14. **Ramni, J.**¹, Dawson, I.K., Anegbeh, P., Asaah, E, Atangana, A., Cordeiro, C.H., Hendrickx, S., Henneh, C., Kadu, A.C. Kattah, C., Misbah, M., Muchugi, A., Munjuga, M., Mwaura, L., Ndangalasi, H.J., Sirito Njau, C., Nyame, S.K., Ofori, D.A., Peprah, T., Russell, J., Rutatina, F., Sawe, C., Schmidt, L., Tchoundjeu, Z. & Simons, T. (2009).

Allanblackia, a new tree crop in Africa for the global food industry: market development, smallholder cultivation and biodiversity management. *Forest, Trees and Livelihoods (in Review)*

WORKSHOP AND CONFERENCE PAPERS

1. **Adu-Bredu, S.** (2009). Carbon stock under different land-use systems in some sites in Ghana. Workshop on *Building a Carbon Map of Ghana*. 2nd December, 2009, Sunlodge Hotel, Tesano, Accra.
2. **Adu-Bredu, S.** (2009). REDD+ Readiness Stage in Ghana (Methodology Component). Seminar on *Carbon Accounting*. 15th December, 2009, ITC, Enschede, The Netherlands.
3. **Adu-Bredu, S.**, Abekoe, M.K., Tachie-Obeng, E. & Tschakert, P. (2009). Carbon stock under four land-use systems in three varied ecological zones in Ghana. *Proceedings of the Open Science Conference on "Africa and Carbon Cycle: the CarboAfrica project"* Accra, (In Press)
4. **Agyeman, V.K.**, Blay, D., Dwomoh, F.K. and Damnyag, L. (2009). Rehabilitation of degraded tropical forest lands in Africa: the case study of Ghana. Paper presented at side events of the XIII World Forestry Congress (WFC). Buenos Aires, Argentina 18-25th October 2009.
5. **Apetorgbor, M.M.** and Bosu, P.P. (2009). Current status of invasive species in Ghana. 2nd Executive Committee Workshop on Forest Invasive Species Network for Africa (FISNA), Kumasi, 22nd-26th February, 2009.
6. **Apetorgbor, M.M.** and Apetorgbor, A.K. (2009). Status of edible and medicinal mushrooms in Southern Ghana. 2nd African Conference on Edible and Medicinal Mushrooms (ACEMM), Accra, 24th-28th March, 2009.
7. **Apetorgbor, M.M.** and Bosu, P.P. (2009). Management of insect and disease outbreak in plantations. Training of Trainers Workshop for the Forestry Commission and Ministry of Food and Agriculture on Community based Rural Development Project (CBRDP). Organised by Rural Infrastructure Co-ordinating Unit of the CBRDP and Faculty of Forestry Resources Technology. 29th March to 3rd April, 2009. FFRT, KNUST, Sunyani Campus.
8. **Apetorgbor, M.M.** and Apetorgbor, A.K. (2009). Diversity and sustainable use of macrofungi in selected protected areas in two ecological zones of Ghana. SCBD BioNET Project Development Workshop 16th to 18th November 2009, Nairobi, Kenya.
9. **Apetorgbor, M.M.**, Bosu, P.P. and Afriyie, K.O. (2009). Changes in the frequency and intensity of fire in a dry forest ecosystem of Ghana following invasion by *Broussonetia papyrifera*. SCBD BioNET Project Development Workshop 16th to 18th November 2009, Nairobi, Kenya. Consultancy Reports

10. **Amusant N.**, Boutahar N., Derkyi, N.S.A. and Chaix, G. (2009). Development of a method to predict natural durability of teak wood by Fourier transform near-infrared spectroscopy. In: *Conference Knowledge-Based Management of Tropical Rainforests, 22-28th novembre 2009, Cayenne, Guyane française*. s.l. : s.n., 1 p.. Conference Knowledge-Based Management of Tropical Rainforests, 2009-11-22/2009-11-28, Cayenne, Guyane française
11. **Bosu, P.** and Apetorgbor, M.M. (2009). Strategies for control of *Broussonetia papyrifera*. 2nd Executive Committee Workshop on Forest Invasive Species Network for Africa (FISNA), Kumasi, 22nd-26th February, 2009.
12. **Buck, A.**, Cheteu, L.B., Cobbinah, J.R., Dwomoh, F.K., Eastaugh, C., Foahom, B., Foli, E.G., Kliene, M., Makungwa, S.D. and Utila, H.J. (2009). “Making African Forests Fit for Climate Change”: Key Messages. Presentation made at the side events of the United Nations Climate Change Conference, COP 15. Copenhagen, Denmark, 7 -18th December, 2009.
13. **Dzomeku, M.**, Apetorgbor, A.K. and Apetorgbor, M.M. (2009). Ethnobotanical studies of *Pleurotus tuber regium* in two administrative regions in Ghana. 2nd African Conference on Edible and Medicinal Mushrooms (ACEMM), Accra, 24th-28th March, 2009.
14. **Foli, E.G.** (2009). CSIR-FORIG’s experience with enrichment planting in Ghana. Invited paper presented at the FORM International Expert Consultation Workshop on Assisted Natural Regeneration. FORIG, Kumasi. 23 November 2009.
15. **Foli, E.G.** (2009). Methodological issues for the validation of the REDD+ Readiness Preparation Proposal. Invited paper presented at the National REDD+ Validation Workshop, Forestry Commission, Accra. 03 September 2009.
16. **Foli, E.G.** (2009). Status of Research on Climate Change in Ghana. Invited paper presented at the FORNESSA Networking Week Symposium. Blantyre, Malawi, 22 – 26 June 2009.
17. **Foli, E.G.** (2009). Silviculture and sustainable forest management in Ghana. Paper presented at the UK Royal Society/University of Leeds Liana Project Seminar, University of Leeds, UK., 28 September – 05 October 2009.
18. **Foli, E.G.** and Agyeman, V.K. (2009). The role of CSIR-FORIG in national development in Ghana. Paper presented at the UK Royal Society/University of Leeds Liana Project Seminar, University of Leeds, UK., 28th September – 5th October 2009.
19. **Gineste, M.1.**, Martel S., Henry M., Adu-Bredu, S. & Saint-Andre, L. (2009). Estimating the impact of selective logging on above ground carbon stocks in Bia Tano Forest Reserve. *Proceedings of the Open Science Conference on “Africa and Carbon Cycle: the Carbo-Africa project”* Accra, (*In Press*)

20. **Henry, M.**, Gineste, M., Martel, S., Asante, W.A., Adu-Bredu, S., & Saint-André, L. (2009). Impact of forest degradation caused by selective logging on carbon stocks in a wet evergreen forest of Ghana. *XIII World Forestry Congress* Buenos Aires, Argentina, 18th – 23rd October 2009.
21. **Ofori, D.A.**, Peprah, T., Cobbinah, J.R., Tchoundjeu, Z., Jamnadass, R. and Simons, A.J. (2009). Enhancement of *Allanblackia parviflora* seed germination. Poster presentation, ICRAF Science meeting, ICRAF, Nairobi, Kenya, 31st August – 2nd September 2009.
22. **Ofori, D.A.**, Peprah, T., Cobbinah, J.R., Atchwerebour, H.A., Asuming, F., Osabutey, F., Tchoundjeu, Z., Jamnadass, R. and Simons A.J. (2009). Germination of *Allanblackia parviflora* seeds and seedling management. Paper presented at a Regional workshop on local fruit tree species for nutrition, poverty alleviation and biodiversity conservation in Sub-Saharan Africa. 23rd – 26th February 2009, Splendid Hotel, Ouagadougou, Burkina Faso.
23. **Peprah, T.**, Ofori, D.A., Siaw, D.E.K.A., Oduro, K.A., Cobbinah, J.R., Tchoundjeu, Z., Jamnadass, R. and Simons, A.J. (2009). Conservation and use of genetic resources of *Allanblackia parviflora* A. Chev. in Ghana. Presentation at regional workshop on local food tree species for nutrition, poverty alleviation and biodiversity conservation in Sub-Saharan Africa. Splendid Hotel, Ouagadougou, Burkina Faso, 23rd to 26th February 2009.
24. **Obodai, M.** and Apetorgbor, M.M. (2009). An ethnobotanical study of mushroom germplasm and its uses in the Bia Biosphere Reserve of Ghana. 2nd African Conference on Edible and Medicinal Mushrooms (ACEMM), Accra, 24th-28th March, 2009

THESES

1. **Dwomoh, F. K.** (2009). Forest fire and carbon emission from burnt tropical forest: The case study of Afram Headwaters Forest Reserve, Ghana. MSc. thesis, International Institute for Geo-information Science and Earth Observation (ITC), Enschede, The Netherlands.
2. **Owusu Afriyie, K.** (2008). Forest fire incidence, damage and control measures in Ghana.

WORKSHOP/CONFERENCES ATTENDED

1. **Adu-Bredu, S.** REDD at the Copenhagen Climate Talks and Beyond – Bridging the Gap between Negotiation and Action, 16th – 18th November, 2009. Laico Regency Hotel, Nairobi, Kenya.
2. **Adu-Bredu, S.** Ghana National REDD Process Workshop. 11th - 15th May, 2009. Forestry Commission, Accra.

3. **Appiah, J.K., Owusu, F. W. & Damnyag, L.** FC/CSIR-FORIG Collaboration, Maiden Lecture, FC Headquarters, September 2009
4. **Bandoh, W.K.N.** Workshop on Biosafety Clearing House Mechanism. Organized by the Ministry of Environment, Science and Technology and UNEP, at CSIR-INSTI, Accra, April 2009.
5. **Bandoh, W.K.N.** Workshop on Biosafety Clearing House Mechanism. Organized by the Ministry of Environment, Science and Technology and Government of Belgium, at CSIR-INSTI, Accra, June 2009.
6. **Bosu, P.P.** Third Workshop of the Forest Invasive Species Network for Africa (FISNA). Kumasi, Ghana. 23 – 26th February 2009.
7. **Bosu, P.P.** Ghana AGRIS Pilot Project Stakeholders Meeting. Crystal Palm Hotel, Tesano, Accra. 8th October 2009.
8. **Bosu, P.P.** REDD-Plus Readiness Field Dialogue in Ghana. Organized by The Forest Dialogue. Busua Beach Hotel. 16-19 November 2009
9. **Bosu, P.P.** The Impact of Global Economic Downturn on Ghana's Timber Trade. Colloquium Organized jointly by CSIR-FORIG and the Forestry Commission. Forestry Commission Conference Room, Accra. 31st July 2009.
10. **Darko Obiri, B.** Tropenbos Africa regional chainsaw workshop. Accra, May 2009.
11. **Darko Obiri, B.** Expert panel discussion on policy options for chainsaw lumbering in Ghana. Lake Bosomtwi, June 2009
12. **Darko Obiri, B.** FORNESSA Networking week. Blantyre, Malawi, June 2009
13. **Dwomoh, F. K.** IUFRO-FORNESSA thematic workshop "Making African Forests Fit for Climate Change". IUFRO Headquarters, Vienna, Austria 3rd – 4th December, 2009.
14. **Dwomoh, F. K.** Stakeholder validation workshop on the ecological mapping of the Songor Ramsar site - UNESCO Man & Biosphere (MAB) National Committee. Environmental Protection Agency (EPA), Accra. 10th September 2009
15. **Dwomoh, F. K.** Stakeholder session on review of Research-Extension-Farmer Linkage Committees (RELC) Manual. CSIR-Crops Research Institute of Ghana, Kumasi. 30th – 31st July, 2009.
16. **Darko Obiri, B.** World Forestry Congress
17. **Derkyi, N.S.A.** Ghana Science Association Conference

18. **Derkyi, N.S.A.** IUFRO-SPDC Traditional knowledge workshop
19. **Derkyi, N.S.A.** Sustainable production and use of biofuels workshop
20. **Derkyi, N.S.A.** Roundtable discussion on recycling of waste into industrial products.
21. **Darko Obiri, B., Nutakor, E. and Marfo, E.** Tropical forests for Poverty alleviation: from household data to global Analysis: Ghana PEN project narrative World forest congress. 13th World Forestry Congress, Argentina 2009
22. **Foli, E.G.** ITTO REDDES Thematic Programme Advisory Committee meeting. Yokohama, Japan, 2nd -3rd April 2009.
23. **Foli, E.G.** FORNESSA Networking Week Workshop. Malawi Sun Hotel, Blantyre, Malawi. 22nd – 26th June, 2009.
24. **Foli, E.G.** Forestry Commission-Kumasi Zonal Workshop to develop a draft REDD+ strategy for Ghana. WITC, Kumasi, 9th July 2009.
25. **Foli, E.G.** FAO/FC Regional Sensitization Workshop on the Forest Instrument: A Contribution to Reducing Deforestation and Forest Degradation. WITC, Kumasi. 14th July 2009.
26. **Foli, E.G.** FC Synthesis Workshop to develop a draft REDD+ strategy for Ghana. FC Headquarters, Accra, 16th July 2009.
27. **Foli, E.G.** FC/CSIR-FORIG Colloquium on the Impact of the global economic downturn on Ghana's timber trade. Accra, 31st July 2009.
28. **Foli, E.G.** FC Validation Workshop on REDD+ Preparation Proposal (R-PP). Forestry Commission, Accra. 3rd September 2009.
29. **Foli, E.G.** National Climate Change Committee Retreat and Workshop on Ghana's Climate Change Adaptation Strategy. Royal Plaza Hotel, Koforidua. 10th – 13th September 2009.
30. **Foli, E.G.** Royal Society/University of Leeds/FORIG Liana Project Workshop. Leeds, UK. 28th September – 5th October 2009.
31. **Foli, E.G.** Tropenbos International-Ghana Workshop on the Potential impacts of VPA implementation on livelihoods of communities and timber industry in Ghana. Erata Hotel, Accra. 8th – 9th October 2009.
32. **Foli, E.G.** XIII IUFRO World Forestry Congress, Buenos-Aires, Argentina, 18th – 23rd October 2009.
33. **Foli, E.G.** ABS/IISD Workshop for Climate Change Negotiators: "REDD at the Copenhagen Climate Talks and Beyond – Bridging the Gap between Negotiation and Action", Nairobi, Kenya, 16th -18th November 2009.

34. **Foli, E.G.** IUFRO/GFEP/FORNESSA Thematic Workshop for the preparation of a Regional Policy Brief on Climate Change. Vienna, Austria, 3rd – 4th December, 2009.
35. **Nutakor, E.** Workshop to Upscale and develop CRiSTAL - tool (Community-based Risk Screening Tool-Adaptation and Livelihoods) into forest ecosystem 23rd-24th Nov. 2009, Ouagadougou Burkina Faso
36. **Nutakor, E.** Micro, Small and Medium Enterprise development and promotion start-up workshop, 24th March 2009 Kumasi.
37. **Nutakor E.** International workshop on Chainsaw Lumber Production in Ghana and Guyana, June 2009, Accra.
38. **Ofori, D. A.** Participant – ‘Understanding the implementation of the forest instrument in Ghana’, Regional sensitization workshop, Wood Industries Training Centre, Ejisu, Ashanti Region, 14th July 2009.
39. **Ofori, D.A.** Participant - Workshop on Agricultural Biodiversity Initiative for Africa (ABIA), FARA Secretariat, Accra, 4th – 5th June 2009
40. **Ofori, D. A.** Resource person – Strategic planning for propagation of *Allanblackia floribunda* in Nigeria, Port Harcourt, Nigeria 11th -15th May 2009
41. **Oteng-Amoako, A.** EU Bamboo bioenergy project inception workshop. Ethiopia
42. **Owusu, F.W.** Regional workshop on chainsaw lumber production under the project “Developing Alternatives to illegal Chainsaw Lumbering through Multi-stakeholder Dialogue in Ghana and Guyana” held at ERATA Hotel, Accra, Ghana. Organized by Tropenbos International in collaboration with Forestry Commission of Ghana and CSIR-FORIG with support from the European Union. May 25th -26th, 2010.
43. **Peprah, T.** Regional workshop on local Food Tree Species for nutrition, poverty alleviation and biodiversity conservation in sub-Saharan Africa. Splendid Hotel Ouagadougou, Burkina Faso. 23rd-26th February 2009.

TRAINING WORKSHOPS

1. **Appiah, J.K.** Training workshop on wood cluster development and management, organized by SPEED Ghana, WITC, Akyawkrom, 17th – 19th February, 2009
2. **Bosu, P.P.** Short course on Effective Leadership for Environmental Management and Conservation. Organized by Smithsonian Institute. Washington DC, 4th -14th January 2009.

3. **Foli, E.G.** University of Ghana, Legon, Training Workshop on the Global Biodiversity Information Facility. 31st August – 1st September 2009, Erata Hotel, Accra.
4. **Foli, E.G.** IUFRO-SPDC Training Workshop on “*Working Effectively at the Interface of Science and Forest Policy*” Buenos-Aires, Argentina, 16th – 17th October 2009.

TRAINING

Bandoh, W.K.N. Certificate course on Molecular Bioinformatics; College of Health Sciences, University of Ghana. November 2009.

PUBLICITY ACTIVITIES UNDERTAKEN BY STAFF IN 2009

Ofori, D.A. ‘*Allanblackia* – High Value Oil from the Rainforest’, AGFAX Radio, <http://www.allanblackia.info>

Ofori, D. A. ‘Domestication of *Allanblackia*’, Radio interview, Love FM, Kumasi, 13th March, 2009

Ofori, D. A. Radio talk show, ‘CSIR-FORIG at glance’, New Mercury, Kumasi, 11th and 18th August, 2009

Ofori, D.A. ‘Forestry Research Institute; Advances’, *The Source*, 27th July 2009, P5

APPENDIX II**SCHEDULE FOR INTERNAL COLLOQUIA FOR 2009**

In 2009, 21 individuals from CSIR-FORIG and other Institutions made presentations. The dates, speakers and topics are presented in the table below;

Date	Speaker	Title
29/01/09	Mr. George Ametsitsi	Quality Control and Standardization of Ghanaian Wood Products
29/01/09	Dr. E. Opuni-Frimpong	Towards Sustainable Timber Production in Ghana: Stage I. Improving Shoot Borer Resistance and Developing Silvicultural Systems to Maximize Mahogany Plantation Success.
19/02/09	Dr. P. Bosu	Alternative mixed plantation systems and restoration strategies for conservation and sustainable production of timber species in Ghana
19/02/09	Dr. E. Owusu-Sekyere	Conservation and utilization of medicinal plants in Ghanaian forest fringe communities
26/02/09	Ms. Gillian Allard (FAO Forest Protection & Health Officer)	Global Forest Health Issues
12/03/09	Mr. K.S. Nketiah (Programme Team Leader, Tropenbos)	CSIR-FORIG – Tropenbos Partnership
19/03/09	Mrs. S. Britwum Acquah	PROTA: Unlocking the potential of African plants
19/03/09	Dr. E. Owusu-Sekyere	Development and integrated study for control of stem dieback of <i>Ceiba pentandra</i>
02/04/09	Mr. Lawrence Damnyag	Fire Management and post-fire restoration with Collaboration of Local Communities in Ghana
02/04/09	Dr. B. D. Obiri	Tropical forests for poverty alleviation: from household data to global analysis (DANIDA)
09/04/09	Dr. S. Adu-Bredu	Relating site index of Teak to environmental variables
17/04/09	Dr. P. Bosu	Integrated management of <i>Nauclea diderichii</i> shootborer

17/04/09	Mr. Eric Nutakor	Availability, utilization and conservation of Medicinal Plants: A case study of the Sawah Farming System in Ghana
23/04/09	Mr. Agyeman Bonsu (EPA)	CSIR-FORIG's role in Climate Change in Ghana
30/04/09	Dr. D. Ofori & Dr. K.A. Adam	Ethnobotany of Medicinal Plants
30/04/09	Dr. B. Darko Obiri	Ethnobotany of Medicinal Plants
21/05/09	Mr. F.K. Dwomoh	Spatial modelling of fire-induced carbon emission from Tropical Forest using Remote Sensing and GIS
21/05/09	Mr. F. W. Owusu	Processing and utilization of trees on farmlands and logging residues through collaboration with local communities
29/05/09	Dr. Ton van der Zon (Environment and Water, Royal Netherlands Embassy, Accra)	Natural Resources and Environment Governance (NREG) Programme for Ghana
04/06/09	Mr. John Abraham (M.Sc. Student, Georg-August University, Goettingen, Germany)	Olfactory response of <i>Hypsipyla robusta</i> to the African Mahogany Species; <i>Entandrophragma</i> and <i>Khaya</i> .

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
Dep. Director-General, CSIR | Member |
| 3. | Dr. Lawrence M. Aboagye
Director, CSIR-PGRRRI | 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 – 2009/10**

	Name	Qualification	Institution
1.	Opoku-Kwarteng Christian	B.Sc. Nat. Res. Mgt. (Agroforestry)	KNUST
2.	Samuel Atusong	BBA Accounting	Christian Service Univ. College
3.	Amaning Kwarteng David	B.Sc. Nat. Res. Mgt. (Wild life & Range Mgt.)	KNUST
4.	Ms. Awura Ama Antwiwaa	B.Sc. Forest Resources Technology	FFRT Sunyani
5.	Seth Nuamah Kankam	Dip. Natural Resources Mgt.	FFRT Sunyani
6.	Felix Frimpong	B.Sc. Nat. Res. Mgt. (Agroforestry)	KNUST
7.	Isaac Arthur	B.Sc. Nat. Res. Mgt. (Agroforestry)	FRNR-KNUST
8.	Sarah Owusu Twum	HND Accounting	K-Poly
9.	Nyamekye Isaac Benedict	Dip. Nat. Res. Mgt.	FFRT Sunyani
10.	Eunice Afia Agyeiwaa	HND Accounting	K-Poly
11.	Prince Kwadwo Aduboffuor	B.Sc. Nat. Res. Mgt. (Wood Science)	KNUST
12.	Ms. Aurelia Afi Azumah	B.Sc. Biochemistry & Biotechnology	KNUST
13.	Osei Achamfour Yaw	B.Sc. Agriculture	UCC
14.	Urget Konadu Yiadom	B.Sc. Nat. Res. Mgt.	FRNR-KNUST
15.	Ernestina Osei	B.Sc. Nat. Res. Mgt. (Silviculture & For. Mgt)	FRNR-KNUST
16.	Opoku Ware Emmanuel	B.Sc. Nat. Res. Mgt.	FRNR-KNUST
17.	Oppong Barnes	B.Sc. Nat. Res. Mgt.	FRNR-KNUST
18.	Danso-Frimpong Andrews	B.Sc. Nat. Res. Mgt	FRNR-KNUST
19.	Gyedu Seth	B.Sc. Biological Science	Biological Science
20.	Asiamah Karikari Williams	B.Sc. Biological Science	Biological Science
21.	James Oppong Amponsah	B. Sc. Environmental Science	KNUST
22.	Acheampong Gabriel	B.Sc. Nat. Res. Mgt	KNUST
23.	Donyinah Mavis Kwabea Rebecca	B.Sc. Nat. Res. Mgt	KNUST
24.	Emmanuel Ato Eyeson	B.Sc. Molecular Biology & Biotechnology	UCC

