Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

The Forestry Commission, Republic of Ghana

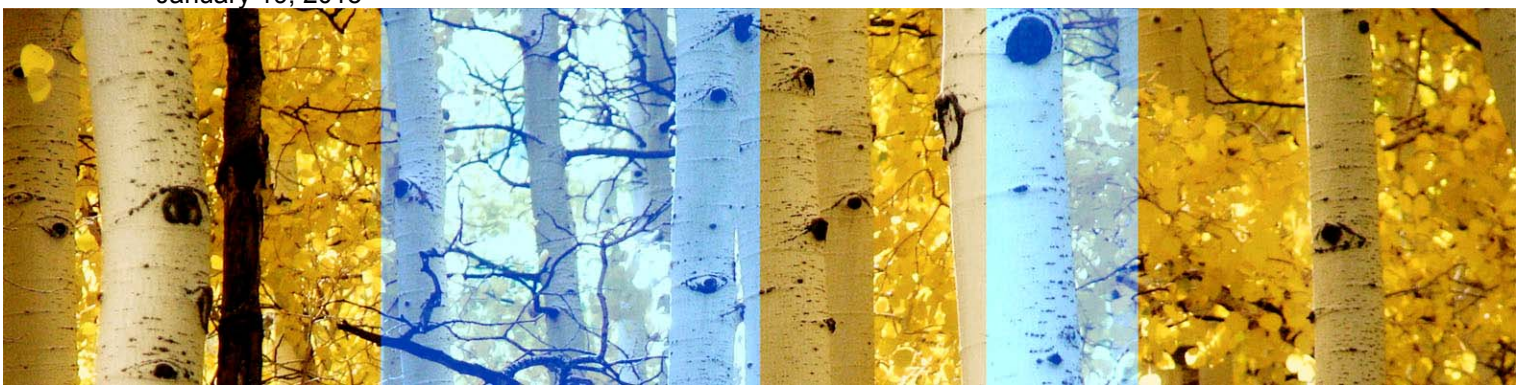
Development of Reference Emissions Levels and Measurement, Reporting and Verification System in Ghana FC/FCPF/MRV/REL/RFP/01/2013

Final Report

Indufor Oy, Finland

Helsinki, Finland
January 19, 2015

6947
ID 67005



Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict

NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Chief Executive Officer
The Forestry Commission of Ghana
Accra, Ghana

Attn: Mr Robert Bamfo,
Head of the Climate Change Unit

January 19, 2015/ab

Re: Project for: Development of Reference Emissions Levels and Measurement, Reporting and Verification (MRV) System in Ghana

Dear Mr Bamfo,

Please find attached the Final Report for the Ghana Forest MRV Project.

This final report has been revised to accommodate all the suggestions and changes identified by the Forestry Commission of Ghana.

An integral part of the final report are the 12 Standard Operating Procedures, which have been provided to you in September 2014. They are also attached as a separate volume.

Recognising the administrative requirements for processing and approval that need to be met in this very tight timing that we are all subject to, Indufor requests that the Forestry Commission check this final report and process our final payments.

We have been grateful for the inputs and guidance of the Climate Change Unit and our sub-consultants from Forest Consult and GISD, and look forward to working with the Forestry Commission again.

Best regards,

Indufor Oy

Jyrki Salmi
Managing Director

Indufor

Indufor Oy
Töölönkatu 11 A, FI-00100 Helsinki, Finland
Tel. +358 9 684 0110

Fax +358 9 135 2552
indufor@indufor.fi
www.indufor.fi

Business ID: 0410756-9
VAT number: FI04107569
Domicile: Helsinki

TABLE OF CONTENTS

LIST OF APPENDICES

STANDARD OPERATING PROCEDURES - AS A SEPARATE VOLUME

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

AAC	Annual Allowable Cut
AfDB	African Development Bank
AWTS	Automated Wood Tracking System
BAU	Business as usual
BUR	Biennal Update Report
CBDRRC	Common but differentiated responsibilities and respective capabilities
CCU	Climate Change Unit
CDM	Clean Development Mechanism
CERSGIS	Center for Remote Sensing & Geographic Information Services, University of Ghana
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
COCOBOD	Ghana Cocoa Board
COP	Conference of Parties
CSLP	Costal Sustainable Landscapes Project
CSO	Civil Society Organisations
DFID	Depatment for Internatinal Development
DS	Dry Semi-deciduous
EC	Energy Commission
ELE	Extracted Log Emissions
ENRAC	Environment and Natural Resources Advisory Council
EPA	Environmental Protection Agency
EPP	Expanded Plantation Program
ER	Emission Reduction
ERP	Emission Reduction Program
ERPA	Emission Reduction Payment Agreement
ER-PIN	Emission Reductions Program Idea Note
FAO	Food and Agriculture Organization of the United Nations
FC	Forestry Commission
FCG	Forestry Commission of Ghana
FCPF	Forest Carbon Partnership Facility
FIB	Financial Incentives Benchmark
FIP	Forest Investment Plan
FLEGT	Forest Law Enforcement, Governance and Trade
FORIG	Forestry Research Institute of Ghana
FPP	Forest Preservation Programme
FR	Forest reserves
FREL	Forest reference emission levels
FRL	Forest reference levels
FSD	Forest Service Division
GDP	Gross domestic product
GEF	Global Environment Facility
GFOI	Global Forest Observation Initiative
GFOI-MGD	Global Forest Observation Initiative Methods and Guidance Document
GHG	greenhouse gas
GIS	Geographic Information System
GISD	Geo-Info Systems Developers
GOFC-GOLD	Global Observation of Forest Cover and Land Dynamics
GoG	The Government of Ghana
GPDP	Government Plantation Development Program
GPS	Global Positioning System
ha	Hectare
HFZ	High Forest Zone

ICT	Information and communication technologies
IDA-WB	International Development Association
IFC	International Finance Corporation
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
JICA	Japanese International Co-operation Agency
KC	Key categories
KNUST	Kwame Nkrumah University of Science and Technology
LAS	Legality Assurance System
LC	Lands Commission
LiDAR	Light detection and ranging
LMS	Legal Management Scheme
LPG	Liquefied Petroleum Gas
LULUCF	Land Use, Land Use Change and Forestry
M&E	Monitoring and Evaluation
m^3	Cubic metre
MAT	Mean annual temperature
MC	Minerals Commission
ME	Moist Evergreen
MEST	Ministry of Environment, Science and Technology
MESTI	Ministry of Environment, Science, Technology and Innovations
MGD	Methods and Guidance Document
MLNR	Ministry of Lands and Natural Resources
MMR	Measurement, Monitoring and Reporting
MNF	Modified natural forest
MOFEP	Minitstry of Finance and Economic Planning
MOU	Memorandum of understanding
MRV	Monitoring Reporting and Verification
MSNW	Moist Semi-deciduous North West
MSSE	Moist Semi-deciduous South East
N_2O	Dinitrogen monoxide
NC2	Second National Communication
NC3	Third National Communication
NCCC	National Climate Change Committee
NDPC	Ntaional Development Planning Commission
NFF	National Forest Forum
NFI	National forest inventories
NFMS	National Forest Monitoring Systems
NFPDP	National Forest Plantation Development Program
NGO	Non-governmental organization
NLBI	Non-Legal Binding Instrument
NMHC	Non-methane hydrocarbon
NORAD	Norway's Agency for Development Cooperation
NOx	Mono-nitrogen oxides
NREG	Natural Resources and Environmental Governance Programme
NRS	National REDD+ Secretariat
NRWG	National REDD+ Working Group
NTFP	Non-timber forest product(s)
PASCO	PASCO Corporation
PDU	Primary Designated Use
PF	Primary forest
PLMCC	Plantation Log Measurement and Conveyance Certificate
PPC	Plantation Production Certificate
PSP	permanent sample plots

QA/QC	Quality asurance and quality control
QC	Quality Control
REDD	Reducing emissions from deforestation and forest degradation
REDD+	Reducing emissions from deforestation and forest degradation and foster conservation, sustainable management of forests, and enhancement of forest carbon stocks
REL	Reference Emissions Level
RL	Reference Level
RMSC	Resource Management Support Centre
RNG	Royal Netherland Government
R-PP	Readiness Preparation Proposal
RS	remote sensing
SESA	Strategic Environmental and Social Assessment
SNC	Second National Communication
SOP	Stardard Operating Procedure
SRI	Soil Reseach Institute
TCC+	Technical Coordination Committee
tCO_2-e	Tonnes of CO_2 equivalent
TIDD	Timber Industry Development Division
TIF	Tree Information Form
TOR	Terms of Reference
TVD	Timber Validation Department
TZ	Transitional Zone
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	US Agency for International Development
USD	United States Dollar
USFS	The US Forest Service
VCS	Voluntary Carbon Standard
VPA	Voluntary Partnership Agreement
WE	Wet Evergreen

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

PREFACE

This report was prepared at the request of the Forestry Commission of Ghana (the Client) by Indufor Oy and its partners Forest Consult and Geo-Info Systems Developers (GISD). The intended users of this study/report are the Client, and the Client's auditors and accountants. No other third party shall have any right to use or rely upon the report for any purpose.

The project involves the development of the methods and approaches for reference emissions levels and measurement, reporting and verification system for forest carbon stocks in Ghana. This report covers the implementation of the project Development of the Forest Monitoring Reporting and Verification (MRV) system for Ghana and contains the deliverables and outputs of the project.

The Project Planning and Inception of the Forest MRV for Ghana commenced on Monday 25th November 2013 with the meeting of the Project Team and the Project Oversight Committee of the Forestry Commission. The project team has since then conducted workshops, meetings and consultations while working on the elements of the project. We have met regularly with officers of the Forestry Commission and maintained contact with the work streams of the other elements being conducted under the Readiness Preparedness Program approved under the Forest Carbon Partnership Facility, managed by the World Bank.

Please find attached the Ghana Forest MRV Draft Final Report.

This report may only be used for the purpose for which it was prepared and its use is restricted to consideration of its entire contents. The conclusions presented are subject to the assumptions and limiting conditions noted within.

We are grateful for the support of the Ghana Forestry Commission and its partners and stakeholders on the Ghana Forest MRV.

Indufor Oy

Dr Peter F Moore

Team Leader

Contact:

Anni Blåsten

Indufor Oy
Töölönkatu 11A, 3rd Floor
FI-00100 Helsinki
FINLAND

Tel. +358 9 684 0110
Fax +358 9 135 2552

indufor@indufor.fi
www.indufor.fi

EXECUTIVE SUMMARY

The Ghana Forest Measurement, Reporting and Verification (MRV) system project sought to create a firm basis for embarking on activities to establish reference emission levels, emission factors, and develop a framework for measuring, reporting and verifying emissions reductions resulting from REDD+[1] activities. It is currently neither practical nor efficient to measure and report the stocks and changes for the whole terrestrial carbon reservoir with the level of detail and certainty to address all drivers and processes that have a carbon impact on the land. It is therefore expected that the REDD+ readiness activities in Ghana would be phased in a manner which builds incrementally on the level of detail by testing carbon measurement, accounting and MRV procedures, prior to the full implementation of REDD+.

Ghana's land area is 24 million hectares. The natural landscape comprises four major ecological zones (of nine zones in total) with tropical moist forest in the south and south west (the high forest zone); transitional zone in the middle belt between north and south; savannah woodlands in the north; and the Accra coastal plain. The greatest above-ground carbon stores are in the high forest zone (HFZ).

Despite the heavy historical dependence of the country on its forests, their exploitation is increasingly becoming unsustainable. The extent of deforestation and forest degradation is a matter of national concern, with major implications for national income and employment as well as environmental integrity and services, and for social welfare. The major driving forces are unsustainable logging, unsustainable farming, annual bushfires, surface mining and infrastructural development. Underlying these driving forces are forest policy challenges, population growth, weak institutional coordination, and lack of stakeholder participation in forest management.

Objective

The main objective of the assignment has been to support Ghana in the development of REDD+ reference levels and systems for Monitoring, Reporting and Verification (MRV) of REDD+ impact using suitable approaches based on careful analyses of forest inventory, remote sensing applications and other monitoring capacities and historical data, and thereby strengthen national capacities.

Terms of Reference

The Ghana Forest MRV project undertook the following tasks in close consultation with the national REDD+ Secretariat and key national and international stakeholders:

1. Review the existing national land use and land cover classification scheme, the accuracy of existing land-use assessments, and of carbon stock and inventory data;
2. Develop reference levels for emissions associated with the key drivers of deforestation and forest degradation; the methods and approaches follow established international protocols;
3. Develop methods and approaches for establishing a national MRV; following good international practice and established techniques; and
4. Develop a detailed plan to establish sustained MRV capacities within Ghana.

The proposal and the approved work plan were based on the Scope of Services in the TOR that went into more detail and were to:

1. Review the existing national land use and land cover classification scheme and the accuracy of existing land-use assessments, and of carbon stock and inventory data;

[1] According to UNFCCC Decision 1/CP.16, paragraph 70 REDD+ encompasses the following activities: a) Reducing emissions from deforestation; b) Reducing emissions from forest degradation; c) Conservation of forest carbon stocks; d) Sustainable management of forests; e) Enhancement of forest carbon stocks.

2. Develop methods and approaches following established international protocols for establishing reference levels associated with the key drivers of deforestation and forest degradation;
3. Develop methods and approaches for establishing a national MRV; following good international practice and established techniques;
4. A detailed plan to establish sustained MRV capabilities within Ghana.

These tasks were undertaken using the existing resources in Ghana, including the human skills and capacities developed in earlier projects such as the Forest Preservation Project (FPP). That project also provided sufficient data to prepare a worked example of the quantification of GHG emissions for deforestation presented in section 9.

Forest MRV System Context and Requirements

The main government agencies responsible for forest land management in Ghana are the Ministry of Lands and Natural Resources (MLNR) and the Forestry Commission of Ghana (FCG). In line with the above framework, the FCG is mandated to manage, develop and regulate the utilization of the nation's forest and wildlife resources, and to co-ordinate related policies. To achieve this mandate, the FCG together with its stakeholders; such as the Environmental Protection Agency (EPA) and the Ministry of Environment, Science, Technology and Innovations (MESTI); have developed Forest and Wildlife Management Plans, procedures and systems that give the overall direction on how to manage the nation's forest and wildlife resources.

The International Panel on Climate Change (IPCC) Good Practice Guidance (Penman et al., 2003) is a starting point for the development and implementation of MRVs under the auspices of REDD+. Additional guidance is provided by the Global Forest Observation Initiative (GFOI) Methods and Guidance Document (MGD) as well as the GOFC-GOLD Source book (Global Observation of Forest Cover and Land Dynamics, 2012). The IPCC guidance and MGD focuses on methods for obtaining estimates of activity data and emissions factors. The selection of the most appropriate methodology and approach to use in the development of Ghana's forest reference emission level (FREL) took into consideration the following:

1. UNFCCC guidelines and modalities, specifically decisions adopted in 12/CP.17 and 13/CP.19
2. Consistency with the Forest Carbon Partnership Facility (FCPF) Requirements
3. Available activity data and emissions factors within Ghana
4. State of forest transition and available information on drivers of deforestation and forest degradation.

Additionally in the near future the UNFCCC secretariat will prepare a synthesis report on the technical assessment process of countries Forest Reference Emission Levels (FRELs) which will be made public. The technical assessment will cover data quality, methodologies, and procedures used for developing FRELs.

In the design of Ghana's MRV system all of these elements have been taken into consideration to develop a system that is consistent with the IPCC good practice guidance. The design is also flexible in that it recognizes previous capacity building work and existing institutional infrastructure already in place within Ghana. The design also allows the stepwise progression to a more comprehensive multipurpose land based monitoring system should Ghana wish to extend its reporting to all land uses.

Forest MRV System Characteristics

Ghana's MRV system has been designed to be national in extent while allowing for nested project and program reporting. This design enables consistency between national and international reporting. The system has been designed to monitor and report on spatial and temporal changes of Ghana's forest resources as well as assessing the dynamics of land use change.

It is estimated from canopy cover analysis previously prepared (2010) that approximately 3.1 million hectares or 67% of the forest land is subject to gradual carbon stock loss. This is consistent with the current understanding of drivers of deforestation and forest degradation in Ghana. It should be noted that in the development of deforestation and forest degradation estimates, limitations in the existing land cover change maps were identified and emissions from degradation have not yet been quantified due to data limitations.. It is recommended that the skills and capacity gained from the FPP process be applied in the reclassification of satellite imagery for a time series that corresponds to the FCPF requirements. This would mean at a minimum that the analyses of 2000 and 2010 should be redone and another year between 2000 and 2010 analysed.

The monitoring of emissions and removals requires that ongoing efforts be put in place. The UNFCCC reporting requirements are yet to be formalized but will commence in 2020 and continue for some decades after that, and possibly indefinitely, with reporting every two years. This means within Ghana, once the Standard Operating Procedures (SOPs) are being implemented and the institutional arrangements are in place then the collection of the relevant data on changes in carbon stocks and enhancement in carbon stocks has to become routine. These routine processes must become part of normal business for the relevant institution with the appropriate mandate. Each SOP needs to be considered in terms of its implications on district and other management and institutional reporting with perhaps reporting to be enhanced and modified to meet the requirements of the Forest MRV.

The elements that will have to be collected and reported on routinely include:

- Use of remote sensing to monitor vegetation trends; perhaps apply medium resolution for detection and then higher resolution for confirming and estimating.
- Routine collection of data/information to a standard consistent with the SOPs relating to land management such as logging, fires, encroachment, mining, fuel wood collection, plantation establishment etc.
- Collation and analysis of that data for the purpose of GHG estimation according to the SOPs.
- District reporting monthly according to the standards and requirements for Forest MRV. This information to be included in their routine operational monitoring with the report collated and submitted quarterly by the Region.
- The re-measurement of PSP and potentially FPP plots and incorporation of the changes measured.

For some data needs there is no system in place for data collection. In these cases the SOP will need to be developed, according to standards and with the appropriate institutions involved.

National land use and land cover classification scheme

Standard Operating Procedure SOP 004 Stratification of Lands - applies to the wall-to-wall classification of all lands within Ghana and is the recommended classification. It relates to IPCC methods that require forest classification and associated stratification and the area of each stratum. The suggested basic stratification is into primary forest (PF), modified natural forest (MNF) and planted forest (PF).

The stratification of forest in Ghana also acknowledges legal management regimes and distribution of the forest resources across the ecological zonation. It also takes into consideration the level of canopy closure of the forest which reflects on the condition of the forest and carbon content of the various carbon pools across the ecological zones. Plantations established to restore the forest cover of Ghana are also delineated.

The steps described in this standard operating procedure follow the general principles outlined in the FPP report and, the national definition of forest land which falls within the UNFCCC definitional thresholds. This SOP meets the good practice approaches set by the IPCC 2006 guidelines and also takes into account the diversity of the forest resource within and across the

ecological landscape of Ghana. Develop methods and approaches for establishing a national MRV; following good international practice and established techniques.

Ghana Forest MRV

The design of the Ghana's Forest MRV system has created the following operational documents (standard operating procedures - SOPs) corresponding broadly to generate activity data and emissions factors for key activities and pools as required by IPCC good practice guidelines:

- 001 Estimating annual forest emissions and removals
- 002 Key category analysis
- 003 Acquisition of remote sensing data and generation of activity data
- 004 Stratification of lands
- 005 Field inventory protocol
- 006 Estimation of above- and belowground biomass and deadwood
- 007 Estimation of emissions from soil organic carbon
- 008 Estimation of emissions and removals from timber harvest
- 009 Estimation of emissions from extraction of wood for fuel
- 010 Estimation of emissions from fire
- 011 Estimating national and sub-national reference emission level
- 012 Combining uncertainty
- 011 Estimating national and sub-national reference emission level
- 012 Combining uncertainty

Ghana should reconsider the application of Tier 3 approaches as the Tier 2 system designed within this document matures and repeated measurements and modelling of key carbon stock changes through time become available.

Quantification of GHG Emissions – Methods and approaches for establishing forest reference levels

A worked example of how to prepare an estimate of Ghana's reference level has been developed using the FPP data including how to establish the ecological zone RELs. This provides an indication of what can be done, with the existing data, with the improvements needed for an improved REL identified. The figures are a preliminary indication and as noted in the final report a "worked example". The estimates provided should be considered preliminary and subject to change once key data gaps and limitations in existing wall-to-wall mapping identified during the MRV design phase have been filled and rectified.

It should be clearly understood that this is the change in emissions estimated from inadequate data as a "worked example" of HOW to calculate the REL. The change estimated is also not the "reduction" in emissions. Any reduction in emissions will be as a result of interventions and actions that are taken to change the trend of emissions that are monitored, reported and verified by the national system to international standards. The majority of the data utilized was generated through the FPP which ended in 2011 and prior to the finalization of guidelines from the UNFCCC as well as the World Bank FCPF to which Ghana must also adhere. As a result, there are some data gaps that currently present some limitations to generating estimates that will meet all the requirements of a technical assessment of a FREL/FRL. However the data that is available is useful and valuable as it:

- demonstrates there is capacity to develop and analyses such data within Ghana
- demonstrates that Ghana has data sets that will contribute to achieving Approach 3 / Tier 2 accounting once data gaps have been filled.

Priorities for collecting data to complete the reporting of emissions are:

- Increase temporal resolution (time series) to include (at a minimum) the years 2013 OR 2014 and 2003, 2005 or 2004 for the development of the FREL

- Estimating area of plantations
- Compiling and collecting data sets for forest degradation and reforestation as outlined in the SOPs.

Estimation Approach

Ghana's first attempt at developing a FREL/FRL has been designed and documented to be compliant with UNFCCC and IPCC approaches and procedures. The approaches and procedures developed are documented in a number of Standard Operating Procedures (SOPs) referred to in Section 7.2 of this report and provided as Annexes to this report. The methods presented in these SOPs were developed based on available national specific data from a combination of remote sensing and ground-based forest carbon inventory sources as required by the UNFCCC.

The majority of this national specific data was generated through the Forest Preservation Project (FPP) which ended in 2011 and prior to the finalisation of guidelines from the UNFCCC as well as the World Bank FCPF to which Ghana must also adhere.

- For each deforested polygon, the associated CO_2-e emission is estimated as the product of its area and the associated change in carbon stock of the above and below ground biomass, deadwood and soil organic carbon affected by deforestation within each ecozone. Subsequently for any year, the total emission from gross deforestation, *CDefor* is estimated using the appropriate equation as set out in the SOP.
- The average annual rate of change in deforestation is determined by taking the total area deforested between the reference period start and end data and dividing the rate by the years duration of the time period in accordance with the relevant equation.
- Ghana's FREL has a reference period start date of 2000 and the end date 2010 therefore the historical reference period is 10 years. Refer to SOP 011 for a step by step description of the calculation approach for the FREL. The approach also draws on procedures described in detail in SOP 003 and SOP 004.

Geographical Scope of the FREL

Ghana has taken a **national** approach to developing its FREL/FRL. The National FREL is developed using a stratified approach to recognize broad ecozones in Ghana and enable ER Programs to be 'nested' within the National REL. The approach taken[2] calculated the national FREL as the sum of the FREL constructed for each of the nine (9) ecozones identified in Ghana. This will allow Ghana to assess and evaluate the effect of greenhouse gas reduction policies and measures developed at the ecozone level.

Scope of Activities Included in the FREL - Deforestation and Forest Degradation

Both deforestation and forest degradation are significant activities driving emissions from the forestry sector in Ghana and therefore approaches and procedures for measuring and reporting emissions from both of these activities are included in the design and documentation of the FREL.

Using the FPP data Ghana has been able to develop a preliminary national level estimate of emissions related to **deforestation**. It is recognised that emissions from other REDD+ activities, such as forest degradation, are likely to be a significant source of greenhouse gas emissions in Ghana and therefore according to the UNFCCC guidelines, emissions from forest degradation should be included in the FREL/FRL. The MRV SOPs[3] detail the approach to measuring/estimating emissions from other REDD+ activities including forest degradation and

[2] As described in standard operating procedure 011 Estimating National and Sub-National Reference Emission Level.

[3] Specifically SOP 008 and SOP 009.

also identify priorities for data collection to enable future reporting of emissions from currently excluded activities. A lack of data sources prevent testing fully the suggested approaches to estimate emissions from other REDD+ activities in the FREL/FRL.

Limitations: Estimates provided are developed on activity data and ground inventory data generated/collected from the FPP. During the design phase of Ghana's MRV system the activity data has been found to have limitations in detecting forest canopy cover change. This has led to an inability to generate estimates for forest degradation and questions around the accuracy of the activity data for deforestation. Additional remote sensing classification work is required before degradation estimates can be developed for reporting.

Information Used

Activity Data

Activity data for estimating annual gross emissions from deforestation in Ghana derives from the analysis of remotely sensed data from sensors of adequate spatial resolution (mostly from Landsat and ALOS satellites).

The FPP generated three (3) land cover maps (1990/2000/2010) from which two land cover change data sets were generated; 1990-2000 and 2000-2010. The area of the annual gross deforestation by forest type (in hectares) is referred to as activity data.

Carbon Stock and Emissions Factors

This activity data is then combined by emission factors that, consists of the carbon stock associated with forest types in Ghana, provided in tonnes of carbon per unit area (tC ha-1). The carbon stock change associated with deforestation was estimated using look up tables generated from allometric equations developed for each ecozone of Ghana. These National values for above and below ground biomass as well as deadwood and soil organic carbon were also developed as part of the FPP (PASCO, 2013).

Reference Period

The end-date for the reference period is 2010 and represents the most recent date prior to 2013 for which forest-cover data is available to enable IPCC Approach 3. The start-date for the Reference Period is 2000 which is 10 years before the end-date and not more than 15 years before the end-date.

> *Limitations: The wall-to–wall land cover classification is available only for 2 time periods. At least 3 time periods should be used to develop historical deforestation trends and rates to develop the FREL. Additional years of remote sensing classifications are required to meet World Bank FCPF reference period requirements and improve the estimates of historical deforestation and forest degradation.*

Forest Definition Applied

The definition of forest used by Ghana in the construction of the FREL is:

> *"A piece of land with a minimum area of 1 hectare, with a minimum tree crown cover of 15%, [or] with existing tree species having the potential of attaining more [than] 15% crown cover, with trees which have the potential or have reached a minimum height of 5.0 meters at maturity in situ".*

This is the same definition used by Ghana in its all reporting of forestlands to the UNFCCC.

Forest Stratification Applied

Forest stratification was conducted according to the strata that is outlined in SOP 004 Stratification of Lands. This strata meets the IPCC good practice guidance stratification recommendations.

Table 1.1 Stratification of Forest Lands in Ghana

Ecozone(i)	Allometric / Carbon Stock Allocation (j)	Landuse(k)	FAO/FRA(l)	Forest Management(m)	Forest Condition(n)
1 Wet Evergreen	Wet zone	1 Forestland	1 Primary Forest	1 Protection	1 Closed Canopy
2 Moist Evergreen	Wet Zone	2 Cropland	2 Modified Natural Forest	2 On reserve forest	2 Open Canopy
3 Upland Evergreen	Moist Zone	3 Grassland	3 Planted Forest	3 Off reserve forest	
4 Moist Deciduous (NW)	Moist Zone	4 Wetland			
5 Moist Deciduous (SE)	Moist Zone	5 Settlement			
6 Semi Deciduous (fire zone)	Dry Zone	6 Other land			
7 Semi Deciduous (inner zone)	Dry Zone				
8 Southern Marginal	Dry Zone				
9 Savannah	Dry Zone				

Note: Greyed strata cannot yet be delineated due to data limitations

Carbon Pools and Gases Included

For deforestation activities calculations were conducted and a key category analysis completed to identify which pools should be included in the FREL (refer to SOP002 for the procedures used to conduct the key category analysis). According to the criteria, if a pool contributes >25-30% to the category then it is considered key. Key categories are the minimum that should be included. Non-key categories may be reported if a country decides to do so.

The analysis showed that the pools of Soil Organic Carbon, Aboveground Biomass and Deadwood should be included in the inventory as their individual contribution to the total emissions is >25%. Additionally the Belowground Biomass pool is included as it makes up the 95% cumulative total of emissions and Ghana has national specific data for this pool which is estimated from aboveground biomass measurements used as a proxy. Emissions from litter and non-tree biomass are excluded as they are insignificant to the overall inventory.

Historical Emissions

The FREL was developed using a simple historic average approach over the 10 years of available data. The annual average rate of deforestation was established simply by determining the total deforestation between two points in time (i.e. from wall-to-wall land cover data from the years 2000 and 2010) and then dividing the total area deforested by the number of years between the two points in time (i.e. 10 years) to get an annual area deforested.

The average simple historic rate of deforestation between 2000–2010 was estimated to be 2.0% this is higher than the average annual rate for both Central and Western Africa which stands at 0.6 % (FAO, 2006; FAO, 2010). The activity data generated for deforested between 2000–2010 by ecozone is presented in Table 1.2.

Table 1.2 Deforestation Activity Data 2000-2010

Ecozone	Area of forest in 2000 (ha)	Area of Deforestation (ha)		
	Total	Total	Annual	Annual Loss, %
Wet Evergreen	702,941	147,057	14,706	2.1%
Moist Evergreen	1,714,232	431,952	43,195	2.5%
Upland Evergreen	59,441	7,345	734	1.2%
Moist Deciduous NW	1,318,956	190,305	19,030	1.4%
Moist Deciduous SE	1,482,074	244,474	24,447	1.6%
Dry Semi Deciduous (fire)	638,513	186,850	18,685	2.9%
Dry Semi Deciduous (inner)	538,717	115,432	11,543	2.1%
Southern Marginal	92,215	48,464	4,846	5.3%
Savannah	2,570,823	460,247	46,025	1.8%
Total	**9,117,913**	**1,832,126**	**183,213**	**2.0%**

Limitations: The trend of deforestation was not able to be assessed due to a lack of additional years of wall-to-wall activity data between 2000–2010. Wall-to-wall land cover change detection should be conducted for at least one additional year between 2000–2010 and preferably another year closer to 2013 to meet the FCPF methodological guidelines.

The annual emissions profile was generated according to the MRV design standard operating procedures provided as separate Annexes to this report. The FREL is presented in Table 1.3 as both sub-national estimates (ecozone row) and national estimates (total row). As required by UNFCCC guidelines the estimates are presented in units of t CO_2-e.

This constitutes a preliminary working example of how an estimate would be calculated. The "reduction" in emissions that may attract payments will be as a result of interventions and actions that are taken to change the trend of emissions that are monitored, reported and verified by the national system to international standards.

Table 1.3 Forest reference emission level (deforestation only) reported at sub-national FREL (ecozone) and National FREL (total) level

Ecozone	Total Emissions over reference period (t CO_2-e)	Forest Reference Emission Level as average annual emissions (t CO_2-e / yr)
Wet Evergreen	-10,030,601	-1,003,060
Moist Evergreen	-20,000,917	-2,000,092
Upland Evergreen	-363,915	-36,392
Moist Deciduous NW	-5,990,629	-599,063
Moist Deciduous SE	-10,635,075	-1,063,507
Dry Semi Deciduous (fire)	-6,720,080	-672,008
Dry Semi Deciduous (inner)	-4,680,185	-468,018
Southern Marginal	-2,049,259	-204,926
Savannah	-14,131,347	-1,413,135
Total	**-74,602,008**	**-7,460,201**

A detailed plan to establish sustained MRV capabilities within Ghana.

Institutional Analysis

From the analysis carried out of the institutions, the main actors for the Forest MRV system are unsurprisingly from the relevant government agencies and related research and academic institutions. Based on these institutional arrangements the roles for the Forest MRV can be attributed as set out below. The actors involved directly in the Forest MRV are:

- Forestry Commission
  - The Climate Change Unit (CCU) of the FC
  - RMSC of the FC – most of the role is dictated by the sops and is technical. RMSC is responsible for the setting of standards and data collection for the FC
    - Mapping and GIS Department
    - Natural Forest Production Department (Harvested Wood Products)
    - Plantation Department
    - Environmental Conservation Department (Fire monitoring and reporting)
    - ICT Department (Data storage and handling)
  - Forest Services Division of the FC
    - District Offices (Harvested Wood Products raw data; Charcoal and fuel wood data)
    - Regional Offices (compilation; quality control and coordination).

The major 'clients' of the Forest MRV system include the EPA and the World Bank. Though vitally interested in the Forest MRV, and dependent upon it, they do not have any direct role in the operation of the system.

Managing the Forest MRV

The evolution of methods and guidance from the UNFCCC and its subsidiary bodies will continue with specific information emerging ahead of 2020. Additionally there are interpretations of the existing guidance and emerging science to consider as Ghana evolves its Forest MRV system and continuously improves it. In order to ensure appropriate revision and improvement of the SOPs and the recognition of any need to add SOPs to the existing set of guidance for Ghana, a Process and Monitoring Cycle has been framed up and is described.

The monitoring of the SOPs for the Forest MRV for Ghana is a critical task and a national responsibility with international profile and significant accountability. Consequently it is appropriate to utilize the existing framework that has been put in place in Ghana for environment and natural resources in general and REDD+ in particular. The routinely scheduled and facilitated meetings of those entities that have been set up should be used as a cyclic process for monitoring the SOPs and their ongoing relevance and continuous improvement.

Forest MRV Communications

To accommodate the wide range of system contributors and users as well as meet the complexity and demands of the system, the Forest MRV communications strategy needs to concentrate on methods and means that will suit the institutions. The elements of the strategy have been formulated to ensure continuity and consistency of engagement and to lead to strong understanding of the Forest MRV and continuous improvement in the systems and institutional contributions to it. A critical role of the participants in the Ghana Forest MRV will be networking to find, engage with and enable projects, agencies, institutions and individuals that have potential interest in, may benefit from or can contribute to the system. The communication coverage will be needed:

- within government in Ghana
- across donors and multilateral organizations in Ghana
- for the information of international institutions and resources.

The communications required for the Forest MRV needs to create an effective mix of modes and a frequency that supports the enhancement of the understanding, engagement and use of the Forest MRV by stakeholders. The opportunities and means of communication should be routine and regular to build a body of interest in the Forest MRV and have been set out in the report.

Capacity Building

The reporting, monitoring and auditing requirements for Ghana under technical and review processes proposed by the UNFCCC necessitate a systematic and coherent approach to documentation of all types of data, information, decisions and operations related to the Forest MRV.

Technical expertise requires not only knowledge, but equally good management and leadership to be fully useful to the organizations. The data, capacities, experience, and systems need to be in place so that Ghana can continue reporting for the coming decades.

Within the Climate Change Unit, the National REDD+ Secretariat, a deeper understanding of the requirements, interactions and implications of the different REDD+ programs should be achieved. At present, the Secretariat is heavily committed, probably over-committed, with projects and programmes, and there is the time to digest the materials, plan strategically and apply sound management to the many activities is insufficient. The R-PP (2010) established the need for increased capacity in the unit.

RMSC has a critical role in the production of data for the MRV. Forest inventory data provided by the RMSC is utilized in the biomass estimation, and the GIS unit of RMSC provides GIS support, ground survey data and remote sensing (satellite, aerial photographs, LiDAR) for the stratification of the forest resource.

The enhanced participation of staff in attending and having responsibility for external and internal meetings would promote capacity-building and simultaneously ease the overall workload of those holding managerial positions. The level of participation in different meetings could be framed up to allow more junior staff to participate in technical meetings, and more senior staff in high-level policy meetings as appropriate. This would also contribute to sustainability within the institutions, build capacities and improve the flow of information.

The Organisation, management and security of electronic documents at present appear to be a matter for individuals. The reliability, accessibility and structure of electronic materials are likely to vary with the approach, attitude and capacity of each Forestry Commission staff member.

There is an urgent need to establish GIS hardware and software training to all Forest Regions and some, if not all Forest Districts. Further training in GIS software in RMSC Kumasi would be also needed to ensure sustainability.

District Officers should be trained in the MRV data collection on deadwood estimates, soil sampling and fuelwood estimations. Ideally, the Districts should be able to collect, enter and process data digitally, as they will most likely be responsible for the data collection. This would, however, require significant investments in hard and software and training. While transferring data in paper form, formal channels of data flows should be documented and respected.

Potential Improvements / Training Needs

- Monitoring of RMSC's work requires some new/additional capacities so managerial and leadership training is required, also more broadly across the Forestry Commission.
- Units are under-staffed in many cases, leading to a sustainability risk. Within some units only one person is fully aware of the requirements with the appropriate understanding.
- Deeper understanding of the UNFCCC/IPCC requirements is necessary for all units and personnel.

- Regional officers could have their own GIS and training to collect, insert and send data to RS/GIS unit for verification, cleaning and compiling.
- More data management capacity needed - the server has all data now, but retrieving data and producing maps and reports is a limitation.
- The existing system for document management, should be reviewed and improved including sharing, circulation, and archives. All documents should be archived in electronic format and on-line access should be ensured on a common server or a cloud service.

1. INTRODUCTION

The forestry sector contributes substantially to the global greenhouse gas (GHG) balance. Among the five economic sectors identified by the United Nations Framework Convention on Climate Change (UNFCCC) as sources of anthropogenic GHG emissions, the Land Use, Land Use Change and Forestry (LULUCF) sector is the only sector with the potential for removal of GHG emissions from the atmosphere. Conversely, the global annual conversion of approximately 13 million hectares of forest land to other land uses contributes to the net annual forest land decrease of 5.2 million hectares (FAO, 2010). These forest and related land use changes have been estimated to account for 17% of global human-induced GHG emissions.

Parties to the UNFCCC treaty recognized the contribution of GHG emissions from deforestation in developing countries to climate change and the need to take action to reduce such emissions. After a two-year process, the Conference of Parties (COP) adopted a decision on “Reducing Emissions from Deforestation and Degradation in developing countries: approaches to stimulate action” (REDD), Decision 2/CP.13 (United Nations Framework Convention on Climate Change, 2008). The decision provides a mandate for actions by parties relating to reducing emissions from deforestation and forest degradation in developing countries. In particular, REDD is an effort to offer financial incentives for developing countries to reduce emissions from forestlands and to invest in low-carbon paths to sustainable development. REDD+ goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks. As part of REDD+ programs, the importance of national carbon accounting systems has been highlighted (FAO, 2008).

As a form of carbon accounting, GHG emissions accounting assesses emissions from the forestry sector. Approaches to emissions accounting are of two types: the stock difference and the gain-loss approach. The stock-difference approach relies heavily on ground sampling and estimates annual emissions as the mean annual difference in carbon stocks between two points in time. The stock-difference approach is fairly easy to implement for countries with well-established national forest inventories (NFIs) with repeated measurements, but may be financially and logistically difficult for developing tropical countries, particularly those with remote and inaccessible forests.

For the latter countries, the gain-loss approach may be a more feasible alternative. In fact, the gain-loss approach is the often used approach for estimating GHG emissions for national measurement, reporting, and verification (MRV) systems under the auspices of the IPCC. With the gain-loss method, additions to and removals from a carbon pool are estimated as the product of two factors, the area of land use change, called activity data, and the carbon stock changes for particular land use conversions, called emission factors. MRV systems may include a remote sensing-based component for estimating activity data and a ground-based inventory to obtain data for estimating emission factors, calibrating volume or biomass models, and training and/or assessing the accuracy of remote sensing classifiers and predictors.

The IPCC Good Practice Guidance (Penman et al., 2003) is a starting point for the development and implementation of MRVs under the auspices of REDD+. Additional guidance is provided by the GFOI Methods and Guidance Document (MGD) and the GOFC-GOLD Source book (Global Observation of Forest Cover and Land Dynamics, 2012). The IPCC and MGD guidance focuses on methods for obtaining estimates of activity data and emissions factors.

Ghana’s MRV system has been designed to be national in extent while allowing for nested project and program reporting. This design enables consistency between national and international reporting. The system has been designed to monitor and report on spatial and temporal changes of Ghana’s forest resources as well as assessing the dynamics of land use change.

The main government agencies responsible for the forest land management in Ghana are the Ministry of Lands and Natural Resources (MLNR) and the Forestry Commission of Ghana (FCG). In line with the above framework, the FCG is mandated to manage, develop and regulate the utilization of the nation’s forest and wildlife resources, and to co-ordinate related

policies. To achieve this mandate, the FCG together with its stakeholders; such as the Environmental Protection Agency (EPA) and the Ministry of Environment, Science, Technology and Innovations (MESTI); have developed Forest and Wildlife Management Plans, procedures and systems that give the overall direction on how to manage the nation's forest and wildlife resources.

Previous work (the Forest Preservation Programme (FPP) funded by the Government of Japan) aimed to establish good correlation between field sample measurements and LiDAR measurements and satellite imagery to improve the extrapolation of carbon estimates using these sampling strategies.

Whilst Ghana does have a history of forest inventory within its on reserve forests this inventory was effectively abandoned in the early 1990s. Based on the remote sensing data the forest landscape of Ghana underwent a significant change in structure and extent between 2000 and 2010 compared with the range of change detected between 1990 and 2000. Since the inventory has not been repeated during the historical reference period it is of little use to the MRV system. The plots are also only representative of a relatively small area of forest in Ghana because they are only measured in on-reserve forests.

The design of the Ghana's Forest MRV system has created the following operational documents (standard operating procedures - SOPs) corresponding broadly to generate activity data and emissions factors for key activities and pools as required by IPCC good practice guidelines:

- 001 Estimating annual forest emissions and removals
- 002 Key category analysis
- 003 Acquisition of remote sensing data and generation of activity data
- 004 Stratification of lands
- 005 Field inventory protocol
- 006 Estimation of above- and belowground biomass and deadwood
- 007 Estimation of emissions from soil organic carbon
- 008 Estimation of emissions and removals from timber harvest
- 009 Estimation of emissions from extraction of wood for fuel
- 010 Estimation of emissions from fire
- 011 Estimating national and sub-national reference emission level
- 012 Combining uncertainty.

2. BASIS OF GHANA'S FOREST MRV SYSTEM DESIGN

2.1 UNFCCC Requirements

Reducing emissions from deforestation and forest degradation (REDD) has been under negotiation by the United Nations Framework Convention on Climate Change (UNFCCC) since 2005. These negotiations have had the two objectives of:

- mitigating climate change through reducing emissions of greenhouse gases
- removing greenhouse gases through enhanced forest management in developing countries.

The specific activities relating to these objectives known as REDD+ are (Decision 1/CP.16, paragraph 70):

a) Reducing emissions from deforestation;
b) Reducing emissions from forest degradation;
c) Conservation of forest carbon stocks;
d) Sustainable management of forests;
e) Enhancement of forest carbon stocks.

The COP of the UNFCCC adopted six decisions on REDD+ between 2007 and 2012 representing the basis for REDD+ readiness activities:

- Decision 2/CP.13 is the 2007 Bali Decision: Reducing emissions from deforestation in developing countries: approaches to stimulate action.
- Decision 4/CP.15 is the 2009 Copenhagen Decision: Methodological guidance for activities relating to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.
- Decision 1/CP.16 is the 2010, "Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention".
- Decision 2/CP.17 is the 2011 Durban Decision: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention, including the modalities and guidelines on International consultation and Analysis.
- Decision 12/CP.17 is the 2011 Durban Decision: Guidance on systems for providing information on how safeguards are addressed and respected and modalities relating to forest reference emission levels and forest reference levels as referred to in decision 1/CP.16.
- Decision 1/CP.18 is the 2012 Doha Decision: Agreed outcome pursuant to the Bali Action Plan.

Building on earlier decisions adopted by the COP, the Warsaw Framework for REDD+ consists of the following seven decisions which were adopted at COP19:

- Decision 9/CP.19: Work programme on results-based finance to progress the full implementation of the activities referred to in decision 1/CP.16, paragraph 70.
- Decision 10/CP.19: Coordination of support for the implementation of activities in relation to mitigation actions in the forest sector by developing countries, including institutional arrangements.
- Decision 11/CP.19: Modalities for national forest monitoring systems.
- Decision 12/CP.19: The timing and the frequency of presentations of the summary of information on how all the safeguards referred to in decision 1/CP.16, appendix I, are being addressed and respected.
- Decision 13/CP.19: Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels.
- Decision 14/CP.19: Modalities for measuring, reporting and verifying.
- Decision 15/CP.19: Addressing the drivers of deforestation and forest degradation.

These decisions are made in the context of encouraging developing country Parties to contribute to forest sector mitigation actions by undertaking REDD+ activities, as they deem appropriate and in accordance with their respective capabilities and national circumstances.

The Warsaw Framework reaffirmed, in line with decision 4/CP.15, that National Forest Monitoring Systems (NFMS) should be guided by the most recent IPCC guidelines and guidance adopted or encouraged by the COP. NFMS should provide data and information that is transparent, consistent over time, and suitable for MRV of REDD+ activities, as well as consistent with decisions on nationally appropriate mitigation actions (NAMAs). They should build on existing systems, enable assessment of different forest types, including natural forest, as defined by a country, be flexible and allow for improvement. An NFMS should reflect, as appropriate, a phased approach. This begins with the development of national strategies or action plans, policies and measures, and capacity-building, is followed by their implementation and possibly further capacity-building, technology development and transfer and results-based demonstration activities, and evolves into results-based actions that should be fully measured, reported and verified[4]. COP19 acknowledged that Parties' NFMS may provide appropriate information on how the safeguards set out in Decision 1/CP.16 are addressed and respected. A separate decision at COP19 establishes that information on how the safeguards set out in 1/CP.16 are being addressed and respected should be provided via National Communications and on a voluntary basis via the REDD+ Web Platform on the UNFCCC web site[5], once implementation of REDD+ activities has begun, and as a prerequisite to obtain and receive results-based payments.

Although not specified by the COP19 decision, the Global Forest Observation Initiative Methods and Guidance Document (GFOI-MGD) assumes that, while building upon existing systems, an NFMS could engage a range of stakeholders including national authorities with responsibilities for forest land[6], agencies responsible for collecting national data such as census information, agencies responsible for estimating forest related emissions and removals of greenhouse gases in the context of national greenhouse gas inventory estimates, and possibly stakeholder representatives including community representatives and the private sector. Depending upon national circumstances, the NFMS could be useful in delivering a number of additional functions.

In the design of Ghana's MRV system all of these elements have been taken into consideration to develop a system that is consistent with the International Panel on Climate Change (IPCCC) good practice methods and guidance. The design is also flexible in that is recognizes previous capacity building work and existing institutional infrastructure already completed in place within Ghana. The design also allows the stepwise progression to a more comprehensive multipurpose land based monitoring system should Ghana wish to extend its report to all land uses.

2.2 Good Practice Design Basis

Good practice is defined by IPCC[7] as applying to inventories that contain neither over- nor under-estimates so far as can be judged, and in which uncertainties are reduced as far as is practicable. This definition has no pre-defined level of precision, but aims to maximize precision without introducing bias given the level of resources reasonably available for GHG inventory development. This level of resource is implicitly decided by the international inventory review process administered by the UNFCCC.

[4] See paragraphs 73 and 74 of Decision 1/CP.16

[5] See http://unfccc.int/redd

[6] Such agencies could include those responsible for Forestry, Agriculture, and Environment.

[7] See Section 1.3, 2003GPG, or Section 3 in the Overview in Vol 1 of the 2006GL

Good practice also covers cross-cutting issues relevant to GHG inventory development. These cover data collection including sampling strategies, uncertainty estimation, methodological choice based on identification of key categories (those which make greatest contributions to the absolute level of emissions and removals, and to the trend in emissions and removals), quality assurance and quality control (QA/QC), and time series consistency. QA/QC entails amongst other things *validation* (defined as internal self-consistency checks), and may include *verification*, defined as checks against independent, or at least independently-compiled, estimates. Remote sensing data may be useful for verification as well as for greenhouse gas inventory compilation, provided it is independent – that is, not already used for compiling the inventory.

Good practice entails the following general principles:

- **Transparency** (documentation sufficient for reviewers to assess the extent to which good practice requirements have been met)
- **Completeness** (that all relevant categories of emissions and removals are estimated and reported)
- **Consistency** (so that differences between years reflect differences in emissions or removals and are not artefacts of changes in methodology or data availability)
- **Comparability** (that inventory estimates can be compared between countries)
- **Accuracy** (delivered by the use of methods designed to produce neither under- nor over-estimates).

The decisions of the COP relating to REDD+ MRV specify that forest carbon stock and forest area changes resulting from REDD+ activities should be consistent with the most recent IPCC guidance and guidelines adopted or encouraged by the COP (Decision 4/CP.15). The UNFCCC Decisions on REDD+ identifies the most recent guidance as the Revised IPCC 1996 Guidelines and the IPCC Good Practice Guidance 2000 and 2003 (Annex III, part III of Decision 2/CP17).Consequently, for REDD+, the inventory framework used in the design of Ghana's MRV system is defined by the GPG2003. Scientific updates in the 2006GL are utilized where necessary.

Guidance consistent with the GPG2003 from the Global Forest Observation Initiative Methods and Guidance Document (GFOI-MGD), the GOFC-GOLD Source book (Global Observation of Forest Cover and Land Dynamics, 2012) was also used in the development of the MRV design.

The GPG2003 guidance focuses on methods for obtaining estimates of activity data and emissions factors. The term approaches is used to categorize methods for estimating activity data:

- **Approach 1** estimates total area for individual land-use categories but does not provide detailed information on area changes between categories and is not spatially explicit other than at regional or national levels;
- **Approach 2** tracks land use changes between categories and produces a non-spatially explicit land use change matrix; and
- **Approach 3** tracks land use changes on a spatial basis and generally requires sampling with broad geographic coverage or remote sensing-based mapping.

To participate in REDD+ a country must have activity data developed using Approach 3 wall–to-wall mapping (whole of country). The IPCC guidance also uses the term tiers to describe methods for estimating GHG emissions and removals by source:

- **Tier 1** uses default emissions factors and spatially coarse estimates of land use change such as national or global deforestation rates;
- **Tier 2** uses emissions factors and fine resolution land use change estimates for specific regions and specialized land-use categories; stock change methods can also be used; and

- **Tier 3** uses fine resolution land use change estimates and estimates of emissions factors obtained using models and inventory measurement systems tailored to address national circumstances.

An underlying assumption is that the highest tier possible would be used. Thus, because the stock change method can be readily used with Tier 2, it would not usually be used with Tier 1.

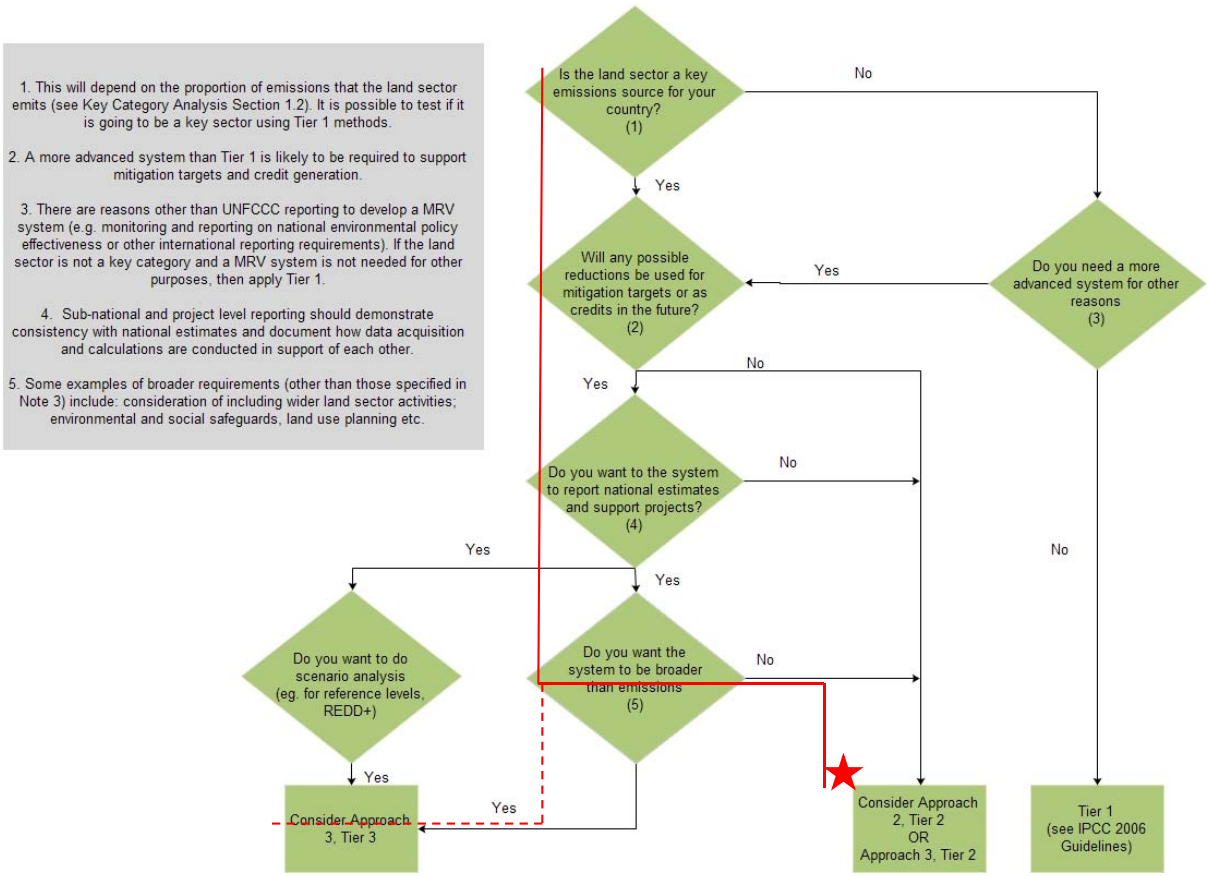
Similarly, although the gain-loss method can be crudely implemented with Tier 1, transition to Tier 2 or 3 is usually the goal. Only Australia and Canada report using Tier 3 approaches.

Guidance presented in the GFOI-MGD provides a decision tree process to assist countries in the selection of the appropriate Tier and Approach to use for GHG estimation in relation to REDD+ reporting. The results of working through this decision tree for Ghana's position are presented in Figure 2.1 and subsequently the design of Ghana's MRV system is consistent with Approach 3, Tier 2.

The decision tree has two paths. The solid red line indicates the short to medium term reporting requirements of Ghana and the red hashed line represents a longer term aspiration. The foundation decision for using Approach 3 land tracking will ensure time series consistency and comparability in the long term and selection of Tier 2 recognizes the current available national data and capacity.

Recommendation: Ghana should reconsider the application of Tier 3 approaches as the Tier 2 system designed within this document matures and repeated measurements and modelling of key carbon stock changes through time become available.

Figure 2.1 MRV Design Elements: Approach and Tier Selection for Ghana



2.3 Current Reporting Situation for Ghana

Ghana became a party to the UNFCCC after ratification in September 1995 and has since engaged in policies and measures to facilitate its implementation. Ghana prepared, published and reported its Initial National Communication (INC) to the COP to the UNFCCC in December 2000 covering the period 1990 to 1996. The preparation of the Second National Communication (SNC) has the main objective to present and communicate to the extent possible to the Conference of Parties, how Ghana is implementing the Convention and in particular, highlighting pertinent issues, gaps, problems, constraints and achievements. The information provided in the SNC covers between 2000 and 2006. The SNC is also considered by Ghana as its flagship drive to shaping climate change policy development, planning and facilitating its integration into sustainable development.

Ghana has submitted its first and second national communications to the COP in 2000 and 2011 respectively as part of its reporting obligations under articles 4 and 12 of the UNFCCC.

The preparation of the SNC was very participatory, interactive and above all delivered in a systematic manner. The Project Advisory Committee (PAC) and Project Steering Committee (PSC) were the highest bodies responsible for providing guidance and direction in the SNC process. The PAC was made up of the Ministry of Environment, Science and Technology (MEST), Environmental Protection Agency (EPA), Ghana UNDP Representative, Energy Commission (EC), Forestry Commission (FC), representatives from the Universities, National Development Planning Commission (NDPC) and Civil Society Organizations (CSOs) representatives. The SNC had project and assistant project coordinators drawn from the Environmental Protection Agency of Ghana, who were responsible for the administrative and technical coordination of the various working groups.

2.3.1 Ghana's Third National Communication[8]

Throughout the preparation of first and second national communications, significant achievements were made. The national communication process has helped to: create considerable awareness on climate change and its impacts at all levels; build some level of institutional capacities among key institutions; facilitate access to international climate funding; and contribute integrating climate issues into national development. In order to ensure that there is continuity in reporting and at the same time be able to further strengthen Ghana's capacity (including the institutional mechanism established under the previous communications), Ghana has received funding from GEF to conduct its Third National Communication (NC3). The NC3 is the continuation of work done under the Second National Communication (NC2).

The Environmental Protection Agency (EPA) is the National Entity responsible for the implementation of the NC3 in Ghana. The NC3 is being implemented from January 2012 to December 2014 with a Project Implementation Unit has been set up at the Environmental Protection Agency. The Ghana Forest MRV Project has been engaged with the NC3 team throughout its tasks.

To ensure that delivery of the NC3 is on time, robust and meet the essential standards of the guidelines for the preparation of national communications, the strategies for implementation are being anchored on the following key working principles:

- Inclusiveness and wide participation
- Deployment of good science
- Ensuring more local content
- Use defensible data, tools and models
- Build on good and new initiatives

[8] Material drawn from http://www.epa.gov.gh/tnc/ last accessed 27th July 2014

Consultation and wide public participation are at the centre of the implementation of the NC3. To be able effectively ensure proper national ownership, the national communication is undertaking comprehensive consultation and participation that reflect the various views and interests of all stakeholders in the process. Nearly thirty national institutions (public, private, CSOs, private sector, NGOs, research, consulting and academic) will be involved in the various activities of the NC3.

Most developed countries and developing countries where country or regional specific data is available report using Tier 2 approaches. With respect to forests and to participate in REDD+ the country must obtain activity data developed using approach 3 (wall to wall mapping). The country must also report using at least Tier 2 emission factors. Consequently with respect to forests Ghana has adopted Tier 2 approach 3 for its GHG reporting for the following reasons

- There is a significant body of country specific emissions factors that have been incorporated into the SOPs with their sources referenced.
- Existing in country experiences of wall-to-wall mapping and capacities gained from FPP process.
- The country has a well-documented methodology including justification for data and documented areas for priority improvement.

3. REPORTING REQUIREMENTS

3.1 Reporting Forest Reference Emission Levels / Forest Reference Levels

Reporting of forest reference emissions levels or reference levels (FREL/FRLs) and the REDD+ annex are separate voluntary processes for countries seeking results based payments for REDD+ mitigation actions.

The processes for reporting and technical assessment of FREL/FRLs were decided at COP 17 in Durban. Decision 12/CP.17 invited countries to submit, voluntarily and in the context of results based payments, proposed forest reference emission levels and/or forest reference levels for technical assessment. This decision addressed modalities for forest reference emission levels and forest reference levels, which are to be established taking into account decision 4/CP.15 from Copenhagen and maintaining consistency with each country's greenhouse gas inventory.

The COP invited developing country Parties, on a voluntary basis and when deemed appropriate, to submit proposed FREL/FRL report and requested the secretariat to make these reports available on the UNFCCC REDD+ web platform.

The Warsaw REDD+ Framework includes a decision on guidelines and procedures for the technical assessment of proposed FRELs/FRLs (Decision 13/CP.19). These procedures require the FREL/FRL to be subject to a technical assessment (paragraph 1), with details of the technical assessment process given in the Annex of Decision 13/CP.19 (paragraph 3), including the requirement to publish the FREL/FRL and the report from the technical assessment on the UNFCCC REDD web platform (paragraph 18).

The reporting and subsequent technical assessment of the FREL/FRL is a separate process to the submission and technical analysis of the BUR REDD+ technical annex. The submission and technical assessment of the FREL/FRL must happen prior to the submission of the REDD+ annex.

3.2 Submitting the REDD+ Technical Annex to the Biennial Update Report

COP19 specified reporting requirements for REDD+ activities in the context of results based payments as part of the decision on MRV. Decision 14/CP.19 states that data and information on results related to the implementation of REDD+ activities should be provided by Parties, through Biennial Update Reports (BUR).

The REDD+ technical annex to the BUR must contain the following information and be available for technical analysis by LULUCF experts on the Technical Team of Experts appointed by the UNFCCC:

1. A summary of information from assessed forest reference emission levels and forest reference levels including:
    a. The assessed forest reference emission level and/or forest reference level expressed in tonnes of carbon dioxide equivalent per year;
    b. The REDD+ activity or activities included in the forest reference emission level and/or forest reference level;
    c. The territorial forest area covered;
    d. The date of the forest reference emission level and/or forest reference level submission and date of the final technical assessment report;
    e. The period (years) of the assessed forest reference emission level and/or forest reference level.

The technical annex is also requested to include:

1. Results from the REDD+ activities in tonnes of CO_2-e per year, consistent with the assessed FREL/FRL.
2. Demonstration that the methodologies used to produce these results are consistent with those used to establish the assessed FREL/FRL.
3. Description of national forest monitoring systems and the institutional roles and responsibilities for measuring, reporting and verifying the results.
4. Necessary information that allows for the reconstruction of the results.
5. A description of how elements109 set out in previous decision 4/CP.15, paragraph 1(c) and (d), have been taken into account.

The material submitted through the BUR, will be subject to technical analysis by two LULUCF experts to analyse the extent to which:

a) There is consistency in methodologies, definitions, comprehensiveness and the information provided between the assessed reference level and the results of the implementation of REDD+ activities;
b) The data and information provided in the technical annex is transparent, consistent, complete (in the sense of allowing reconstruction) and accurate;
c) The data and information consistent with the guidelines for preparing the technical annex referred to;
d) The results are accurate, to the extent possible.

The outcome of the technical assessment will be published via the UNFCCC web platform. COP19 also decided that results-based actions that may be eligible for appropriate market-based payments may be subject to additional modalities for verification.

4. DEFORESTATION AND FOREST DEGRADATION IN GHANA

4.1 General Background and Situation for Ghana

Ghana is well-endowed with natural resources, including fertile soils, forests, and mineral deposits of gold, diamonds, manganese, and bauxite. The climate is generally tropical and warm, with aridity increasing from south to north. Occupying central Ghana, the Volta River Basin drains nearly half of the country. While the coastal zone represents only 6.5 per cent of the total land area, it supports one-quarter of the population and most of the country's industries (Amlalo 2006). One of the most commonly used natural resources is its forests which has been undergoing rapid depletion and degradation as a result of anthropogenic causes.

A distinction is commonly made between proximate/direct causes and underlying/indirect causes of deforestation and forest degradation (Geist and Lambin, 2001; Millennium Ecosystem Assessment, 2005). Proximate causes are human activities or immediate actions that directly impact forest cover and loss of carbon. These causes can be grouped into categories such as agriculture expansion (both commercial and subsistence), infrastructure extension and wood extraction.

Underlying causes are complex interactions of fundamental, social, economic, political, cultural and technological processes that are often distant from their area of impact. These underpin the proximate causes and either operate at the local level or have an indirect impact from the national or global level. They are related to international, (i.e. markets, commodity prices), national (i.e. population growth, domestic markets, national policies, governance) and local circumstances (i.e. change in household behaviour; Geist and Lambin, 2001; 2002; Obersteiner et al., 2009).

4.2 Key Drivers of Deforestation and Forest Degradation in Ghana

Ghana has one of the highest deforestation rates in Africa; at approximately two per cent annually (UN 2007). Forest resources have reduced from 7 million ha in 1990 to approximately 6 million ha in 2000 (FAO, 2006). Almost all the forests are depleted and 0.39 million ha of forests reserves are considered as degraded (Marfo, 2010). The average estimated annual rate of deforestation between 1990 and 2000 was 2% (135,000 ha per year), which is higher than the average annual rate for both Central and Western Africa which stands at 0.6 % (FAO, 2006; FAO, 2010).

According to the Forest Investment Plan (FIP, 2012) timber harvesting and slash-and-burn agriculture represent the greatest threats, but wildfires, mining, and rising demand for fuel wood/charcoal are also important contributors. The current understanding, based on three decades of interventions in the sector, is that deforestation in Ghana is largely a process of progressive forest degradation driven by a range of agents both from within and outside the forest sector.

The Readiness Preparation Proposal (R-PP, 2010) of Ghana identified the direct causes of drivers of deforestation and forest degradation as:

1. Harvesting of trees for fuelwood, charcoal, and timber
2. Wildfires
3. Agricultural practices
4. Population and infrastructure development
5. Mining and mineral exploitation.

Over-harvesting has led to the downward revision of the national Annual Allowable Cut (AAC) in Forest Reserves from 1.2 million m^3 in 1990 to 500,000 m^3 in 2005 (ITTO, 2006). The off-reserve component of the total national AAC (2 million m^3) was set as high as 1.5 million m^3 mainly due to extensive illegal logging and the assumption that with time those areas are likely to be converted to other land uses (Marfo 2010). Unsustainable wood harvesting is driven by a range of factors including:

- The tenure and benefit sharing regimes both within and outside reserves;
- The obvious demand – supply imbalance in the domestic market;
- Overcapacity in processing and inappropriate technology to process the current wood;
- Supply; access to credit and financing; and
- Policy and institutional failures to deal with the sector challenges.

The underlying causes involve a complex mix of demographic, economic and policy factors. The immediate direct drivers include, among others:

- Policy and market failures in the timber sector which has been unable to shift from high volume and low value timber products to the preferable state of low volume and high value timber products through tertiary processing and value addition as envisaged by the Forest and Wildlife Policy of 1994;
- High demand for wood and forest products on the international market;
- Limited technology development in farming systems;
- Continued reliance on cyclical 'slash and burn' as a method for land preparation in farming systems; and
- A shift from traditional shade tolerant cocoa to open grown cocoa varieties.

Indirect drivers of deforestation include; weak incentive structures, weak regulatory mechanisms, complex tenure and rights regimes and demographic changes (Ghana R-PP - FCPF December 2010), over-exploitation of trees as timber, inadequate implementation of forest management systems, poor farming practices, the complex nature of Ghana's land tenure system, lack of community involvement, non-transparent benefits-sharing system, weak institutions, inefficiency of the timber industry, flouting of existing regulations and lack of political will and commitment, growing population in rural and urban areas, leading to an increase in local demand for agricultural and wood products; heavy dependence on charcoal and wood fuel for rural and urban energy; and limited access to affordable credit for investments.

Despite efforts to improve on governance to address direct and indirect causes, not much has been achieved in the reduction of deforestation and forest degradation. For example despite Ghana's pilot role and commitments to the Voluntary Partnership Agreement/Forest Law Enforcement, Governance and Trade (VPA/FLEGT) process to address illegal logging, there appears not to have been significant reductions forest loss and degradation. There is the need for considerable improvement of timber tracking, information management and application of best practice in forest governance and law enforcement. The most pronounced feature of the situation with regard to illegal logging is the supply of timber from the chain saw milling sector. The Government of Ghana recognizes these governance challenges. According to the 2012 Forest and Wildlife Policy there is poor accountability in resource exploitation and lack of cost-effectiveness in the use of resources and creation of appropriate benefits in a transparent and accountable manner.

4.2.1 Fuelwood Energy and Timber

The bulk of energy supply in Ghana is met from woodfuels, i.e. firewood and charcoal. Woodfuels account for about 71±1% of total primary energy supply and about 60% of the final energy demand. The bulk of woodfuels amounting to 90% is obtained directly from the natural forest. The remaining 10% is from wood waste i.e. logging and sawmill residue, and planted forests. The transition and savannah zones of Ghana, mainly the Kintampo, Nkoranza, Wenchi, Afram Plains, Damongo districts provide the bulk of dense wood resources for woodfuels. However, woodfuel resources are depleting at a faster rate as a result of unsustainable practices in the production and marketing of the product that incurs high levels of waste. In 2000, the annual production or yield of wood was about 30 million tonnes of which about 18 million tonnes was estimated to be available and accessible for woodfuels.

Since a majority of households in Ghana, about 80%, depend on woodfuels for cooking and water heating in addition to commercial, industrial and institutional use, the demand for

woodfuel has for the past years been on the increase. If this trend of consumption continues, Ghana is likely to consume more than 25 million tonnes of fuel wood annually by the year 2020.

Charcoal production is the only energy subsector where the cooking appliances and most production equipment are produced locally. In the past most wood supply for charcoal production was from off-reserve sources. Increasingly, the forest reserves are also being used for illegal charcoal production. There have been numerous studies of fuelwood and charcoal but no systematic interventions are underway in Ghana. The objective would be to move charcoal production away from sources in natural forests and woodlands and towards plantation woodlot supply to ensure sustainable production and avoid deforestation.

4.2.2 Wildfire

Wildfire has been one of the most important threats to the integrity of Ghanaian forest. This trend is predominant in the dry forest and the savannah woodland ecological zones of Ghana. The causes are mainly anthropogenic such as setting fires for hunting and slash and burn agricultural practices. In the savannah, fire is used as a management tool for grazing, land preparation and bud initiation for some economic species (e.g. Dawadawa and Shea butter trees). Under a Wildfire Management Project (WFMP) conducted between 2000 and 2008 in the fire prone areas (Transitional Zone of Ghana) there has been a progressive decrease in wildfire incidence in Ghana. It has been estimated that the incidence of wildfires within the Transitional Zone (TZ) decreased by 76.5% between 2009 and 2010. This is overwhelmingly attributed to the WFMP initiated within the TZ, confirmed by the fact that wildfire incidence increased over the same period in the savannah areas within Northern and Volta regions of Ghana (RMSC, 2011). Increasing surface mining activities in recent times in forest lands sees mining as a driver of deforestation and degradation. Under the environmental guidelines for mining in forest reserves, only 2% of the total forest reserve area is allowed for mining. This policy has been undermined as a result of increasing small scale mining activities, mostly illegal, causing widespread deforestation and forest degradation in recent times. Illegal miners don't follow the existing rules and regulation relating to mining. Consequently, areas are not rehabilitated after mining operations leading to continuous deforestation and forest degradation.

4.2.3 Agricultural Expansion

Agricultural crops (including annuals, such as maize and millet, and tree crops, such as cocoa, coffee, cashew and oil palm) provide much of the natural wealth of Ghana, and agricultural land accounts for more than half of all land use (R-PP World Bank, 2010) also provides employment for the majority of the population. There is a range of crops and practices that are considered typical of 'small-scale agriculture'. In Ghana cocoa has been highly commercialised for a century or more and is operated very much as business ventures (Hill, 1963 cited in R-PP World Bank 2010).

In Ghana, forest degradation is linked to agricultural expansion of which the conversion of forest lands into cocoa farms is a primary driver (Ghana R-PP - FCPF December 2010). The importance of cocoa in the national economy and the rapid expansion of the cultivated areas, especially in the forested Western Region, have resulted in loss of forest cover and decline in carbon stocks in the agricultural landscape.

Cocoa contributes 20% of the country's GDP and is the main source of livelihood activity in the high forest zone of Ghana where the crop is cultivated. The Forest Reserves of Ghana were primarily constituted to create an enabling environment for the growth of cocoa. Consequently, cocoa has been given priority compared with the forests. The realization of the importance of forests globally has put some pressure on the need to conserve forests; however forests lands are still being cleared for cocoa for the following reasons:

- The ownership and returns of cocoa is guaranteed to the farmer
- Forest resources is vested in the state and the farmer has little benefit from it, so there is no incentive for the farmer to keep or invest in forest

- The long gestation period of trees to mature for harvesting as compared to cocoa
- All land in Ghana is under some form of ownership, with some under the authority of the chieftaincy (the 'stool'). This confers the right to tribute and, in appropriate instances, a share of land-based revenues. This control means that the decisions on land use are by the chieftaincy or a delegated sub-chief. The immediate farmers/land managers receive little benefit from tree harvest operations. The local revenue contributions accrue to the traditional authorities and to the District Assemblies. Hence maintaining or growing trees has little attraction there is support or encouragement for the expansion of cocoa growing in preference to other agriculture or forests due to the revenue stream that is generated, in part to the farmer.

This combination of factors have encouraged the replacement of forest with cocoa in the past continuing to the present and consequently making cocoa cultivation the main driver of deforestation in the high forest zone of Ghana.

4.2.4 Population and Infrastructural Development (Urbanization)

Population and urbanisation have both increased rapidly since independence, and Ghana is becoming a predominantly urban society. Population has more than tripled, from 6 million (1957) to 20 million (2002), and is expected to reach 31 million by 2025 (WRI, 2007). Urban population has increased from 15% in 1950 to 46% in 2005, and is anticipated to reach 58% by 2030 (UNEP, 2005). The rate of urban population increase is significantly in excess of overall growth.

Two major conurbations (Accra and Kumasi) account for a third of the urban population. Accra, the capital, increased threefold between 1970 and 2000, with the population of Greater Accra now standing at over 2 million people (Ghana Statistical Service, 2002). With increased urbanisation has come increased demand for timber, non-timber forest products (NTFPs) and agricultural products, increasing the stress on forest resources.

Along with the rapid rate of urban growth has been a significant increase in rural population, adding to the pressures on productive land. Rural population is now more than two and a half times the 1950 level (at 11 million people). Combined with weak improvement in agricultural productivity and efficiency, this has led to an increased need for agricultural land and pressure on forests and woodlands.

4.2.5 Mining and Mineral Exploration[9]

Mining has a long history in Ghana, chiefly gold which goes back many centuries and in part gave rise to the naming of the "Gold Coast". Minerals production accounts for 4% of GDP and 9% of government revenues, gold making up 93% of mining exports with manganese, bauxite and diamonds also mined, though in much smaller amounts. It is one of the largest contributors to Government revenue through the payment of mineral royalties, employee income taxes and corporate taxes. The sector also employs 28,000 people in large scale mines while perhaps over 1,000,000 people are engaged in small scale mining of which a greater percentage are illegal miners popularly called Galamsey operators (Obiaw et al, 2014). There are 58 mining leases for gold and other minerals approved by the Government, over a total area of c.300,000 ha. – 1.3% of the national territory (Ghana Minerals Commission, 2009; World Bank, 2006). Gold production is in a phase of expansion, and a number of new operations are opening up.

Galamsey is also likely to be highly polluting, and suffers from the additional problem that only 5-15% of operators are working on legal concessions, with most operating outside the planning and environmental management. Given the favourable outlook for gold prices and the prospect of a significant expansion in the demand for minerals concessions, pressures from mining in the forest areas are set to increase. The Government of Ghana developed a new draft Mining

[9] Material based on the R-PP World Bank 2010

Policy with specific provisions for mining in forest areas. These include a limit of 2% [cumulative] conversion of land area to mining in production reserves, with no processing facilities or buildings allowed (previously no conversion was allowed); guidelines for mining in production reserves to be subject to regular review, maintenance of a strong regulatory framework and monitoring regime, review of benefit sharing arrangements in the sector, better regulation of the galamsey sector, though a supportive framework, and ongoing registration of small-scale miners.

The importance of mining in terms of government revenue and the increasing pressure due to rising prices, for gold in particular, will likely ensure that pressure on forests from mining will continue. Currently there is escalation of small scale mining which has made gold mining a significant driver of deforestation in Ghana.

4.3 Extent of Revegetation in Ghana

Over the last two decades the high levels of deforestation has compelled the Forestry Commission to embark on a large scale reforestation programme. The Government of Ghana embarked on the National Forest Plantation Development (NFPDP) Programme in 2002. The NFPDP was initially largely implemented within degraded Forest Reserves and was expanded with the introduction of the Expanded Plantation Program (EPP) to cover private lands located outside Forest Reserves. The EPP ensured that most of the District /Municipal Assemblies without degraded Forest Reserves resorted to private lands to ensure that they also benefited from the job opportunities.

The implementation of the EPP of the NFPDP was out-sourced to private companies with the Forestry Commission responsible for monitoring (National Forest Plantation Development Programme Annual Report, 2012). In addition to these government initiatives, there are also reforestation activities by private individual tree farmers and farmer groups on relatively small scale scaling up to large scale plantations in both on and off-reserve areas. The specific extent of the relatively small size holdings will be difficult to obtain data on and estimate unlike the commercial large scale plantations.

4.4 Summary[10]

The condition of Ghana's forests has been in decline for many years, particularly since the 1970s.Many forest reserves are heavily encroached and degraded, and the off-reserve stocks are being depleted.

By and large, the problem is one of gradual 'degradation' rather than 'deforestation', and is incremental rather than dramatic, with no single dominant driver. The underlying causes involve complex interaction of demographic, economic and policy influences which can be summarised as:

- policy/market failures in the timber sector;
- burgeoning population in both rural and urban areas;
- increasing local demand for agricultural and wood products;
- high demand for wood and forest products on the international market;
- heavy dependence on charcoal and woodfuel for rural and urban energy;
- limited technology development in farming systems and continued reliance on cyclical 'slash and burn' methods to maintain soil fertility and fire as a tool in land management.
- expansion of mining activities
- land tenure.

[10] Material extracted from the in R-PP World Bank 2010

4.5 Conclusion

From the foregoing, the drivers of deforestation and forest degradation in Ghana are well established in the REDD+ readiness proposal (2010) and the R-PIN (2008). The drivers have not been linked strongly to the underlying agents and how the long term interventions of government including its reforestation programme (NFPDP & GPDP) will collectively operate to help resolve these drivers. Increasing population growth, government policy failures, cocoa expansion policies, expansion of agricultural plantation and expanding infrastructural development are among the key agents. It is important to note that the over reliance on wood fuel for energy and the removal of subsidies presently on Liquefied Petroleum Gas (LPG) are agents worthy of consideration in the quest to resolve these challenges. Unless these agents are holistically tackled in a concerted approach by all the relevant stakeholders they will continue to exacerbate the issue of deforestation and forest degradation. It is important to reiterate that the long term sustainability of the reforestation programmes is subject to factors such as availability of funds by the Forestry Commission from the Government.

5. REVIEW THE EXISTING NATIONAL LAND USE AND LAND COVER CLASSIFICATION SCHEME

Key Points:

- Ghana has confirmed its forest definition with the IPCC of minimum 1 hectare, minimum of 5 metres in height and minimum of 15% canopy cover.
- The review of existing classification schemes included documents, reports and maps of Ghana prepared by the FPP, CERSGIS and NCRC; the laws and policies and forest inventories carried out in Ghana.
- The approach applies the forest definition of Ghana to stratifying the Land Cover and Land Use aspects of the Forest MRV through the following steps set out in Standard Operating Procedure 004 Forest Stratification:
    1. Step 1: Stratify by ecozone
    2. Step 2: Allocate allometric equations to ecozones
    3. Step 3: Classify by the six IPCC land cover class
    4. Step 4: Stratification of forestlands
        a. By Forest management regime
        b. By Canopy Cover
    5. Step 5: Validation of Map
- The SOPs set out the procedures to be followed and incorporate the decisions that have been made by Ghana in respect of its forest definition and using the data and information available in Ghana.

5.1 Land Context

The national land use and land cover classification operates within the context of Ghanaian law and regulations including traditional ownership and use rights. In Ghana, there is a dual system of land ownership and control: customary (land held according to customary law) and statutory (public land). After gaining independence, Ghana's government gradually took over the administration and management of land by issuing legislation and statutes. While the customary land law has not been abolished, the state systems for administering land effectively monopolize all important land management functions. Ownership of public lands is vested in the President on behalf of and in trust for the people of Ghana.

Land held under customary law is owned by stools, families, or clans and is generally held in trust by the chief, head of family, or clan for the benefit of its members. Customary title to land has always been considered to include forests on that land over which the head of the community has power to grant use rights to its subjects. Land under customary ownership is regarded as belonging to the whole social group (stool, family, or clan) and not to any individual. Yet individuals within the collective enjoy virtually unrestricted rights of access and use. By statute, all revenue and income from land is to be paid into a Stool Land Account to be distributed as follows

- 10% to the Administrator of Stool Lands for administrative expenses;
- 55% (of the remainder) to the relevant District Assembly;
- 20% (of the remainder) to the relevant Traditional Authority; and
- 25% (of the remainders) to the relevant landowning stool.

All forest land in Ghana is managed by the government in trust for the stool landowners. Forest reserves and their natural resources are protected by the state and exploitation of the resources contained in reserves is regulated. By statute, reserves are managed by the Ghana Forestry Commission. In theory, the establishment of forest reserves does not affect land ownership, meaning that although forest reserves are regulated by the government, they are owned by communities represented by their chiefs. In practice, the establishment of forest reserves greatly diminishes the rights of adjoining communities to timber and NTFP by restricting forest access and use.

Forests in Ghana include not only reserve and off-reserve, but also communal forests, community plantations, private/individual plantations, and institutional plantations. These are allocated to Primary Designated Use and may also be considered within a Legal Management Scheme and are further described below.

5.2 National Definition of Forests

Key Points:

- The UNFCCC will accept only a single forest definition for each country. There is no option to provide different forest definitions for the various ecological zones.
- Ghana has confirmed its forest definition with the IPCC of minimum 1 hectare, minimum of 5 metres in height and minimum of 15% canopy cover. Ghana has submitted its change in forest definition to the UNFCCC Secretariat on 21st July 2011.
- The definition of forests submitted by Ghana may classify some tree crops as "Forestland" such as cashews, oil palm, rubber, shade cocoa and others. Similarly coastal vegetation, including mangroves, may be classified as forestland if these areas meet the thresholds defined above. To specifically include or exclude these areas from forestland their location and extent needs to be specifically known and additional land use definitions defined.
- The Ghana Forest Definition is consistent with the FAO FRA definition [0.5 hectares, 5 metres and 10% canopy cover].

5.2.1 Why is a Forest Definition Needed?

The definition of forest cover for any country depends on its national circumstances as was agreed to under the Kyoto Protocol. Such international agreements allow for definitions to be decided by a country within certain guidelines. Ghana must have one definition of forest. Then lands defined as forest according to the selected definition can be further stratified by characteristics such as eco-zone. Ghana cannot choose to develop various national definitions of forest cover that correspond to its different vegetation zones, such as the high forest, transition forest and the savannah woodland zones.

For the purposes of REDD+ (which Ghana is currently pursuing), it is a UNFCCC requirement to define one canopy cover threshold across the entire country that will be used to develop an estimate of historic emissions and also used for future monitoring. This should also be consistent with other reporting such as to the FAO. If the UNFCCC definition varies, say from the FAO definition, Ghana must justify why this is the case and provide appropriate explanation. The use of different definitions under REDD+ for the two main forest zones High Forest Zone (HFZ) and transition zone is not permitted and would add complication to the future monitoring system in any case.

For Ghana, it would be advantageous to define forest at a low canopy cover threshold (e.g. 15% canopy cover). This would ensure that most lands that contain tree cover will be classified as forest and will thus be eligible for REDD+ incentives either through reduced degradation, reduced deforestation, or enhancement of carbon stocks. The other advantage is that it will also be applicable to the various ecological zones and ensure regional balance thereby potentially reducing potential political conflict.

Adopting the low canopy cover threshold will however increase the likelihood of lands primarily used as agriculture being defined as a forest. Ghana could opt to define agricultural activities on lands that meet the definition of forest. For example a cocoa plantation grown under shade may meet the definition of forest, however the primary use is for a crop; therefore the land would be defined as agriculture, even though from the satellite image it looked like a forest. This approach would require significant ground base records of land use (i.e. spatial boundaries of agricultural crops) to meet MRV processes and requirements.

5.2.2 What are the Components and Attributes of a Forest Definition?

There are three attributes of a forest that are set out in UNFCCC documentation and also used as the basis for other global reporting requirements. They are:

- Area expressed in hectares
- Canopy cover expressed as a percentage of area
- Minimum tree height or potential tree height expressed in metres

All three have implications for Ghana's participation in international activities, such as carbon markets and should be examined and clearly understood to ensure that Ghana's decision is informed and consistent with its interests.

5.2.3 What is Ghana's Current Forest Definition?

Under the Clean Development Mechanism (CDM), a "forest**"** is defined as being within the range of area of 0.05–1.0 ha; with a minimum "tree" crown cover in the range of 10–30%; with "tree" defined as a plant with the capability of growing to be more than 2–5 m tall [UNFCCC 2002]. In 2007, recognising the potential that CDM activities had for sustainable development, Ghana decided to define its forest as:

"A piece of land with a minimum area of 0.1 hectares, with a minimum tree crown cover of 15% or with existing tree species having the potential of attaining more than 15% crown cover, with trees which have the potential or have reached a minimum height of 2.0 meters at maturity in situ ".[11]

Ghana's definition of forest addressed the CDM concept which could not be pursued, consequently the definition had to be revised to suite a broader agenda including REDD+ initiative. In pursuit of a new definition, a series of stakeholder consultations amongst personnel from the Ministry of Lands and Natural Resources, Ministry of Food and Agriculture, the Forestry Commission, universities, Forestry Research Institute of Ghana, the Environmental Protection Agency, industry players, civil society organisations amongst others was held. A new forest definition of Ghana was agreed at the final stakeholder meeting held on March 1st, 2011. It is defined as:

"A piece of land with a minimum area of 1 hectare, with a minimum tree crown cover of 15%, [or] with existing tree species having the potential of attaining more [than] 15% crown cover, with trees which have the potential or have reached a minimum height of 5.0 meters at maturity in situ".

This change was conveyed to the UNFCCC Secretariat on 21st July 2011.

The definition fits into the IPCC guidelines, the FAO FRA and the Marrakesh Accord.

- **FRA Definition of Forest:** Land spanning more than 0.5 hectares, with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use.
- **The UNFCCC Definition of Forest***:* The UNFCCC as part of the Kyoto protocol defines forest as 'a piece of land with a minimum area of 0.05-1.0 hectare with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential to reach a minimum height of 2-5 meters at maturity in situ' (Peter et al., 2014*).*

[11] Letter dated 6th November 2007 to The Executive Secretary UNFCCC Secretariat, from William Kojo Agyemang-Bonsu UNFCCC Focal Point/COM-DNA Source: http://cdm.unfccc.int/DNA/cdf/files/2008/1706_ghana.pdf

5.2.4 What Does This Mean for Cocoa Landscapes and Other Lands?

While there is a focus on cocoa landscapes in terms of REDD+ the decisions that are made will also need to be assessed with respect to their application and implications for other lands, including savannah, other tree crops (coffee, rubber, cashew, fruit trees) and cropland.

For cocoa landscapes this means that:

- Areas of planted cocoa under shade that meet the canopy cover threshold of 15% are mapped as forest.
- Areas of cocoa not under shade but where the trees are more than 5m high are mapped as forest.
- All other areas of cocoa that do not meet this definition are mapped as cropland.

Cocoa plantings do not match the forest definition adopted by Ghana due to not meeting the height requirement of five metres. From the smallholder cocoa agroforestry perspective, using the number of non-cocoa trees to express shade regime, is inconclusive. There are many species of inherently smaller diameter in the cocoa landscape, but their contribution to shade is very minimal and in the true sense, they are not really contributing to shade the cocoa. However, a few indigenous timber trees currently existing in the cocoa landscape contribute to relatively high shade cover due to their broad crowns, in effect, the number of stems of non-cocoa trees does not necessarily translate into shading for the cocoa. Consequently the opportunities for REDD+ under various strategies rely on upper canopy non-cocoa trees (mostly indigenous timber trees) that will contribute to meeting the forest definition in the cocoa landscape with respect to canopy cover, which must be 15% or greater.

A study is therefore under way to obtain an estimate of the shade provided by the upper canopy trees to cocoa, and the contribution of these upper canopy trees to canopy cover, relative to the national forest definition. The crown area of each upper canopy non-cocoa tree within a sample of cocoa farms has been estimated by measuring the diameter of the crown in eight different directions, following the cardinal points and a subdivision within the cardinal points, i.e. North, South, East and West and then North-West, North-East, South-West and South-East. The diameter measurements are taken from one tip of the crown to the other. This approach ensures that the variation of the pattern of the crown is captured. The total crown cover for all the upper canopy trees is expressed as a percentage per hectare to ensure easy comparison with the parameters of the national forest definition at the plot level.

The study is assessing the possibility of using Landsat, in this case using imagery derived from google earth, to differentiate contiguous cocoa from ‘shade cocoa’ mostly occurring in patches, using the different colour regimes that are presented for the crowns of upper canopy trees and that of cocoa. The knowledge of the percentage crown cover per hectare at the plot level derived from actual measurements of the crown of upper canopy trees in over 90 one-ha plots is to be used as a guidance to identify shade distribution within the landscape. As understanding and research improves it may be feasible to develop a supervised classification of remote sensing imagery that segregates cocoa and shade cocoa that matches the forest definition adopted by Ghana. Subject to the progress of the research this approach using Landsat is consistent with the Standard Operating Procedure 003 Acquisition of Remote Sensing Data and Generation of Activity Data.

These same evaluations should be made in Ghana at least for the other types of land classes to be applied under the UNFCCC guidance.

Alternatively, Ghana could adopt a definition for cropland which includes areas that meet the definition of forest, but their primary function is the production of food rather than timber products.

5.2.5 What Are the Implications of Ghana's Forest Definition?

Under REDD+, a Monitoring, Reporting and Verification (MRV) system for tracking deforestation, forest degradation, reforestation and enhancement of carbon stocks is required. Such a system would rely in part on satellite remote sensing at the national and sub-national scales. The current definition will allow for the use of satellite imagery for monitoring purposes which will make it less expensive thereby contributing to sustainability and cost effectiveness.

If an area of land meets the forest definition Ghana has adopted then it will be mapped as forestland. If an area of land does not meet the forest definition, as mono-cropped cocoa does not, then it would be mapped as one of the non-forest UNFCCC categories; in this case cropland. The application of the forest definition determines how cocoa has to be treated. If an area of cocoa is 1 hectare has canopy cover 15% or greater, height >5m then it is forestland under the definition.

It may also mean most of the cocoa farms will not be classified as forest since the farm holdings are small in size (less than 1 ha). More accurate mapping of cocoa landscapes will come from other sources, other than remote sensing. The mapping of cocoa landscapes for the purposes of the Forest MRV for Ghana may be achieved by incorporating management information in the stratification of the areas defined as forest. This management information could come from the COCOBOD's ongoing program to map the cocoa farm boundaries. The mosaic nature of the landscape in Ghana suggests that remote sensing at reasonable cost is insufficient on its own to produce reliable activity data in situations where forest, food crops and cocoa are in small intermingled holdings.

5.3 Existing National Land Use and Land Cover Classification Scheme Reviewed

The review of the relevant schemes and approaches in Ghana has led to the development of the Standard Operating Procedure SOP 004 Stratification of Lands. This applies to the wall-to-wall classification of all lands within Ghana and is the recommended classification. It relates to IPCC methods that require forest classification and associated stratification and the area of each stratum. The suggested basic stratification is into primary forest (PF), modified natural forest (MNF) and planted forest (PF).

The stratification of forest in Ghana also acknowledges legal management regimes and distribution of the forest resources across the ecological zonation. It also takes into consideration the level of canopy closure of the forest which reflects on the condition of the forest and carbon content of the various carbon pools across the ecological zones. Plantations established to restore the forest cover of Ghana are also delineated.

The steps described in the standard operating procedure follow the general principles outlined in the FPP report and, the national definition of forest land which falls within the UNFCCC definitional thresholds. This SOP meets the good practice approaches set by the IPCC 2006 guidelines and also takes into account the diversity of the forest resource within and across the ecological landscape of Ghana.

A description of the elements and aspects of the existing national land cover schemes considered, follows.

5.3.1 Description of Ecological Zones of Ghana

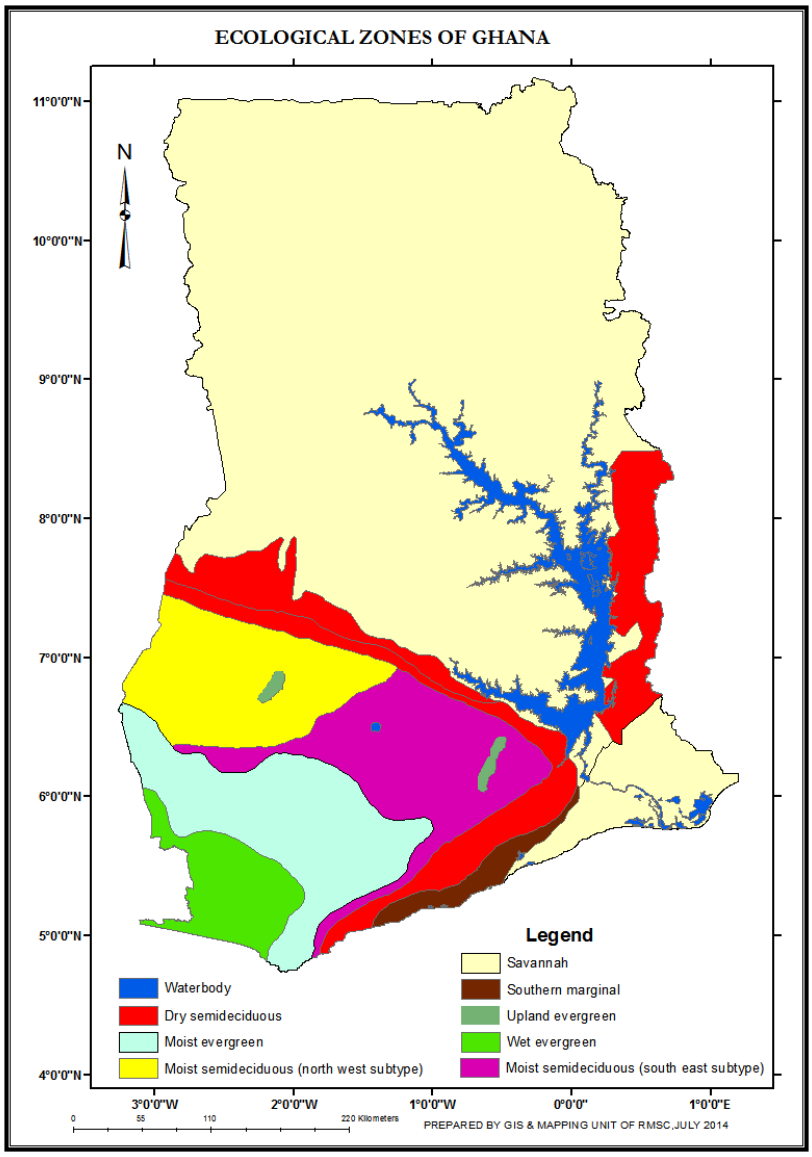
A closer look at Ghana's vegetation cover reveals a pronounced environmental gradient from the evergreen rainforest of the western coasts through to the dry semi-deciduous forest of the forest-savannah transition to the savannah environment of the northern regions. This ecological difference of Ghana has been well classified by Hall and Swaine (1981). These groupings are a reflection of local climatic and altitudinal differences prevailing in the area which stretch beyond the boundaries of Ghana. The classification is based on the gradual change in forest composition, from the south west, where the rainfall is highest and the forests are evergreen, towards the savannah in the east and north, where the forest is dry and deciduous. Mean rainfall

along the vegetation gradient also varies (1000-2150 mm yr^{-1}) and Swaine (1996), reported significant differences in soil fertility reflected in the pH (3.8-7.0).

The nine Ecological Zones are:

1. Wet Evergreen
2. Moist Evergreen
3. Moist Semi-deciduous South East
4. Moist Semi-deciduous North West
5. Dry Semi-deciduous
6. Upland Evergreen
7. Southern Marginal
8. Savannah (Guinea subtype)
9. Savannah (Sudan subtype).

Figure 5.1 Ecological Zone Map of Ghana



Source: RMSC 12/07/2014

The Ecological Zones are described as follows:

1. Wet Evergreen (WE): Rainfall exceeds 1750 mm per annum. It can rain throughout the year. The vertical structure is compressed and Trees rarely exceed 40 m. It has a mean basal area of 25.5 m^2 ha^{-1} and mean density of 445 stems ha^{-1} of all trees ≥ 10 cm dbh. There is scarcity of deciduous trees in the canopy (less than 20%), and very rich species diversity with about 200 tree species found in this zone. There is no fire damage. Soils show severe effects of leaching with soil pH ranges from 3.8-4.3.
2. Moist Evergreen (ME): Mean annual rainfall is between 1500 and 1750 mm. It is sandwiched between WE and moist semi-deciduous. It has less floristic diversity with about 170 tree species. The vertical height of the trees is about 43 m. The deciduous canopy trees account for less than 20%. Basal area estimated at 23.5 m^2 ha^{-1} and stem density is about 505 trees ha^{-1}. It has experienced little fire damage. Soil is poorer in nutrients compared with drier forests.
3. Moist Semi-deciduous South East (MSSE): Mean annual rainfall is between 1250 and 1750 mm. It is the wet part of the semi-deciduous forest. A mixture of evergreen and deciduous tree species and it is the most productive among the forest zones. It has few tree species (about 100) but majority of commonest species in Ghana achieve their greatest frequency here. It has the tallest trees, heights often exceeding 50-60 m. Less depletion of soil nutrients compared to WE and ME, and soil pH = 5-6. Less fire damage to the forest reserves than MSNW and DS. Mean basal area is estimated at 23.2 m^2 ha-^{1}
4. Moist Semi-deciduous North West (MSNW): Mean annual rainfall is between 1250 and 1500 mm. The drier part of the moist semi-deciduous contains several species rare in Ghana. It is also made up of mixture of evergreen and deciduous species. Most of the country's forest reserves are concentrated here. The vertical structure is similar to MSSE. It has frequent wild fires which have caused some damage to forest reserves in the northern portions of this zone. Mean basal area estimated at 22.6 m^2 ha-^{1}
5. Dry Semi-deciduous (DS): This zone was formerly sub-divided to inner and outer (fire) zones. It has a wide range of annual rainfall ranging between 1000 to 1500 mm. The zone has about 156 tree species and the vertical structure ranges from 30-45 m. It is heavily degraded because of frequent fires which have led to frequent salvage logging of its economic species. Most of the forest reserves in this zone are being converted to plantation forest.
6. The Upland Evergreen is a mixture of wet and moist forest species. It has three major forest reserves namely the Atewa Range, Atewa Range Extension and Tano Ofin.
7. The Southern Marginal forest is shorter than 30m, has thick undergrowth and may include high densities of multiple species.
8. The Savannah vegetation is predominantly in the northern territories of the country where mean rainfall is low. It is predominantly made up Guinea Savannah and Sudan Savannah (the boundaries between the two are not distinct). These zones have short vertical structure ranging between 20 to 30 m on average. They are also characterised by low species diversity and most species in this zone are fire resistance.

5.3.2 Primary Designated Use

The Primary Designated Use (PDU) of forest land in Ghana is characterised according to the descriptions of use:

- Off-Reserve: off-reserve areas in Ghana are predominantly for the cultivation of crops and other infrastructural development.
    - Sacred Groves: are usually intact forest in off-reserve areas conserved and protected by local communities through customs, norms and beliefs
    - Wildlife Conservation Areas: consists of National Parks, Wildlife Sanctuaries, Strict Nature Reserves and Game Production Reserves

- Forest Reserves: There are about 280 in Ghana mostly situated within the High Forest Zone. They are divided into four depending on their Primary Designated Use or their major management objective.
    - Production Forest: These are Forest Reserves or areas within Forest Reserves managed primarily for timber production, 715,000 ha. Logging is conducted by TUC Holders and Concessionaires using set out rules and procedures under guidance and monitoring by the Forestry Commission
    - Protection Forest: These are Forest Reserves or areas within Forest Reserves where logging is not permitted and the forest is managed solely for environmental protection. They are sub-divided into Hill Sanctuaries, Swampy Areas, Globally Significant Biodiversity Areas, and Provenance Protected Areas.
        - Hill Sanctuaries: These are protected Reserves or areas within Forest Reserves characterised by steep slopes usually exceeding 15 degrees
        - Swampy Areas: These are protected Reserves or areas within Forest Reserves that are waterlogged
        - Globally Significant Biodiversity Areas: These are protected Reserves or areas within Forest Reserves designated for the protection of biodiversity
        - Provenance Protected Areas: These are protected Reserves or areas within Forest Reserves maintained as gene banks for certain economic species. They are protected completely from logging.

5.3.3 Legal Management Scheme

Some areas of land have a Legal Management Scheme (LMS), which is the tenure allocated to them under law in Ghana and include:

- Gazetted Forest Reserves: are forest areas that fall within the permanent forest estate that were legally constituted and their boundaries well defined. They are managed by the Forestry Commission of Ghana in trust of the people. It comprises of Forest Reserves for the production of timber and provision of environmental services, National Parks and Game Production Reserves.
- Non Gazetted Forest Reserves: These are areas that fall outside the gazetted forest reserves. Timber exploitation is regulated by the FC but ownership is vested in the individual landowners.
    - Sacred Groves: These are predominantly intact forest in off-reserve areas conserved and protected by local communities through customs, norms and beliefs
    - Dedicated Forest: Any forest land outside the permanent forest estate that is conserved and managed by the communities.

5.4 The Forest Definition and Land Use Land Cover Classification for the Historical Reference Level Assessment

Considering the national circumstances of Ghana the forest definition and land use cover classification to be applied for the reference level assessment is:

- Forest Definition for Ghana
    - *"A piece of land with a minimum area of 1 hectare, with a minimum tree crown cover of 15%, [or] with existing tree species having the potential of attaining more [than] 15% crown cover, with trees which have the potential or have reached a minimum height of 5.0 meters at maturity in situ".*
    - This change was conveyed to the UNFCCC Secretariat on 21st July 2011 and fits into the IPCC guidelines, the FAO FRA and the Marrakesh Accord.

- Land use cover classification for Ghana
  - Ecological Zones for Ghana
    - Wet Evergreen (WE)
    - Moist Evergreen (ME)
    - Upland Evergreen
    - Moist Semi-deciduous North West (MSNW)
    - Moist Semi-deciduous South East (MSSE)
    - Dry Semi-deciduous (DS)
      - Semi Deciduous (fire zone)
      - Semi Deciduous (inner zone)
    - The Southern Marginal
    - The Savannah vegetation
- The Primary Designated Use (PDU) of forest land in Ghana is:
  - Off-Reserve:
  - Forest Reserves (or On-Reserve):
- The Legal Management Scheme (LMS):
  - Gazetted Forest Reserves
  - Non Gazetted Forest Reserves.
    - Sacred Groves
    - Dedicated Forest

With 9 Regional Ecological Zones, 2 PDU classes, and 3 reserve classes, the Baseline Forest Resource Map has potentially 54 combinations or strata.

5.4.1 Implication of the Forest Definition to REL

Within Ghana the forest definition has to be applied to the ecological zones and the forest assemblages that they contain, which is briefly described below.

- High Forests:
  - Almost all vegetation cover within the high forest zone will qualify as forest as they meet all the requirements of forest definition: For gazetted forest reserves this corresponds to an area of approximately 1.6 million ha. This figure forms part of area of forest (9,195,137 ha) reported by the FPP (2010) land use mapping.
- Cocoa Landscapes:
  - There are two schemes of cocoa cultivation, namely shaded and non-shaded cocoa farms. Areas of planted cocoa under shade that meet the canopy cover threshold of 15% are mapped as forestland. All other areas of cocoa that do not meet this definition are mapped as cropland
- Savannah Ecosystems:
  - Over the years the savannah ecosystem has been neglected even though it plays a key role in the sustenance of the people living in and around the resources and constitute an important source of GHG emissions into the atmosphere thereby contributing to climate change dynamics The savannah landscape constitutes about two thirds of the entire land mass of Ghana. The forest definition for Ghana allows inclusion of savannah woodlands and other vital landscapes such as gallery forest within the savannah environment to be captured, measured and reported as forest.
- Other Remnant Forests:
  - Sacred Groves, community dedicated forests, fallow lands which meet the criteria of forest definition will be accounted for as forest.

6. METHODS AND APPROACHES FOR ESTABLISHING FOREST REFERENCE EMISSION LEVELS

Forest reference emission levels provide a quantitative way to measure the performance of a country, programme, or project in reducing emissions or increasing removals.

The basic concept of REDD+ is to provide economic incentives for implementing activities and achieving emission reductions. The UNFCCC decisions on REDD+[12] define the requirement to establish a forest reference emission levels (FRLs) and/or forest reference level (FREL/FRLs). FREL/FRLs are expressed in tonnes of carbon dioxide equivalent per year and defined as "benchmarks for assessing each country's performance" in implementing REDD+ activities and results-based payments subsequently based on measured, reported and verified emission reductions.

The terms forest reference emission level (FREL) and forest reference level (FRL) are commonly used interchangeably in the literature. The terms can be more clearly distinguished as follows:

- FREL - the benchmark for emissions from deforestation and forest degradation and relates strictly to REDD activities only.
- FRL – the benchmark for emissions from deforestation and forest degradation and removals from sustainable management of forests and enhancement of forest carbon stocks for all REDD+ activities.

The term FREL will be used throughout this document as at this point in time Ghana will be developing its reference level covering activities that result in emissions (i.e. deforestation); reporting of removals may be included as data availability improves.

6.1.1 Types of Forest Reference Emission Levels

There are effectively two types of FRELs:

1. Business as usual (BAU) baseline which represents a projection of emissions (in t CO_{2-e} / year) from deforestation and forest degradation in the absence of the REDD+ action (Figure 6.1). It is used to measure the impact of REDD+ policies and actions and to define emission reductions, which are the difference between realized emissions and the RL.

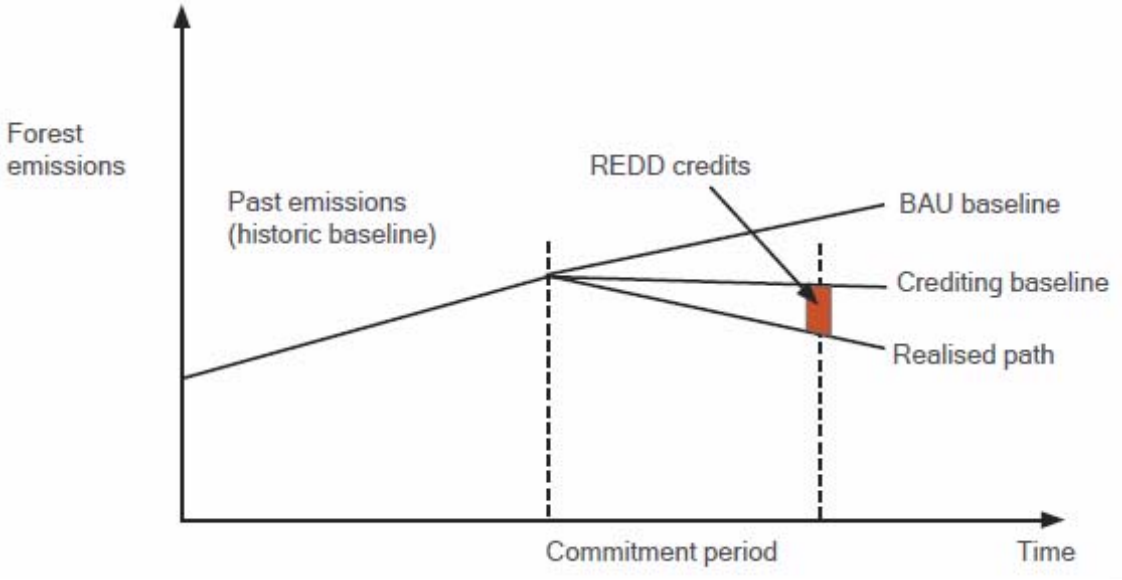
2. Financial Incentive Benchmark FIB (crediting baseline depicted in Figure 6.2) which forms the benchmark for estimating results-based incentives: direct payments to countries, subnational units or projects for emission reductions. The FIB may deviate from BAU baseline, based on national circumstances and political considerations that are relevant for the FIB. It is also referred to as the compensation baseline or crediting baseline. The FIB is not recognized in UNFCCC discussions, however, from an analytical viewpoint it is essential to make the distinction between the two types of RLs.

[12] For the specific decisions see:

UNFCCC, 2012. Decision 12-II/CP.17. Modalities for forest reference emission levels and forest reference levels. http://unfccc.int/resource/docs/2011/cop17/eng/09a02.pdf#page=16

UNFCCC, 2014. Decision -/CP.19. Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels. http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_frl.pdf

Figure 6.1 Types of Forest Reference Levels



Source: www.redd-net.org

The approaches to developing a FREL are data-driven and adopting a step-wise approach enables countries to match data availability and quality in a country and allows the flexibility in considering carbon pools, other gases and REDD+ activities.

Establishing FRELs requires extensive data on historic emissions and national circumstances. Assembling and analysing such data generates knowledge on the drivers of deforestation and forest degradation, and can therefore inform potential policies to address these.

The following three approaches to estimating FRELs are reported in the literature (GOFC-GOLD, 2013)

- **Strictly historical approach** – which is a simple extrapolation using historical forest area estimates. This approach assumes there will be no change in the trend of activities included in the assessment.
- **Adjusted historical approach –** this approach uses the predictive power of historical trends and adjusts that trend to improve predictions based on factors that represent national circumstances such as stage in the forest transition and deforestation drivers.
- **Simulation models -** Basis is usually land rent and the demand and supply of new land for agriculture May include historical deforestation rates.

The strictly historical approach is generally used when there is no certain driver data available or when there is an obvious trend in the data. It is a simple trend projection using national statistics from historical activity. It uses simple rules (in technical terms). The primary data needs for this approach are historical land cover and land cover change statistics.

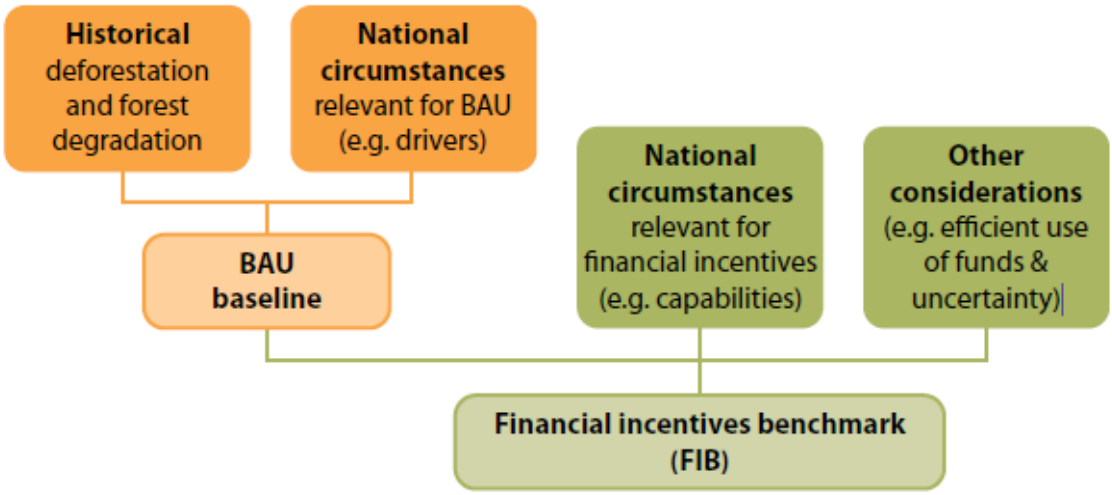
The adjusted historical approach relies on the predictive power of historical trend data but also draws on a driver-based assessment and predictions to adjust the trend using multiple regression analysis. This approach includes data-driven reasoning for deviations from historical trend (i.e. national circumstances). It establishes relationships with underlying causes (proxies) and requires justification why and how deforestation varies from historical trend on the level of drivers and activities. The primary data needs for this approach are historical land cover and land cover change statistics and information on national circumstances such as stage in forest transition / quantitative driver data for key activities / socio-economic factors.

The use of simulation models is suitable when countries have high-quality data for modelling deforestation drivers to test different methods for RL setting and explore the implications of different policy scenarios. The main data needs for this approach are historical land cover and land cover change statistics and information on national circumstances such as stage in forest transition / quantitative driver data for key activities / socio-economic factors.

The financial incentives benchmark (FIB) or compensation baseline is an adjusted reference level needed to determine the eligibility of UNFCCC Parties for international, results-based support for REDD+, and to calculate the support on the basis of measured, reported, and verified emission reductions. The UNFCCC has not yet finalized the details of the financial mechanism yet and therefore has not decided on guidelines on how to set the FIB.

Based on the current available literature setting of FIB is likely to consider a risk based approach that takes into consideration national circumstances such as demonstrated capabilities and policy frameworks as well as other considerations such as efficient use of funds and level of uncertainty in the estimation approaches.

Figure 6.2 Linking Reference Levels to Results Based Finance



Source: Angelsen et al. 2012

Other important considerations in the development of the FIB are likely to include:

- conditions that avoid as much as practicable international leakage
- equity in benefit and burden sharing; consistent with the UNFCCC principle of "common but differentiated responsibilities and respective capabilities - CBDRRC"
- effectiveness and efficiency acknowledging that the lower the FIB is, the higher the carbon price and the greater the incentives for larger emission reductions.

The BAU baseline is equivalent to the terms FREL/FRL in the UNFCCC REDD+ framework and is the type of FREL/FRL referred to throughout the remaining sections of this report.

The methods and approaches for developing the FIB are not yet defined in the UNFCCC REDD+ framework, but in other programs/standards a risk based approach is commonly applied resulting in a percentage based deduction from the BAU baseline.

6.1.2 UNFCCC Guidelines and Modalities Related to Forest Reference Emission Levels / Forest Reference Levels

The guidelines for reporting FRELs/FRLs were adopted at COP17 in Durban (Decision 12/CP.17) and subsequently the guidelines and procedures for the technical assessment of proposed FRELs/FRLs were adopted at COP19 in Warsaw (Decision 13/CP.19). These decisions state that counties can submit their FRELs/FRLs on a voluntary basis and in the context of results based payments.

The guidelines on developing a FREL/FRL set out in the Warsaw Framework specifically state that each developing country Party aiming to undertake REDD+ activities should include in its FREL/FRL submission, information that is transparent, complete,[13] consistent with guidance agreed by the Conference of the Parties (COP) and accurate for the purpose of allowing a technical assessment of the data, methodologies and procedures used in the construction of a FREL/FRL.

The information provided should be guided by the GPG2003 and include:

(a) Information that was used by Parties in constructing a FREL, including historical data, in a comprehensive and transparent way;

(b) Transparent, complete, consistent and accurate information, including methodological information, used at the time of construction of the FREL, including a description of data sets, approaches, methods, models, if applicable and assumptions used, descriptions of relevant policies and plans, and descriptions of changes from previously submitted information, if any;

(c) Pools and gases, and REDD+ activities included in the FREL and the reasons for omitting a pool and/or activity from the construction of the FREL, noting that significant pools and/or activities should not be excluded;

(d) The definition of forest used in the construction of the FREL and, if appropriate, in case there is a difference with the definition of forest used in the national greenhouse gas inventory or in reporting to other international organizations, an explanation of why and how the definition used in the construction of forest reference emission levels and/or forest reference levels was chosen.

Countries developing FRELs must ensure that the methodologies they adopt result in the results being expressed in tCO_2-e per year and consistent with forest emissions and removals included in the national GHG inventories.

Subnational FRLs may be elaborated as an interim measure, with an eventual transition to a national FREL. Countries may also use a step-wise approach for developing FRELs, thereby using better data and improved methods and incorporating additional carbon pools over time. This allows the country the flexibility to update a FREL periodically as appropriate, taking into account new knowledge, new trends and any modification of scope and methodologies.

Once completed and submitted to the UNFCCC, information on submitted FRELs will be made available on the UNFCCC REDD web platform[14]. Proposed FRELs will be technically assessed

[13] Complete here means the provision of information that allows for the reconstruction of the forest reference emission levels and/or forest reference levels.

[14] See http://unfccc.int/4531

in the context of results-based payments, following guidelines and procedures, decided by the COP.

The guidance defined by the UNFCCC highlights the importance of a step-wise 'data-driven' approach to the construction of FRELs. This type of approach recognizes that for many countries existing data may be limited and of low quality and therefore new data may need to be collected and compiled which will take time. Adopting a step-wise approach for FREL development assists countries to match data availability and quality in a country to the approach adopted. It provides a starting point for all country situations and facilitates improvements over time with the motivation to reduce uncertainties.

Countries should focus on key categories during early steps when data are highly uncertain and also consider the important of maintaining consistency through time in reporting of pools and/or activities for reporting REDD+ performance. It is widely recognised that the inclusion of degradation in early RL development will be a challenge as historical activity data at the national level will be limited for small-scale, locally driven degradation processes.

6.1.3 Forest Carbon Partnership Methodological Framework

Other relevant guidance to Ghana in its development of a FREL is the methodological guidance recently published by the World Bank FCPF.

The FCPF is designed to pilot the implementation of REDD+ programs, via use of positive incentives that seek both to achieve net emission reductions across the portfolio, and pilot REDD+ across a diverse set of countries. FCPF Participants, of which Ghana is one, will take this into account when selecting Emission Reductions Programs (ER Programs) for signing an Emission Reduction Payment Agreement (ERPA).

In relation to the development of FRELs the methodological framework outlines a number of indicators which are consistent with UNFCCC framework and IPCC methodological guidelines however are also more prescriptive in relations to some design elements.

How each of these elements, along with UNFCCC requirements and data quality/availability with Ghana contributed to the selected FREL approach is outline in **Table 7.1**.

6.1.4 Technical Assessment of Forest Reference Emission Level / Forest Reference Level

The FREL is subject to a technical assessment (Decision 13/CP.19, paragraph 1), with details of the technical assessment given in the Annex of Decision 13/CP.19 (paragraph 3), including the requirement to publish the FREL and the report from the technical assessment on the UNFCCC REDD web platform (paragraph 18).

The technical assessment process will be coordinated by the UNFCCC secretariat. The assessment team will be composed of land use, land-use change and forestry (LULUCF) experts selected from the UNFCCC roster of experts. Each submission shall be assessed by two LULUCF experts selected from the UNFCCC roster of experts, one from a developed country and one from a developing country.

Participating experts will serve in their personal capacity and will be neither nationals of the Party undergoing the technical assessment nor funded by that Party. Each assessment team will conduct a thorough and comprehensive assessment of the submitted forest reference emission level and/or forest reference level and will prepare a report under its collective responsibility.

The guidelines and procedures for the technical assessment of the FREL/FRL are outlined in the Warsaw Framework (Decision 13/CP.19).

The objectives of the technical assessment are:

a) To assess the degree to which the information provided is in accordance with the guidelines for the construction of FRELs detailed by the UNFCCC contained in the annex to decision 12/CP.17;
b) To offer a facilitative, non-intrusive, technical exchange of information on the construction of FRELs with a view to supporting the capacity of developing country Parties for the construction and future improvements, subject to national capabilities and policy.

The scope of the technical assessment covers:

- The assessment of data, methodologies, and procedures used in the construction of its FREL;
- The extent to which the FREL maintains consistency with corresponding anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks as contained in the national greenhouse gas inventories;
- How historical data have been taken into account in the establishment of the FREL;
- The extent to which the information provided is transparent, complete[15], consistent and accurate, including methodological information, description of data sets, approaches, methods, models, if applicable, and assumptions used and whether the FREL are national or cover less than the entire national territory of forest area;
- Whether a description of relevant policies and plans has been provided, as appropriate;
- Whether descriptions of changes to previously submitted FREL have been provided, taking into account the stepwise approach[16];
- Pools and gases, and activities included in the FREL, and justification of why omitted pools and/or activities were deemed not significant;
- Whether the definition of forest used in the construction of the FREL has been provided and, if it is different from the one used in the national greenhouse gas inventory or from the one reported to other international organizations, why and how the definition used was chosen;
- Whether assumptions about future changes to domestic policies have been included in the construction of the FREL;
- The extent to which the FREL value is consistent with the information and descriptions provided by the Party.
- As part of the technical assessment process, areas for technical improvement may be identified and these areas and capacity-building needs for the construction of future FRELs may be noted by the Party concerned. It is not within the scope of the technical assessment to make any judgment on domestic policies taken into account in the construction of the FREL.
- Assessment sessions will be organized once a year with the process involving a number of well-defined requirements and steps.
- Submissions received no later than 10 weeks ahead of a session will be assessed at that session. The assessment sessions will take place in Bonn, Germany.
- The Party that submitted the FREL may interact with the assessment team during the assessment of its submission to provide clarification and additional information to facilitate the assessment by the assessment team.
- The assessment team may seek additional clarifications from the Party no later than one week following the assessment session. This may result in the provision of technical inputs to the Party on the construction of its FREL. The Party is to provide

[15] Complete here means the provision of information that allows for the reconstruction of the forest reference emission levels and/or forest reference levels.

[16] Decision 12/CP.17, paragraph 10.

clarifications to the assessment team no later than eight weeks following the request. As a result of the facilitative process referred to above, the Party may modify its submitted FREL in response to the technical inputs of the assessment team.

- In the event that the Party modifies its submitted FREL in response to the technical inputs of the assessment team, the assessment team will consider this information within four weeks from the submission of the modified FREL.
- The assessment team will prepare a draft report and make it available to the Party no later than 12 weeks[17] following the assessment session. The report should include a short summary.
- The Party will have 12 weeks to respond to the draft report of the assessment team.
- The assessment team will prepare a final report within four weeks following the Party's response and the report will be sent to the secretariat for publication via the web platform on the UNFCCC website.[18] The report should contain an assessed FREL and, if appropriate, areas identified for further technical improvement, and capacity-building needs if noted by the Party concerned, for the construction of future FRELs, incorporating the Party's response.

The UNFCCC secretariat will prepare a synthesis report on the technical assessment process of countries FRELs which will be made public. The technical assessment will cover data quality, methodologies, and procedures used for developing FRELs and will focus on:

- Consistency of FREL with the forest emissions and removals included in the national greenhouse gases inventories
- How historical data have been taken into account
- The extent to which the information provided is transparent, complete, consistent and accurate
- Whether descriptions of changes to previously submitted FRELs have been provided taking into account the stepwise approach
- Pools and gases, and activities included, and justification of omitting pools and/or activities
- The definition of forest that has been provided
- Whether assumptions about future changes to domestic policies have been included
- The extent to which the FREL is consistent with the information and descriptions provided by the country

Therefore in the design, development and documentation of the FREL all of these elements will need to be covered. Following the completion of the technical assessment process, areas for technical improvement and capacity building needs may be identified and the country will be expected to respond to these suggestions in a process of continual improvement.

[17] In the case that a Party modifies its submitted FREL/FRL in accordance with paragraph 15, this period will be extended to no later than 16 weeks.

[18] <http://unfccc.int/redd>.

7. APPROPRIATE APPROACHES FOR DEVELOPING A FOREST REFERENCE EMISSION LEVEL

Key points of this section:

- Consultations with the EPA on Ghana's GHG inventory process discussed the 3rd NC and the approach taken using the SOPs. Ghana will go ahead with the existing BUR report as drafted noting the development of the Forest MRV and the plan for that to replace the current method and be improved over time.
- The Ghana National GHG inventory arrangements and cycle have been considered in developing the method and approach for the Forest MRV.
- The Forest MRV is clearly noted in the national GHG reporting arrangements (Section 11).
- The approach developed takes into account the previous GHG inventories and forest inventories and biomass studies that Ghana has undertaken. Ghana is already able to provide Tier 2 estimates.
- The Forest MRV system relies on forest monitoring that has been done in the past and is operational, including forest inventories and district management information.
- SOP 005 - National Forest Inventory sets out the field procedures consistent with the approach taken in the FPP and includes the identification of numbers of plots for field measurements.
- The details of sources for national and default values to be used for estimating emissions are provided in the SOPs.
- The SOPs have been developed to ensure Ghana meets the requirements set out by the UNFCCC and the FCPF and are consistent with IPCC methods and its own national circumstances using the data sets and information that are available in Ghana.

The selection of the most appropriate methodology and approach to use in the development of Ghana's FREL took into consideration the following:

1. UNFCCC guidelines and modalities, specifically decisions adopted in 12/CP.17 and 13/CP.19
2. Consistency with the Forest Carbon Partnership Facility Requirements
3. Available activity data and emissions factors within Ghana to meet IPCC Approach 3 and Tier 2 reporting
4. State of forest transition and available information on drivers of deforestation and forest degradation.

The following additional reference material was also relied in the decision making process:

- GFOI Methods and Guidance Document
- GOFC-GOLD Sourcebook

The assessment approach for the most appropriate FREL construction approach was divided into two phases. The first phase focused on selecting the most appropriate methodology based on the guidelines and criteria for establishing FRELs, the second phase focused on the scope of the FREL.

This assessment approach required the development of two tables to assess the requirements of the UNFCCC modalities and guidelines as defined in REDD+ decisions, the FCPF methodological framework and Ghana's country specific data resources.

The results of the two phase assessment are provided in Table 7.1 and Table 7.2.

7.1 Approaches and Methodologies Determined and Recommended

The guidance provided by the GFOI-MGD and GOFC-GOLD interpret the UNFCCC decisions on REDD+ to require Approach 3 for generating activity data (wall-to-wall mapping using remote sensing techniques) and at least Tier 2 (national specific emission factors).

In addition the UNFCCC requirement to rely on historical data combined with the limitations imposed by the FCPF guidelines on the historical reference period and the situations when adjustment of historical average deforestation rates are allowed, leads to the recommendation of a simple historical average approach to develop the projected future deforestation rate in the forest reference emission level.

The UNFCCC requirement to rely on historical data combined with the limits and thresholds imposed by the FCPF methodological framework in the development of FRELs leads to the recommendation of a **simple historical average approach** to develop the projected future deforestation rate in the forest reference emission level.

The guidelines and criteria for the establishment of FREL/FRLs are presented in Table 7.1 and Table 7.2. The first table, 7.1, identifies that Ghana's circumstances allows only a simple historic approach in setting a FREL for Ghana In accordance with the FCPF methodological guidelines. The adjusted historical approach and simulation models are not applicable. The second table, 7.2, sets out the basis for the scope of the FREL for Ghana. The combination of the UNFCCC and FCPF requirements are set out against the available data for Ghana. These aspects are then incorporated in the Standard Operating Procedures that provide the detail of preparing the FREL from the acquisition of remote sensing, applying stratification, preparing the emissions factors, including the national forest inventory, calculating the REL and uncertainty of the estimate.

As the socio-economic data on drivers of deforestation, degradation and REDD+ are developed and analysed the potential for an adjusted historical approach or a simulation approach, using models, could be applied for Ghana.

Table 7.1 Basis of Selection of Simple Historic Approach to FREL Construction

Element	UNFCCC Requirement	FCFP Requirement	Available Data
Historical reference time period	Information used by Parties in constructing a FREL must include historical data	Indicator 11.1 - The end-date for the historical Reference Period is the most recent date prior to 2013 for which forest-cover data is available to enable IPCC Approach 3	Ghana has wall-to-wall forest cover data equivalent to IPCC Approach 3 for 2010.
		Indicator 11.2 - The start-date for the historic Reference Period is about 10 years before the end-date. An alternative start-date could be allowed (but) not more than 15 years before the end-date	Ghana has wall-to-wall forest cover data equivalent to IPCC Approach 3 for 2000.
Approach	Any modalities for the construction of forest reference levels and forest emission reference levels to be flexible so as to accommodate national circumstances and capabilities. Parties are to submit information and rationale on the development of their forest reference emission levels and/or forest reference levels, including details of national circumstances and if adjusted include details on how the national circumstances were considered,	Reference Level may be adjusted upward by a limited amount above average annual historical emissions only if the historical deforestation rate has been minimal AND are likely to increase in comparison to historical rates	Ghana's historical deforestation rate from the FPP data was found to be on average 1.58% over the past decade. By comparison, the mean annual deforestation rate in tropical forested non-Annex I countries, based on FAO FRA data from 2010, was 0.52%. Therefore Ghana's historical deforestation rate could not be considered to be minimal and so the reference level does not meet the adjustment criteria. **For Ghana a simple historic approach applies.**

Table 7.2 Basis of Establishing the Scope of the FREL

Element	UNFCCC Requirement	FCFP Requirement	Available Data
National Forest Definition	Decision 12/CP.17 - Shall be established maintaining consistency with anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks as contained in each country's greenhouse gas inventories;	Indicator 12.1: The definition of forest used in the construction of the Reference Level is specified. If there is a difference between the definition of forest used in the national greenhouse gas inventory or in reporting to other international organizations (including an Forest Reference Emission Level or Forest Reference Level to the UNFCCC) and the definition used in the construction of the Reference Level, then the ER Program explains how and why the forest definition used in the Reference Level was chosen.	Ghana has submitted the National forest definition to the UNFCCC and this definition is consistent with the FAO reporting. This same definition was used in the development of wall-to-wall land cover and land cover change analysis and is consistent with the definition used in the National Inventory.
Scale: Sub(National)	Decision 12/CP.17 - Subnational forest reference emission levels and/or forest reference levels may be elaborated as an interim measure, while transitioning to a national forest reference emission level and/or forest reference level, and that interim forest reference emission levels and/or forest reference levels of a Party may cover less than its entire national territory of forest area;	Indicator 10.2: The ER Program explains how the development of the Reference Level can inform or is informed by the development of a national Forest Reference Emission Level or Forest Reference Level, and explains the relationship between the Reference Level and any intended submission of a Forest Reference Emission Level or Forest Reference Level to the UNFCCC.	To enable consistent reporting at the program level and the National level for FCPF ER program reporting and UNFCCC REDD+ and National Greenhouse Gas Inventories, Ghana's FREL had to be capable of reporting at both the National and the sub-National levels.
IPCC Tiers and Approaches	Decision 12/CP.17 - Annex requirement to use the approaches that are consistent with guidance agreed by the Conference of the Parties and methodologies and procedures used in the construction of a forest reference emission level and/or forest reference level should be guided by the most recent Intergovernmental Panel on Climate Change guidance and guidelines, as adopted or encouraged by	Indicator 10.3: The ER Program explains what steps are intended in order for the Reference Level to achieve consistency with the country's existing or emerging greenhouse gas inventory	In order to account for historical emissions to project future emission, Approach 3 – geographically explicit land use data (wall-to-wall activity data) is required (MGD, 2013, GOFC-GOLD, 2012, IPCC, 2003). Additionally, the use of Tier 2 or 3 – country specific data should be the aim

Element	UNFCCC Requirement	FCFP Requirement	Available Data
	the COP.		for key categories (MGD, 2103, IPCC, 2006). Therefore Approach 3, Tier 2 methods are used in the development of the FREL. In some cases Tier1 default emissions factors have been used and where these factors are considered key (i.e. significant) to the national account these have been highlighted as priority development/collection items.
Activities	Decision 1/CP.16, paragraph 70, a Party undertakes activities as deemed appropriate by it and in accordance with its respective capabilities and national circumstances, noting that significant pools and/or activities should not be excluded. Decision 12/CP.17 (II) states that a step-wise approach to national forest reference emission level and/or forest reference level development may be useful, enabling Parties to improve the forest reference emission level and/or forest reference level by incorporating better data, improved methodologies and, where appropriate, additional pools, noting the importance of adequate and predictable support as referenced by decision 1/CP.16, paragraph 71.	Indicator 3.1: The ER Program identifies which anthropogenic sources and sinks associated with any of the REDD+ Activities will be accounted for in the ER Program. Indicator 3.2: The ER Program accounts for emissions from deforestation. Indicator 3.3: Emissions from forest degradation are accounted for where such emissions are more than 10% of total forest-related emissions in the Accounting Area, during the Reference Period and during the Term of the ERPA. These emissions are estimated using the best available data (including proxy activities or data).	Ghana has sufficient data to include deforestation using Approach 3 and Tier 2 methods. Additional information is required to report forest degradation. The design documents an approach to developing estimates for forest degradation as it is believed this activity represents more than 10% of the total forest-related emissions. These approaches will be priority development areas.
Carbon Pools		Indicator 4.1: The ER Program accounts for all Carbon Pools and greenhouse gases that are significant within the Accounting Area, both for	A key category assessment was conducted for the carbon pools using available country specific data. The carbon pools identified as included and

Element	UNFCCC Requirement	FCFP Requirement	Available Data
		Reference Level setting and Measurement, Monitoring and reporting (MMR). Indicator 4.2: Carbon Pools and greenhouse gases may be excluded if: i. Emissions associated with excluded Carbon Pools and greenhouse gases are collectively estimated to amount to less than 10% of total forest-related emissions in the Accounting Area during the Reference Period; or ii. The ER Program can demonstrate that excluding such Carbon Pools and greenhouse gases would underestimate total emission reductions.	excluded (based on the specific thresholds provided by the FCPF guidelines) were: Included – soil organic carbon, aboveground tree biomass, deadwood, and belowground tree biomass. Excluded – litter, non-tree biomass.

8. METHODS AND APPROACHES FOR ESTABLISHING A NATIONAL MRV SYSTEM

Key points of this section:

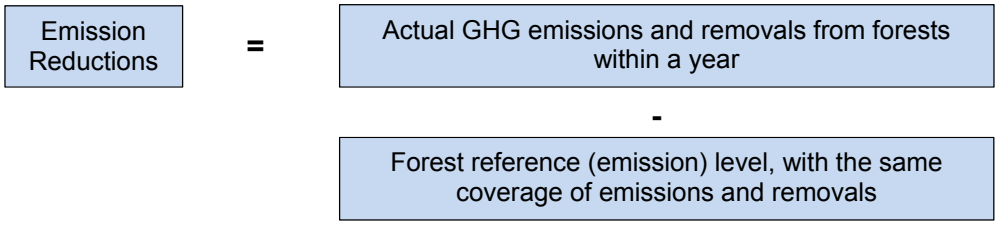
- The design of Ghana's REDD-plus MRV system consists of a number of standard operating procedures to generate activity data and emissions factors for key activities and pools as required by IPCC good practice guidelines.
- SOP 011 presents approaches for estimating emissions from deforestation and forest degradation at the national and sub-national levels from lands defined as forest in Ghana. Due to current data limitations in relation to forest degradation activities, only emissions from deforestation can be developed.
- Priorities for collecting data to complete the reporting of emissions from forest degradation are outlined, being:
    - Increase temporal resolution (time series) to include the years 2013 OR 2014 and 2003, 2005 or 2004 for the development of the RL
    - Estimating area of plantations
    - Data sets for forest degradation and reforestation
- At this stage, the FREL does not include approaches to develop estimates of removals from conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks (in degraded forests).
- There is one national FREL, created from stratification of the nine ecozones of Ghana that are combined into three broad categories for calculation - "Wet", "Moist", "Dry" which is consistent with the available national allometric equations. The FREL is the summation of the calculations of emissions using ecozones as one stratification. The "sub-national" ecozone is a sub-set of the national FREL.
- The integration of data from a wide range of sources is essential. Methods of integrating remotely sensed, model based and measurement data has largely been overlooked. A tool or calculator to do this needs to be developed, as a 'solution' does not exist.

8.1 System Design Framework

Guidance from UNFCCC indicates that MRV is an essential component of the REDD+ mechanism, not only to ensure transparency of the system, but also to be able to reward countries for their efforts in reducing emissions (decision 14/CP.19). Accurate and reliable measurements of forest carbon stocks and changes are needed to report emission reductions and calculate REDD+ credits.

To receive results based payment developing country Parties must be able to report reductions in GHG emissions from forests compared against the forest reference emission level (FREL; Figure 8.1).

Figure 8.1 Measurement / Estimation of REDD+ Results in the Context of Results-based Payments



Demonstrating the results requires the measurement / estimation of:

- actual GHG emissions and removals from forests
- a reference level with the same coverage of emissions and removals, in order to estimate achieved emissions reductions
- a robust and transparent national forest monitoring system to obtain the essential measurements on forest cover and carbon change and to report emission reductions that can be repeated through time.

The UNFCCC recognizes that national forest monitoring systems, with, if appropriate, subnational monitoring and reporting as an interim measure should (decision 4/CP.15 and 11/CP.19):

- build upon existing systems, as appropriate
- enable the assessment of different types of forest in the country, including natural forest
- be flexible and allow for improvement
- reflect, as appropriate, the phased-approach
- use a combination of remote sensing and ground-based forest carbon inventory approaches
- provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities
- be transparent, and the results should be available and suitable for review.

8.2 Standard Operating Procedures

The design of Ghana's REDD+ MRV system consists of a number of standard operating procedures corresponding broadly to generate activity data and emissions factors for key activities and pools as required by IPCC good practice guidelines.

These documents are attached to this report as a separate volume.

8.2.1 SOP 001 Estimating Annual Forest Emissions and Removals

This overarching SOP describes how the outputs from the various SOPs are combined to generate estimates of Annual Emissions and Removals to compare against the FREL and ultimately report progress towards reported REDD+ activities in the context of results based payments for inclusion in a REDD+ annex to the Biennial Update Report (BUR).

This SOP covers approaches for measuring and reporting deforestation and forest degradation which are consistent with the latest IPCC methods and guidance where deforestation is defined as *Conversion of Forestlands.* Neither the GPG2003 nor the *2006GL* identifies forest degradation by name, but since it occurs on Forest Land and does not entail deforestation, GHG emissions associated with degradation are estimated using the methodologies described for *Forest Land remaining Forest Land* set out in section 3.2.1 of the GPG2003[19].

This SOP relies on input data from the following SOPs:

- 003 Acquisition of Remote Sensing Data and Generation of Activity Data
- 004 Stratification of Lands
- 006 Estimation of Above- and Belowground Biomass and Deadwood
- 007 Estimation of emissions from soil organic carbon
- 008 Estimation of emissions and removals from timber harvest
- 009 Estimation of emissions from extraction of wood for fuel
- 010 Estimation of emissions from fire

[19] Corresponding to Section 4.2 of volume 4 of the 2006 GL

- 012 Combining uncertainty

8.2.2 SOP 002 Key Category Analysis

The concept of "key categories" (KC) was created by the IPCC as a way to help countries prioritize resources for improving national greenhouse gas inventories. Key categories have the greatest contribution to the overall level of national emissions. When an entire time series of emission estimates is prepared, key categories can also be identified as those categories that have the largest influence on the trend of emissions over time. In addition, when uncertainty estimates are incorporated into emission estimates, additional key categories are identified.

Sources/sinks of emissions/removals that contribute substantially to the overall national inventory or are key sources of uncertainty in quantifying the overall trend are considered to be KC. Within KC, a pool is significant if it constitutes >25-30% of emissions from the category (GOFC-GOLD, 2012). Key categories should be monitored with Tier 2 or 3 methods. In the REDD+ phased approach a tier lower than required may be reported until national data becomes available.

The results of the key category analysis provide a country with a list of their most important inventory categories. This list is a starting point from which a country can begin the process of improving their greenhouse gas inventory. To improve the national greenhouse gas inventory, it may be necessary to consider applying more accurate or higher tier methodologies, collect more detailed activity data, or develop country-specific emission factors. The inventory category list resulting from this analysis can provide a quantitative framework for the national greenhouse gas inventory team to develop an inventory improvement plan. The key category analysis also provides more complete and transparent information for the National Communication.

8.2.3 SOP 003 Acquisition of Remote Sensing Data and Generation of Activity Data

The Standard Operating Procedure for generating activity data details the approach to analysing remotely sensed data (specifically optical satellite data). This will generate activity data (areas of land use and land use change) for use in the generation of emissions and removals from forest lands in Ghana.

The standard operating procedure was influenced by and related to the following latest version of MRV system and SOPs:

- 001 Estimating annual forest emissions and removals
- 004 Stratification of Lands
- 011 Estimating national and sub-national reference emissions levels
- 012 Combining Uncertainty
- GFOI Methods and Guidance Document (GFOI, 2013)
- GOFC-GOLD Sourcebook (GOFC-GOLD, 2012)
- Report on Mapping of Forest Cover and Carbon Stock in Ghana [PASCO], 2013 (also known as the FPP Report)
- FPP Manual 1 – Procedure Manual on Data Collection and LULUCF
- Project Developer's Guidebook to VCS REDD Methodologies [Authors: David Shoch, James Eaton, Scott Settelmyer] November 2011, Version / 1.0
- Katoomba Group national biomass map for 2008/2009 and the data and imagery used along with the documentation of the methodology
- IUCN – Ghana Report: Ghana Measures Forests from Sky and Land: http://www.forest-trends.org/documents/files/doc_3015.pdf.

The SOP describes the process of analysing satellite imagery in a consistent and transparent manner to create activity data for the purposes of the National Measuring Reporting and Verification (MRV) of greenhouse gas emissions in the forestry sector of Ghana.

Re-measurement and re-calculations will be done for intervening years between two time points as well as when new and more accurate satellite data becomes available to address time inconsistencies associated with the FPP data to meet FCPC new guidelines which came into effect in January 2014.

The steps described in the SOP follow the general principles outlined in the FPP report, including classification, analysis (spatial and time series consistencies), ground verification and accuracy assessment, whilst ensuring that IPCC 2006 good practice guidelines is adhered to.

8.2.4 SOP 004 Stratification of Lands

This standard operating procedure applies to the wall-to-wall classification of all lands within Ghana.

In particular relation to Stratification of areas defined as Forest lands must be reported as all land with woody vegetation consistent with thresholds used to define forest land in the national GHG inventory, sub-divided into managed and unmanaged, and also by ecosystem type as specified in the IPCC Guidelines. It also includes systems with vegetation that currently fall below, but are expected to exceed, the threshold of the forest land category.

IPCC methods require forest classification and associated stratification and the area of each stratum. The suggested basic stratification is into primary forest (PF), modified natural forest (MNF) and planted forest (PF).

The stratification of forest in Ghana also acknowledges legal management regimes and distribution of the forest resources across the ecological zonation. It also takes into consideration the level of canopy closure of the forest which reflects on the condition of the forest and carbon content of the various carbon pools across the ecological zones. Plantations established to restore the forest cover of Ghana are also delineated.

The steps described in this standard operating procedure follow the general principles outlined in the FPP report and, the national definition of forest land which falls within the UNFCCC definitional thresholds. It This SOP meets the good practice approaches set by the IPCC 2006 guidelines and. It also takes into account the diversity of the forest resource within and across the ecological landscape of Ghana.

The stratification of forest in Ghana acknowledges legal management regimes and distribution of forest along ecological zones. It also takes into consideration the level of canopy closure of the forests which reflect on the condition of the forest and carbon content of the various carbon pools across the ecological zones. Plantations established to restore the forest cover of Ghana are also delineated. These are described as:

- Legal management regime: The forest is classified into gazetted and non-gazetted forest. The gazetted areas are the forest reserves, national parks, game production areas. The non-gazetted reserves areas outside the gazetted forest reserves.
- Extent of canopy cover: There are two main regimes namely closed and open forests. The closed canopy forests are those forests with canopy cover exceeding 60%. The open forest is any forest with canopy cover below 60%.
- Ecological zones stratification: is based on annual rainfall, vertical structure, species association, temperature, and soil characteristics.

8.2.5 SOP 005 Field Inventory Protocol

This standard operating procedure (SOP) details the approach to set up and measure permanent sample plots for the monitoring of stock and stock change for the forest and other land-use systems. In developing

this field inventory protocol experiences and measurements from the following National programmes were draw upon:

- 2001 Multi Resource Inventory of timber and non-timber species within FR of HFZ, carried out only in timber production areas of the forest reserves.
- Forest Preservation Program of 2013 with about 270 plots.

This SOP relates to the latest versions of the following MRV system standard operating procedures:

- 001 Estimating Annual Forest Emissions and Removals
- 004 Stratification of Lands
- 006 Estimation of above- and belowground biomass and deadwood 007 Estimation of emissions from soil organic carbon
- 012 Combining Uncertainty

This standard operating procedure applies to the ecological zones of Ghana and it:

- It applies to managed and unmanaged forest
- It is applicable to measuring above ground biomass and estimating belowground biomass
- It is applicable to measuring non-tree biomass
- It is applicable to measuring litter biomass
- It is applicable to measuring standing and lying dead wood biomass
- It is applicable to measuring soil organic carbon
- It is applicable to non-forest land-use types.

Permanent sample plots (PSPs) shall be established to cover all the ecological zones of the country, and various land-use types. The ecological zones are the Wet (comprising of the Wet and Moist Evergreen forest zones), the Moist (covering the moist semi-deciduous forest zones (North East and South West sub-types)), the Dry (covering the dry semi-deciduous forest and savannah zones), the Southern marginal and Upland Evergreen. The land-use types are closed forest, open forest, cropland, grassland and mangrove.

Two types of sample plot design, namely plots single and nested plots, shall be employed. Single plots are the preferred design for systems with low variability in stem size and preferred for tree plantations and cropland. The size of the single plot shall be 30 by 30 m. The SOP identifies the size of the plots to be 30 by 30 m which is sufficient to capture the variation efficiently and is consistent with the lowest resolution of the imagery used in generating activity data. The FPP inventory is not consistent with the imagery. The 20m by 20m plot size can not be as readily compared with the satellite data. Using a plot size that is consistent with the lowest resolution of imagery is the criteria for moving to 30m plots.

Nested plots are designed for sampling discrete sizes of stem class. The nested plot design contains smaller sub-units of various sizes, practically designed for recording discrete stem diameter at breast height (d_{bh}) in various size classes. It shall consist of four unit plots for the assessment of trees of various diameter classes. It is well suited to natural forests with wide range of stem diameter sizes and stocking densities. (Pearson *et. al.,* 2005). The nested plot is larger than the single plot. This is an attempt to capture the more variant landscape and be consistent with the resolution of the imagery used to develop activity data (i.e. equivalent to twice the area of pixels.

Census shall be carried out in the plots. For a single plot, all the trees above 2.0 cm diameter at breast height (d_{bh}) shall be identified by species and the d_{bh} measured. Each of the subplots of the nested plots shall be regarded as a full single plot. Tree measurement is carried out as with the single plots.

Deadwood shall be differentiated into standing and downed deadwood. The state of decomposition of the standing deadwood shall be classified and recorded into two classes. The line transect method shall be used to sample downed deadwood. The downed deadwood shall be assigned to one of three density

classes and representative deadwood samples, representing each of the density classes, shall be collected for wood density.

The non-tree vegetation shall be determined within 1.0 m^2 quadrats established in the plots for shoot and root mass measurements. Litter stock shall be determined from the quadrats after the non-tree vegetation has been removed.

Soil sample shall be collected from the quadrats after the collection of the litter, for both bulk density and carbon content analyses.

8.2.6 SOP 006 Estimation of Above- and Belowground Biomass, Deadwood and Litter

This standard operating procedure details the approach to estimate carbon stock and stock change within the above- and belowground biomass, dead wood and litter pools within forestlands in Ghana. The approach taken is based on the IPCC gain-loss method using Tier 2 approaches. The steps described in this standard operating procedure follow the general principles outlined in 2006 IPCC guidelines for biomass estimation. National specific allometric equations and look-up tables for deadwood and litter estimates for all the ecological zones are applied to estimate both above and below ground biomass (Ghana FPP Manual 5-4).

This standard operating procedure applies to all the ecological zones of Ghana. It is to be applied for the estimation of carbon stock changes of both forest and other land-use types. This standard operating procedure relates to the latest versions of the following MRV system documentation:

- 004 Stratification of Lands
- 011 Estimating national and sub-national forest reference emission level
- 012 Combining Uncertainty

Measurement of the stocks should be re-estimated from new field measurements after five (5) years and include:

Aboveground Tree Biomass Carbon Stock Estimation

Estimation of carbon stock in the aboveground tree biomass shall be based on data from measurements of live trees carried out in fixed sample plots described in SOP 005 Field Inventory Protocol shall be utilized.

- Step 1: Tree parameter measurement and selection of allometric equation
- Step 2: Aboveground biomass of the sample plots
    - Aboveground biomass of the sample plot shall be estimated by calculating the mass of each individual tree in the plot and then mass of the individual trees in the plot summed up.
- Step 3: Calculation of mean carbon stock of aboveground biomass of each stratum (ecological zone), and convert to carbon dioxide equivalent

Belowground Tree Biomass Carbon Stock Estimation

The following steps shall be carried out to estimate belowground biomass carbon stock:

- Step 1: Tree parameter measurement and selection of allometric equation
- Step 2: Calculation of the mean carbon stock of belowground biomass of each stratum (ecological zone), and converting to carbon dioxide equivalent

Aboveground and Belowground Carbon Stock of Non-Tree Vegetation Biomass

The mean carbon stock of the aboveground and belowground non-tree biomass per unit area shall be estimated from field measurements. The method of measurement is treated in standard operation procedure 005 of *Field Inventory Protocol.*

Carbon Stock of Deadwood

The deadwood shall be differentiated into standing and downed deadwood. The methods for measurements of the two components are described in the standard operating procedure 005 Field Inventory Protocol shall be utilized in the calculation procedures described below.

Combining Estimates of Standing and Downed Deadwood

Mean carbon stock of the deadwood pool within each stratum shall be calculated as the sum of standing dead trees and downed deadwood components, and then converted to carbon dioxide equivalent.

Estimating Combined Carbon Stock and Stock Change within All Pools

The total carbon in a particular inventory year shall be estimated by summing up the mean carbon stock of the various pools namely, aboveground and belowground tree, aboveground and belowground non-tree vegetation, deadwood and litter stocks, and then multiply by the size of the project area.

Change in carbon stock for the various pools shall then be calculated by subtracting the mean carbon stock at inventory year t_2 from that at year t_1. The mean change in carbon stocks per pool per unit area shall then be multiplied by the area of the project to produce an estimate of the change in carbon for the pool. The results of the various pools shall then be combined to produce an estimate of the total change in carbon stock. Mean annual change shall then be calculated by dividing the change in stocks by the number of years between two successive inventory years.

8.2.7 SOP 007 Estimating Emissions from Soil Organic Carbon

This standard operating procedure details techniques and estimation procedures for the soil organic carbon pool within forestlands. The field data collection procedures are described in FPP manuals. The steps described in this standard operating procedure follow the general principles outlined in 2006 IPCC good practices guidelines for soil carbon estimation and applies to non-organic soils under all land types, both forest and non-forest lands.

The estimation of the soil organic carbon pool is known to be subject to high levels of variability and uncertainty. Further development of the techniques and approaches to monitoring and reporting under this SOP should be considered after identification of the potential contribution of soil organic carbon to the national account and the balance that should be struck between accuracy, certainty and the costs to achieve it.

8.2.8 SOP 008 Estimation of Emissions and Removals from Timber Harvest

The SOP is applicable for estimating the emissions from degradation on forest lands in Ghana caused by both legal and illegal extraction of trees for timber. The approach taken for estimating emissions and removals from the harvest wood products pool from SOPs for harvested wood products were informed by the following:

- On-Reserve Natural Forest Timber Extracted Legally
- On-reserve Plantation Timber Extracted Legally
- Off-Reserve Natural Forest Timber Extracted Legally
- Off-Reserve Plantation Timber Extracted Legally
- Confiscated Illegal Harvested Timber – On- and Off Reserve Lumber
- On-reserve and off reserve confiscated illegal round logs.

Ghana has two logging regimes; on- and off-reserves. Sustainable logging takes place in managed forests (on-reserve) with annual allowable cut of 500,000 m^3, whilst controlled logging through granting of permits takes place in off-reserve forest). Logging in off-reserve forests can be considered unsustainable in that it relates to removal of timber from outside on-reserve forest landscapes with the view of conversion to

agriculture and other infrastructural development. The annual allowable cut is applicable only in natural forests. There are plantations within on-reserve areas, however annual allowable cut for plantation forests has not been established for both on- and off-reserve.

Under the Legality Assurance System (LAS) for Ghana's timber, there are seven main principles and criteria for defining legal timber. These are:

1. Source of Timber
2. Timber Rights Allocation
3. Timber Harvesting Operations
4. Transportation
5. Processing
6. Trade
7. Fiscal Obligation

Thus timber is considered legal in Ghana if all these principles are followed.

In all sources of timber harvesting, information to capture volume (m^3) estimates are obtained from the following:

a. Tree Information Form (TIF) records
b. Timber Industry Development Division's (TIDD) timber input-output analysis reports.
c. Automated Wood Tracking System (AWTS). When it is fully developed this system will replace the TIF.
d. Plantation Production Certificate (PPC)
e. Plantation Log Measurement and Conveyance Certificate (PLMCC) issued by TIDD during transport of plantation timber.

Currently, it is very difficult to know the exact quantity (volume m3) of lumber produced illegally either from on reserve or off reserve. In addition tracing the source of confiscated lumber in both on reserve and off-reserve is a challenge.

It is acknowledged that in the calculation of sawn lumber only emissions from the confiscated portion would be accounted for. However this is just a proportion of the harvested tree and is likely to be under estimated. Therefore, confiscated illegal lumber can only be accounted for at the national level as a result. However it is anticipated that with the coming into force of the WTS process for both export and domestic market the issue of under estimation will be addressed.

The steps are prescribed below:

- Step 1: Compilation of annual illegal chain saw lumber volume estimates submitted to RMSC from the various Districts.
- Step 2: Estimation of volume of tree species harvested illegally and processed into chain saw lumber per reporting period using the volume table.
- Step 3: Calculation of the Extracted Log Emissions calculated for each log (ELE) for entire illegal lumber by multiplying the average wood density for Ghana by the carbon fraction
- Step 4: Summation of the volume of confiscated illegal sawn lumber.

8.2.9 SOP 009 Estimation of Emissions from Extraction of Wood for Fuel

Annual emissions from degradation relating to fuelwood collection and charcoal are calculated based on an estimate of the annual volume of wood removed from the forest for fuelwood or for charcoal production.

Sources of information to develop the volume estimate are:

- local studies on fuel-wood consumption and/or charcoal production

- local surveys and interviews.

Volume of fuel wood removed is multiplied by wood density and divided by 0.9 to give the biomass of the tree from which the fuels were cut. The assumption is made here that all biomass is collected for fuels apart from leaves, smallest twigs/branches, and debris from felling activity (90% of total).

Regrowth is accounted for through the application of regeneration models developed from MRV sampling plots.

Non CO2-e emissions related to the production of charcoal and burning of wood are also included in the calculation of net greenhouse gas emissions in the baseline.

Any charcoal that is exported outside Ghana will be accounted for as part of the volume of wood removed for charcoal production. Emissions do not need to be estimated through export figures, which would be 'double counting'.

8.2.10 SOP 010 Emissions from Fire

This standard operating procedure details the approach to developing an emissions estimate for fires in the LULUCF sector. Emissions from fire include not only CO2, but other greenhouse gases originating from incomplete combustion of the biomass material. These include carbon monoxide (CO), methane (CH4), non-methane hydrocarbons (NMHCs) and particulate carbon as well as nitrogen (e.g. N2O, NOx) and sulphur species. GHG emissions should be estimated and reported for both managed fire and for wildfire that occurs on managed land, applying one of the different Tier methods used by IPCC. Ghana's account applies a Tier 1 and Tier 2 method.

The steps described in this standard operating procedure follow the general principles outlined in 2006 IPCC Guidelines for National Greenhouse Gas Inventories and estimate GHGs directly released in fires (CO_2 and non-CO_2 emissions). The calculation requires:

1. The mass of 'available' fuel (amount of fuel burnt).
2. The combustion factor is a measure of the proportion of the fuel that actually burns.
3. Emission factors enable the calculation of the amount of a greenhouse gas emitted per unit of dry matter combusted.

To develop the emissions estimates from fire in the LULUCF Sector the following key data sources are required:

- Area burnt allocated by Stratification of the Forest Resource
- Data on the fuel present on burnt areas by stratification
- The type of fire, low or high intensity, (NB this is a difficult assessment to obtain)
- Combustion factors for the proportion of the fuel that burns by stratification
- Emission factors for Ghana of the amount of a greenhouse gas emitted per unit of dry matter combusted.

Reducing emissions from fire indirectly increases soil fertility and thereby increases agricultural productivity especially cocoa production.

The assessment of emissions from fires gives estimates of annual records required for policy planning and management of interventions. The benefit to Ghana of reporting and potentially reducing fire related emissions needs to be assessed.

8.2.11 SOP 011 Estimating National and Sub-National Reference Emission Level

This standard operating procedure details the approach to developing a Forest Reference Emissions Level (REL) for Ghana. SOP 011 presents approaches for estimating emissions from deforestation and forest degradation from lands defined as forest in Ghana. While approaches are presented for both deforestation

and forest degradation, due to data limitations in relation to forest degradation activities, only emissions from deforestation can be developed at this stage. Priorities for collecting data to complete the reporting of emissions from forest degradation are outlined. At this stage, the FREL does not include approaches to develop estimates of removals from conservation of forest carbon stocks, sustainable management of forests, enhancement of forest carbon stocks (in degraded forests) or enhancement of forest carbon stocks (reforestation). The approach to deforestation has been developed, and is contained in SOP 011.

At this stage the FREL does not include removals from conservation of forest carbon stocks, sustainable management of forests, enhancement of forest carbon stocks (in degraded forests) or enhancement of forest carbon stocks (reforestation).

The REL provides the business as usual (BAU) benchmark against which greenhouse gas (GHG) emission reductions and removals are assessed. The FREL is expressed in tonnes of carbon dioxide equivalent per year (t CO_2-e / yr.). A National forest FREL has been developed with the flexibility to allow reporting on nested projects and emission reduction programs.

The steps to develop the FREL described in this standard operating procedure follow the general principles outlined in Angelsen et al, 2012 and are consistent with the Carbon Fund Methodological Framework. The overall approach to developing the FREL relies on simple historic deforestation (e.g. the past 10 years) to predict future deforestation taking into account the previous **rate** of deforestation. The FREL does not exceed the average annual historical emissions over the Reference Period[20].

For transparency this standard operating procedure documents the FREL design decisions and justifies all assumptions made.

IPCC Approach 3[21] is used to generate the activity data used in the development of the FREL. This activity data is then combined with emissions factors using IPCC Tier 2 methods and the uncertainty for each emission factor is calculated and reported[22]. Emission factors are generated from direct measurements where available as well as indirect methods such as survey data and proxies derived from management or statistical data on timber harvesting.

Forest Degradation

The procedure for the calculation of the FREL is contained in Chapter 9. It was not possible due to the limitations of the data available to calculate an estimate of emissions from forest degradation. The steps to do so are included SOP 011 and have been extracted below in summary form to highlight that the methodology to calculate emissions from forest degradation have been developed.

---

[20] In accordance with the World Bank ER program Reference Level Indicator 13.1: The Reference Level does not exceed the average annual historical emissions over the Reference Period, unless the ER Program meets the eligibility requirements in Indicator 13.2. If the available data from the National Forest Monitoring System used in the construction of the Reference Level shows a clear downward trend, this should be taken into account in the construction of the Reference Level.

[21] In accordance with the World Bank Indicator 14.2: Activity data are determined periodically, at least twice during the Term of the ERPA, and allow for ERs to be estimated from the beginning of the Term of the ERPA. Deforestation is determined using IPCC Approach 3. Other sinks and sources such as degradation may be determined using indirect methods such as survey data, proxies derived from landscape ecology, or statistical data on timber harvesting and regrowth if no direct methods are available.

[22] In accordance with World Bank Indicator 14.3: Emission factors or the methods to determine them are the same for Reference Level setting and for Monitoring, or are demonstrably equivalent. IPCC Tier 2 or higher methods are used to establish emission factors, and the uncertainty for each emission factor is documented. IPCC Tier 1 methods may be considered in exceptional cases.

Ghana's FREL is national in scope with the capability to account for project and program level activities. The activities covered in the REL include deforestation and forest degradation. The estimates include the key pools (categories)[23] of above- and below-ground tree biomass, dead wood, litter, soil organic carbon and harvested wood products.

Deforestation and forest degradation that occur as a result of natural processes and events, e.g. hurricanes, should also be kept outside the crediting to be consistent with the definition of deforestation as the direct, human-induced conversion of land from forest to non-forest (UNFCCC Decision 11/CP7).

The procedures for estimating degradation specifically are part of the FREL and can be calculated when the data required is available. The procedures include:

- Identify areas of deforestation and forest degradation (see SOP 003 Acquisition of Remote Sensing Data and Generation of Activity Data)
- Determination of Areas of Deforestation, Forest Degradation and Reforestation. This requires spatial data inputs generated from the completion of the following standard operating procedures:
    - 003 Acquisition of Remote Sensing Data and Generation of Activity Data
    - 004 Stratification of Lands
- Determine the land use change between years and classify as forest degradation
    - Determine the average rate of change in deforestation, forest degradation and reforestation by taking the average change between the reference period start and end data and dividing the rate by the years duration of the time period in accordance with Equation:

$$ARELDegrad = \sum_{ecozone} \frac{\Delta RELDegrad}{YREL}$$

where

ARELDegrad	Average annual area of forest degradation during the reference period; Ha
RELDegrad	Total area of forest degradation in each ecozone during the reference period deforestation; ha
YREL	Number of years over which the REL is estimated, dimensionless

Note: All areas defined as 'degraded' must remain defined as such. The stratification rules do not allow the transition of 'modified primary forest' to 'primary forest' if/as canopy cover increases. Once a forest is classified as disturbed, it is always considered to be disturbed.

- Estimate the area of forest degradation within the areas defined as Forestland remaining Forestland additional data is required to determine if forest degradation has taken place.
    - Canopy cover classification between years, if canopy cover has decreased assume degradation; see SOP 003
    - Overlay reserve areas on lands classified as Forestland remaining Forestland that experienced a decrease in canopy cover.

[23] See SOP002 Key Category Analysis

- Timber extraction data for both on-reserve and off-reserve areas and estimate carbon stock losses for these areas; see SOP 008
- Estimate emissions from fuelwood (including charcoal) extraction; see SOP 009
- Estimate emissions from fire (including charcoal) extraction; see SOP 010

- Estimate the emission from Forest Degradation
  - Once the areas of forest degradation have been identified (see Section 6.2.2 above) the steps outlined in SOP 008 Harvested Wood Products should be applied for each year of the REL. This includes taking into consideration losses from fellings and regrowth.

$$CDegrad_{REL} = \sum_{ecozone} LFellings \quad + LFirewood \quad + LFire \quad - Gains$$

where

$\mathrm{CDegrad_{REL}}$	Actual annual emissions from forest degradation in the reference period; t CO_2-e
LFellings	Actual carbon loss due to commercial fellings on lands defined as degraded in the reference period, see SOP 008; t CO_2-e
LFuelwood	Actual carbon loss due to fuel wood gathering on lands defined as degraded in the reference period, see SOP 009; t CO_2-e
LFire	Actual carbon loss due to other losses on lands defined as degraded in the reference period, see SOP 010; t CO_2-e
Gains	Total gains from regrowth following reforestation or timber harvest on lands defined as degraded in the reference period; t CO_2-e, see SOP 008; t CO_2-e

8.2.12 SOP 012 Combining Uncertainty

The generation of activity data and rate of deforestation is derived from measurements taken from proxy areas and always contain some level of uncertainty. It must be accounted for to give some level of credibility to the estimates generated. To satisfy the UNFCCC requirements and 2006 IPCC good practice guidelines, estimates presented in GHG inventories should be adjusted by an estimated level of uncertainty at a 95% confidence interval. Uncertainties should be estimated using robust and statistically rigorous methods. The methods for estimating uncertainty for activity data and carbon stocks removals/emissions factors are presented in each of the relevant SOPs that make up the Forest MRV system.

This standard operating procedure details how to estimate the uncertainty of emissions and removals of CO2-e generated from REDD+ activities i.e. how to combine uncertainties from activity data and carbon stocks removals/emission factors. Where an uncertainty value is not known or cannot be calculated, justification must be provided in the relevant parameter tables of the standard operating procedures, demonstrating that the selected number was indisputably conservative and subsequently an uncertainty of 0% will be used.

In general terms, estimates of emissions and removals of carbon dioxide are made by summing differences in carbon density, multiplied by the area in which the change in carbon occurred. This change in carbon between inventory year t1 and inventory year t2 can be calculated in one of two ways (see SOP for

details).The estimates and the uncertainty figures for the carbon pools are listed in the lookup tables listed in SOP Above- and Belowground Biomass, Deadwood and Litter.

For each strata the total uncertainty of all pools considered in the final estimate are combined and expressed as the 95% confidence interval as a percentage of the mean using the equation in the SOPs.

8.2.13 Integration of Sub-National and Project-Level RELs

There is one national FREL, created from stratification of the nine ecozones of Ghana that are combined into three broad categories for calculation - "Wet", "Moist", "Dry" based on national allometric equations. The FREL is the summation of the calculations of emissions using ecozones as one stratification. The "sub-national" ecozone is a sub-set of the national FREL.

To meet all reporting criteria for a country fit to national circumstances multiple measurements or modelling techniques can be used. This is the case in the Ghana Forest MRV where research sites, forest inventory, destructive sampling, soil sampling, ecosystem data, climate data and remotely sensed data, are all being applied to the estimation of emissions from forestland. The integration of data is essential. Despite the clear need for data from such a wide range of sources, methods of integrating remotely sensed, model based and measurement data has largely been overlooked.

A tool or calculator to do this needs to be developed, as a ‘solution’ does not exist. The tool is needed and it would have wider international value beyond Ghana. Other countries have already begun to frame up the problem of bringing together the disparate and different data sets into a coherent whole that constitutes an estimate of emissions. The choice of method to integrate remotely sensed satellite and ground data is based on:

- national and international reporting requirements
- ability to meet specific accounting rules
- policy requirements
- data availability
- technical means
- standards by which the system will be assessed
- cost-effectiveness (both in build and ongoing running).

A workshop was held by the Ghana Forest MRV project on the topic of Tier 2 tool and carbon calculators. There are many GHG tools that have been developed to assess forestry and agriculture practices. These calculators can work at landscape/project scale and cover crops, livestock and forests. Various reviews have been carried out and it is important for Ghana to continue to evaluate advances and new tools/calculators as they emerge. There is ongoing and active development of calculators and tools.

For Ghana the development of a tool/calculator would be of interest to a range of users, institutions involved in development and contributors (of standards and services) as well as stakeholders with potential interests in the data such as:

- EPA
- Agriculture and land use planning
- COCOBOD
- Ghana Statistical Service
- Energy – charcoal
- Ghana Standards Board
- National Development and Planning Commission
- Ghana Investment Promotion Centre.

The tool/calculator is needed to support reporting on various aspects, with REDD+ being an initial focus but others can be considered. There is an important and useful link between land uses and change between

agriculture and forestry and reporting on policy outcomes. This may in part be able to set out the change due to drivers of change. Keeping in mind the potential for tools to contribute in these ways will assist in selection of the most suitable tool(s) or development of a tool/calculator. The tool/calculator might support among other, the following reports:

- Report for REDD+ Activities (markets and national reporting)
- FIP, VPA, CDM, VCS
- Project level reporting
- FAO FRA
- National Communication
- Biannual Update Report.

These will be operational systems that Government decisions rely on. They will need to be thoroughly tested and validated, have internal checks and balances, QA/QC user manuals, data updates, training and compliant with IPCC requirements. Any tool needs to be able to report at a national and sub-national level, would likely have use outside of the emissions estimation and potentially outside of Ghana.

8.3 Required Level of Accuracy for MRV and Related Costs Defined[24]

Assessing and reporting uncertainty associated with estimates in GHG inventories and reports/technical annexes is fundamental in the IPCC and UNFCCC contexts. According to the good practice guidelines outlined by the IPCC and adopted by the UNFCCC Conference of the Parties, GHG inventories consistent with “good practice” as those which “contain neither over- nor underestimates so far as can be judged, and in which uncertainties are reduced as far as practicable”.

The UNFCCC does not specify any specific accuracy level for the estimates generated and reported in BURs/FRELs/REDD+ annexes but rather requires that Parties “present estimates that are transparent, consistent, to the extent possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities”.

It is far more important to report uncertainties than to reach a certain accuracy threshold related to estimates. As such in the design of Ghana’s MRV system each SOP describes the approach to estimating uncertainty for a particular pool and a specific standard operating procedure (SOP 0012 Combining Uncertainty) was developed to describe how to calculate overall inventory uncertainty. This approach can also allow an assessment of the relative contribution each pool in each ecozone makes to the overall inventory uncertainty to allow for targeted actions to reduce uncertainties.

Should Ghana wish to design and conduct a program to reduce uncertainty the focus should be on key categories/pools first. Based on the key category analysis work conducted in accordance with SOP 002 – Key Categories, reducing uncertainty related to deadwood and aboveground biomass estimates through carefully designed data collection from within target areas of change would be recommended.

The consideration of monitoring costs and the required level of accuracy for MRV is a ‘trade-off’ that has to be actively managed and monitored. Climate change and REDD+ policies and the MRV monitoring systems will co-evolve so a MRV system needs to be designed to serve known current and future policy requirements as well as being conditional on technical capabilities, initial development, and ongoing operational costs (Böttcher et al., 2009).

This indicates that Ghana needs to consider the most effective use of human and financial resources to deliver the MRV requirements associated with REDD+ activities. This entails design considerations such as:

[24] Material adapted in part from the MGD January 2014; Section 1.5 Cost effectiveness.

- which pools and activities are likely to be significant in determining the level and trend in emissions and removals;
- assessment of existing data sources and the costs associated with acquiring and processing new sources of data;
- level of support and incentive payments and long-term costs & co-benefits of taking action and opportunity cost of activities foregone;
- availability of low-cost remote sensing data;
- need for pre-processing and associated costs;
- existence of ground-based data sets and need for new or supplementary surveys;
- national support resources, both human capacity and financial to implement, improve and operate the system in the long term.

MRV systems should consider the long term continuous improvement and operational costs, as well as short term implementation costs. The former are likely to be funded by the government of Ghana whereas there may be support from development partners and others for the initial development and implementation, as for example under the FCPF. To assist in reducing the risk of a financially unsustainable MRV program:

- MRV systems should be considered as a program, not a project, and will need to continue indefinitely.
- MRV Program design considerations should consider not only available technologies, but also other factors including: definitions, scale and scope of activities, financing mechanisms, prospects for results-based payments and national costs and benefits.
- The allocation, and possible growth, of annual budgets through all phases of the programme should be considered from the outset as part of the design and implementation stage to help ensure the program can be adequately funded.
- The source of funding is also a consideration as donors may be more likely to provide funds for design and to support implementation phases, but program funds for improvement and long term operational cost may be harder to access.
- The challenge of securing long term funding for the operational phase of the MRV program should not be underestimated given increasing pressure to show cost effectiveness.

The FCPF's estimated costs of readiness preparation activities shows averages per country in excess of USD 10M for African countries. The socioeconomic/policy elements that are developed in FCPF's REDD+ Readiness program constitute about two thirds of these costs, while the establishment of reference level, monitoring system, and program management are about a third of the set-up costs, so approximately 3M. Costs associated with the more technical aspects of set-up might include:

- Facility/rooms/lab for housing the technical work (may use existing space)
- Remote Sensing (RS)/Geographic Information System (GIS) hardware and software/workstation (e.g. ~5-15 workstations depending on the geographic area, Idrisi/ENVI/ESRI type remote sensing software, ArcGIS Enterprise System)
- Ground-based measurement equipment including vehicles, GPS, spectral sensors, data recorders

Ghana is in the fortunate position of having had support from projects and donors that sees it with much of this capacity already available along with capacity building in relation to field work techniques. On-going costs will be significant given that repeated estimates are needed to determine the effects of REDD+ activities on change in GHG emissions.

8.3.1 Costs to Address Key Data Gaps

Applying the experience of the FPP in particular and some other programs carried out in Ghana enabled costs to be estimated for:

- Increase temporal resolution (time series) to include the years 2013 OR 2014 and 2003, 2005 or 2004 for the development of the RL
    - The estimate is GHS 2,313,950
- Estimating area of plantations
    - The estimate is GHS 587,729
- Data sets for forest degradation and reforestation
    - The estimate is GHS 1,782,000.

The major costing assumption is that the Forestry Commission would conduct the work reducing the costs for equipment, vehicles and logistics. The steps required and associated cost estimates are included in Appendix 5.

8.4 Reference Level / Reference Emissions Level

The results of applying the SOP in the development of the FREL highlighted the current limitations of the data sets Ghana has available to it. This approach identified some steps to take to address the shortcomings in time series activity data including:

1. Increase temporal resolution (time series) to include the years 2013 OR 2014 and 2003, 2005 or 2004 for the development of the FREL
2. Spatial boundaries of plantations.
3. Compiling and collection of data sets related forest degradation and reforestation such as establishment dates and species and timber harvest management plans.

The Forest MRV is a technical product to bring together the data sets required for an estimate of emissions from forestland in Ghana. The inclusion of the "+" in REDD+ is via the assessment of carbon stocks related to conservation, sustainable management of forests and enhancement of carbon stocks, that is then able to be detected, stratified and applied. Detection of these changes in carbon stocks might most effectively be through management information in combination with remote sensing. As this data is collected it can be used by the Forest MRV through the application of the SOPs.

9. QUANTIFICATION OF GREENHOUSE GAS EMISSION REDUCTIONS AND REMOVALS

- This section presents a worked example of the methodological approaches for developing FREL estimates for deforestation presented in the SOPs using the available FPP data. The estimates provided should be considered preliminary and subject to change once key data gaps and limitations in existing wall-to-wall mapping identified during the MRV design phase have been filled and rectified. Figures have been developed for deforestation only.
- Developing estimates of other REDD+ activities is not possible at this stage due to limitations in the activity data sets, particularity related to gaps in the time series of wall-to-wall mapping.

Key points of this section:

- The FPP collected significant data and undertook processing that did not provide a sufficiently complete time series of land cover to generate land cover change statistics required to develop an IPCC compliant FREL.
- Priorities for collecting data to generate IPCC compliant FREL and ongoing reporting of emissions are:
  - Increase temporal resolution (time series) to ideally generate annual land cover change statistics OR at a minimum augment the existing data to include the years 2013 OR 2014 and 2003, 2005 or 2004 for the development of the FREL
  - Defining the spatial boundaries of plantations and compiling data sets related to forest degradation and reforestation such as establishment dates and species and timber harvest management plans

9.1 Forest Reference Emission Level

9.1.1 Background

The UNFCCC through its Decision 12/CP.17 invited countries to submit, voluntarily and in the context of results based payments, proposed forest reference emission levels and/or forest reference levels (FREL/FRLs). This decision addressed modalities for FRELs, which are to be established:

- taking into account the most recent Intergovernmental Panel on Climate Change guidance and guidelines as a basis for estimating anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes
- according to national circumstances and capabilities, robust and transparent national forest monitoring systems and, if appropriate, sub-national systems as part of national monitoring systems that maintain consistency with the national greenhouse gas inventory and that:

  (i) Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes;

  (ii) Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities;

  (iii) Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties;

Information provided should:

- be transparent, complete, consistent and accurate;
- include pools, gases and the REDD+ activities which have been included in the forest reference emission level and/or forest reference level and the reasons for omitting any; and
- include the definition of forest used and if this is different from the definition used in the national greenhouse gas inventory or in reporting to other international organizations, an explanation why.

The COP acknowledged that subnational forest reference emission levels and/or forest reference levels may be elaborated as an interim measure.

The FREL/FRL will be subject to a technical assessment in the context of results based payments. The SOPs present a very transparent approach to the proposed estimation approach. Ghana has to invest effort in work on accuracy/completeness and consistency in conducting the priority tasks identified in this final report.

9.1.2 Estimation Approach

Ghana's first attempt at developing a FREL/FRL has been designed and documented to be compliant with UNFCCC and IPCC approaches and procedures. The approaches and procedures developed are documented in a number of Standard Operating Procedures (SOPs) referred to in Section 7.2 of this report and provided as Annexes to this report. The methods presented in these SOPs were developed based on available national specific data from a combination of remote sensing and ground-based forest carbon inventory sources as required by the UNFCCC.

The majority of this national specific data was generated through the Forest Preservation Project (FPP)[25] which ended in 2011 and prior to the finalisation of guidelines from the UNFCCC as well as the World Bank FCPF to which Ghana must also adhere. The data generated by the FPP demonstrates:

- there is capacity to develop and analyses remote sensing and ground based data within Ghana
- that Ghana has data sets that will contribute to achieving Approach 3 / Tier 2 accounting once data gaps have been filled.

Ghana has applied a simple historical average approach to historical deforestation rates to generate estimates of future deforestation in the estimation of its National FREL.

Ghana's National FREL is calculated as the sum of land use change emissions across nine eco-zones. Stratifying the country by eco-zone improves carbon stock estimation, assists in identifying and reporting on particular agents of deforestation/degradation and allows the flexibility for emission reduction programs and projects to report in a consistent manner within the National MRV system.

The FREL approach proposed by Ghana uses the IPCCmethodology as a basis for estimating changes in carbon stocks in forest land converted to other land-use categories as described in the GPG LULUCF (IPCC, 2003). For any land-use conversion occurring in a given year, GPG LULUCF considers both the carbon stocks in the biomass immediately before and immediately after the conversion.

Ghana assumes that the biomass immediately after the forest conversion (deforestation) is equivalent to the average carbon stock for the subsequent land use identified, therefore the approach does consider subsequent CO_2-e removal after deforestation.

[25] Whilst the FPP generated capacity within Ghana in remote sensing and ground based data collection, there remain some data gaps that present limitations in generating estimates that will meet all the requirements of a UNFCCC technical assessment of a FREL/FRL.

The annual CO_2-e emission from gross deforestation for any year is calculated as the sum of the CO_2-e emission associated with each new deforestation increment.

For each deforested polygon, the associated CO_2-e emission is estimated as the product of its area and the associated change in carbon stock of the above and below ground biomass, deadwood and soil organic carbon affected by deforestation within each ecozone. Subsequently for any year, the total emission from gross deforestation, *CDefor* is estimated using Equation 1.

$$CDefor = \sum_{ecozone} \left[\sum_{land\ use\ change} [ADefor \times (\Delta CGA + \Delta CBG + \Delta CDW + \Delta CSOC)] \right]$$

(1)

where

CDefor	Actual carbon stock change as a result of deforestation; t CO_2-e
ADefor	Projected area deforested for each land use change in each ecozone between each reporting period; ha
ΔCAG	Carbon stock change in aboveground tree biomass for each land use change in each ecozone between each reporting period; see SOP 006; t CO_2-e ha^{-1}
ΔCBG	Carbon stock change in belowground tree biomass for each land use change in each ecozone between each reporting period; see SOP 006; t CO_2-e ha^{-1}
ΔCDW	Carbon stock change in deadwood for each land use change in each ecozone between each reporting period; see SOP 006; t CO_2-e ha^{-1}
ΔCSOC	Carbon stock change in soil organic carbon for each land use change in each ecozone between each reporting period; see SOP 007; t CO_2-e ha^{-1}

The average annual rate of change in deforestation is determined by taking the total area deforested between the reference period start and end data and dividing the rate by the years duration of the time period in accordance with Equation 2.

$$ARELDefor = \sum_{ecozone} \frac{\Delta RELDefor}{YREL}$$

(1)

where

ARELDefor	Average annual area of deforestation during the reference period; Ha
RELDefor	Total area of deforestation in each ecozone during the reference period deforestation; ha
YREL	Number of years over which the REL is estimated, dimensionless

Ghana's FREL has a reference period start date of 2000 and the end date 2010 therefore the historical reference period is 10 years. Additionally the change between 1990 and 2000 has been included to demonstrate the trend only, it has not been included in the 10 year reference period over which the rate is calculated (Refer to SOP 011 for a step by step description of the calculation approach for the FREL. The approach also draws on procedures described in detail in SOP 003 and SOP 004).

The assessment of the historical land use change within Ghana is achieved by analysing change between the years of available wall-to-wall spatial data and presenting this information in land use / land use change matrices. As Ghana has only two images to compare (i.e. 2000 – 2010) the true annual rate of change and trend relating to deforestation events cannot be determined. As Ghana works to include forest degradation and reforestation, the number of classified years in the time series will increase and the true annual rates will increase in accuracy.

9.1.3 Geographical Scope of the FREL

Ghana has taken a **national** approach to developing its FREL/FRL. The National FREL is developed using a stratified approach to recognize broad ecozones in Ghana and enable ER Programs to be 'nested' within the National REL. The approach taken[26] calculated the national FREL as the sum of the FREL constructed for each of the nine (9) ecozones identified in Ghana (refer to Figure 5.1 Ecological Zone Map of Ghana). This will allow Ghana to assess and evaluate the effect of greenhouse gas reduction policies and measures developed at the ecozone level.

9.1.4 Scope of Activities Included in the FREL

Included – Deforestation and Forest Degradation

Both deforestation and forest degradation are significant activities driving emissions from the forestry sector in Ghana and therefore approaches and procedures for measuring and reporting emissions from both of these activities are included in the design and documentation of the FREL.

Using the FPP data Ghana has been able to develop a preliminary national level estimate of emissions related to **deforestation**. It is recognised that emissions from other REDD+ activities, such as forest degradation, are likely to be a significant source of greenhouse gas emissions in Ghana and therefore according to the UNFCCC guidelines, emissions from forest degradation should be included in the FREL/FRL. The MRV SOPs[27] detail the approach to measuring/estimating emissions from other REDD+ activities including forest degradation and also identify priorities for data collection to enable future reporting of emissions from currently excluded activities. A lack of data sources prevent testing fully the suggested approaches to estimate emissions from other REDD+ activities in the FREL/FRL.

Developing estimates of other REDD+ activities are not possible due to limitations in the activity data sets, particularity related to gaps in the time series of wall-to-wall mapping. The estimates provided should be considered preliminary and subject to change once key data gaps and limitations in existing wall-to-wall mapping identified during the MRV design phase have been filled and rectified.

As such the estimates presented here should be treated with caution. The estimates are a demonstration of the ability to report using the documented methodology and should be considered part of the step-wise approach to reporting REDD+ activities in the context of results based payments. These should not be considered the final FREL/FRL ready for technical assessment in accordance with the UNFCCC process.

[26] As described in standard operating procedure 011 Estimating National and Sub-National Reference Emission Level.

[27] Specifically SOP 008 and SOP 009.

Limitations: Estimates provided here are developed on activity data and ground inventory data generated/collected from the FPP. During the design phase of Ghana's MRV system the activity data has been found to have limitations in detecting forest canopy cover change. This has led to an inability to generate estimates for forest degradation and questions around the accuracy of the activity data for deforestation. Additional remote sensing classification work is required before degradation estimates can be developed for reporting.

9.1.5 Information Used

Activity Data

Activity data for estimating annual gross emissions from deforestation in Ghana derives from the analysis of remotely sensed data from sensors of adequate spatial resolution (mostly from Landsat and ALOS satellites).

The construction of the forest reference emission level for reducing emissions from deforestation in Ghana was based on a historical time series generated under the Forest Preservation Programme (FPP, 2011-2014) which was supported by the Government of Japan and aimed to contribute to forest conservation in Ghana by providing the Forestry Commission with equipment, materials and services. This program allowed the Forestry Commission of Ghana to access and utilise advanced Japanese technologies and products to map and analyse forestry and land use sectors. The programme was designed with seven key components: land use, land use change and forestry (LULUCF), geographic information systems (GIS), forest inventory system (FIS), light detection and ranging (LIDAR), carbon estimation, a GIS website and capacity building.

The FPP generated three (3) land cover maps (1990/2000/2010) from which two land cover change data sets were generated; 1990-2000 and 2000-2010. The area of the annual gross deforestation by forest type (in hectares) is referred to as activity data.

The consistency of the time series was ensured by using the same definitions, the same minimum assessed area, similar satellite spatial resolution, same forest/non-forest boundaries, and the same methodological approach for each year assessed. For more details of the remote sensing approach conducted under the FPP see (PASCO, 2013).

Carbon Stock and Emissions Factors

This activity data is then combined by emission factors that, here, consists of the carbon stock associated with forest types in Ghana, provided in tonnes of carbon per unit area (tC ha-1).

The carbon stock change associated with deforestation was estimated using look up tables generated from allometic equations developed for each ecozone of Ghana. These National values for above and below ground biomass as well as deadwood and soil organic carbon were also developed as part of the FPP (PASCO, 2013).

9.1.6 Reference Period

The end-date for the reference period is 2010 and represents the most recent date prior to 2013 for which forest-cover data is available to enable IPCC Approach 3. The start-date for the Reference Period is 2000 which is 10 years before the end-date and not more than 15 years before the end-date.

Limitations: The wall-to–wall land cover classification is available only for 2 time periods. At least 3 time periods should be used to develop historical deforestation trends and rates to develop the FREL. Additional years of remote sensing classifications are required to meet World Bank FCPF reference period requirements and improve the estimates of historical deforestation and forest degradation.

9.1.7 Forest Definition Applied

The definition of forest used by Ghana in the construction of the FREL is:

> *"A piece of land with a minimum area of 1 hectare, with a minimum tree crown cover of 15%, [or] with existing tree species having the potential of attaining more [than] 15% crown cover, with trees which have the potential or have reached a minimum height of 5.0 meters at maturity in situ".*

This is the same definition used by Ghana in its all reporting of forestlands to the UNFCCC.

9.1.8 Forest Stratification Applied

Forest stratification was conducted according to the strata that is outlined in SOP 004 Stratification of Lands (Table 9.1). This strata meets the IPCC good practice guidance stratification recommendations.

To generate the activity data the results from the wall-to-wall land use/land cover classification were reported in a land use change matrix. The REDD+ activity related to the land use change area detected is shown in Table 9.2. Note that the grey shaded stratification class 'plantation' is currently unable to be employed due to a lack of data, however is required for compliant reporting to the UNFCCC. Collection of additional data sources to allow compliant land stratification is a priority improvement area.

Table 9.1 Stratification of Forest Lands in Ghana

Ecozone(i)	Allometric / Carbon Stock Allocation (j)	Landuse(k)	FAO/FRA(l)	Forest Management(m)	Forest Condition(n)
1 Wet Evergreen	Wet zone	1 Forestland	1 Primary Forest	1 Protection	1 Closed Canopy
2 Moist Evergreen	Wet Zone	2 Cropland	2 Modified Natural Forest	2 On reserve forest	2 Open Canopy
3 Upland Evergreen	Moist Zone	3 Grassland	3 Planted Forest	3 Off reserve forest	
4 Moist Deciduous (NW)	Moist Zone	4 Wetland			
5 Moist Deciduous (SE)	Moist Zone	5 Settlement			
6 Semi Deciduous (fire zone)	Dry Zone	6 Other land			
7 Semi Deciduous (inner zone)	Dry Zone				
8 Southern Marginal	Dry Zone				
9 Savannah	Dry Zone				

Note: Greyed strata cannot yet be delineated due to data limitations

Table 9.2 Land Use Change Matrix to distinguish REDD+ activities

Period (i.e. 2000/2010)	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land
Forest land	Degradation	Deforestation	Deforestation	Deforestation	Deforestation	Deforestation
Cropland	Reforestation	No change	NA	NA	NA	NA
Grassland	Reforestation	NA	No change	NA	NA	NA
Settlements	Reforestation	NA	NA	No change	NA	NA
Wetland	Reforestation	NA	NA	NA	No change	NA
Other land	Reforestation	NA	NA	NA	NA	No change

9.1.9 Carbon Pools and Gases Included

For deforestation activities calculations were conducted and a key category analysis completed to identify which pools should be included in the FREL (refer to SOP002 for the procedures used to conduct the key category analysis). According to the criteria, if a pool contributes >25-30% to the category then it is considered key. Key categories are the minimum that should be included. Non-key categories may be reported if a country decides to do so.

Table 9.3 below presents the results of the key category analysis conducted. The analysis showed that the pools of Soil Organic Carbon, Aboveground Biomass and Deadwood (shaded blue) should be included in the inventory as their individual contribution to the total emissions is >25% (refer to column F). Additionally the Belowground Biomass pool (shaded grey) is included as it makes up the 95% cumulative total of emissions (see column G) and Ghana has national specific data for this pool which is estimated from aboveground biomass measurements used as a proxy.

Emissions from litter and non-tree biomass are excluded as they are insignificant to the overall inventory.

Table 9.3 Key Category Table for Deforestation Activities

A	B	C	D	F	G
IPCC Category code	**IPCC Category**	**Greenhouse Gas**	**Latest Year Estimate Ex,t (tCO_2-e)**	**Level Assessment Lx,t**	**Cumulative Total of Column F**
Soil Organic Carbon	LULUCF	CO_2	5,555,476	0.29	0.29
Above-ground Biomass	LULUCF	CO_2	4,802,904	0.25	0.55
Deadwood	LULUCF	CO_2	4,828,405	0.25	0.80
Belowground Biomass	LULUCF	CO_2	2,654,239	0.14	0.94
Litter	LULUCF	CO_2	762,196	0.04	0.98
Non-Tree Biomass	LULUCF	CO_2	384,983	0.02	1.00
Total			**18,988,202**	**1**	

9.1.10 Historical Emissions

The FREL was developed using a simple historic average approach over the 10 years of available data. The annual average rate of deforestation was established simply by determining the total deforestation between two points in time (i.e. from wall-to-wall land cover data from the years 2000 and 2010) and then dividing the total area deforested by the number of years between the two points in time (i.e. 10 years) to get an annual area deforested.

As there was only two (2) points in time available the trend of deforestation was not assessed. The rate of deforestation by eco-zone was found to vary between 1.2% and 5.3%. The average simple historic rate of deforestation between 2000–2010 was estimated to be 2.0% this is higher than the average annual rate for both Central and Western Africa which stands at 0.6 % (FAO, 2006; FAO, 2010). As the annual average rate of deforestation in Ghana was found to be more than 2 times the average for West Africa it is considered significant and was not adjusted to be consistent with the World Bank FCPF guidelines. The activity data generated for deforested between 2000–2010 by ecozone is presented in Table 9.4.

Table 9.4 Deforestation Activity Data 2000-2010

Ecozone	Area of forest in 2000 (ha)	Area of Deforestation (ha)		
	Total	Total	Annual	Annual Loss, %
Wet Evergreen	702,941	147,057	14,706	2.1%
Moist Evergreen	1,714,232	431,952	43,195	2.5%
Upland Evergreen	59,441	7,345	734	1.2%
Moist Deciduous NW	1,318,956	190,305	19,030	1.4%
Moist Deciduous SE	1,482,074	244,474	24,447	1.6%
Dry Semi Deciduous (fire)	638,513	186,850	18,685	2.9%
Dry Semi Deciduous (inner)	538,717	115,432	11,543	2.1%
Southern Marginal	92,215	48,464	4,846	5.3%
Savannah	2,570,823	460,247	46,025	1.8%
Total	**9,117,913**	**1,832,126**	**183,213**	**2.0%**

The land use change matrices described in Table 9.2 above were generated for each ecozone and used to generate the activity data presented in Table 9.4. These matrices by ecozone are presented for information as Appendices to this report.

Limitations: The trend of deforestation was not able to be assessed due to a lack of additional years of wall-to-wall activity data between 2000–2010. Wall-to-wall land cover change detection should be conducted for at least one additional year between 2000–2010 and preferably another year closer to 2013 to meet the FCPF methodological guidelines.

The annual emissions profile was generated according to the MRV design standard operating procedures provided as Annexes to this report. The approach used was IPCC Tier 2 utilising National specific data largely collected as a result of the FPP process, specifically a carbon stock look up table for the pools included in the FREL/FRL across the strata defined in standard operating procedure 004 Stratification of Lands. The lookup table is presented as an appendix to this report.

The following assumptions were made in the generation of the estimates:

1. All forestland that was deforested was conservatively assumed to have a carbon stock of an open canopy forest prior to the land use change.
2. Where no carbon stock values were available in the look up table, the carbon stock of the converted land use was assumed to be zero.

The FREL is presented in Table 9.5 as both sub-national estimates (ecozone row) and national estimates (total row). As required by UNFCCC guidelines the estimates are presented in units of t CO_2-e. This constitutes a preliminary working example of how an estimate would be calculated. The “reduction” in emissions that may attract payments will be as a result of interventions and actions that are taken to change the trend of emissions that are monitored, reported and verified by the national system to international standards.

Uncertainties were calculated according to SOP 0012 Estimating Uncertainty and considered the confidence interval of both the activity data and the carbon stock estimates in the lookup tables.

Table 9.5 Forest reference emission level (deforestation only) reported at sub-national FREL (ecozone) and National FREL (total) level

Ecozone	Total Emissions over reference period (t CO_2-e)	Forest Reference Emission Level as average annual emissions (t CO_2-e / yr)
Wet Evergreen	-10,030,601	-1,003,060
Moist Evergreen	-20,000,917	-2,000,092
Upland Evergreen	-363,915	-36,392
Moist Deciduous NW	-5,990,629	-599,063
Moist Deciduous SE	-10,635,075	-1,063,507
Dry Semi Deciduous (fire)	-6,720,080	-672,008
Dry Semi Deciduous (inner)	-4,680,185	-468,018
Southern Marginal	-2,049,259	-204,926
Savannah	-14,131,347	-1,413,135
Total	**-74,602,008**	**-7,460,201**

Consideration of the data by land use change category can give some insight into drivers of deforestation and assist in priorities ground measurement areas and monitoring of hotspots.

Table 9.6 presents the figures by the land cover change matrix categories. This table identifies the majority of deforested land was converted to cropland (62%) and that expansion of settlements and infrastructure were insignificant (~2%). However the majority of emissions came from conversion to grassland (55%). This result is due to a lack of carbon stock data for grasslands and the conservative assumption that the grassland has zero carbon stock following deforestation.

Priority ground data collection should be in grassland areas and to improve the confidence interval of cropland areas, preferably further stratifying cropland with the priority to distinguish cocoa from other cropland types.

Table 9.6 National Emissions by Land Cover Change Matrix Categories

Land Use		Annual Change			
2000	2010	Area (ha)	%	Emissions (tCO2-e)	%
Managed Forest	Cropland	113,237	62	- 3,073,070	41
Managed Forest	Grassland	66,128	36	-4,125,841	55
Managed Forest	Settlement	1,699	1	-259,222	3
Managed Forest	Other Land	1,345	1	-2,069	0
Total		**182,409**		**-7,760,201**	

Note: All forestlands in Ghana are considered Managed according to the IPCC definition of Managed.

Table 9.7 National Emissions by Land Use Change (Deforestation Driver)

Year	Deforestation (ha)	Emission from Deforestation (t CO_2-e / yr)
2000	183,213	7,460,201
2001	183,213	7,460,201
2002	183,213	7,460,201
2003	183,213	7,460,201
2004	183,213	7,460,201
2005	183,213	7,460,201
2006	183,213	7,460,201
2007	183,213	7,460,201
2008	183,213	7,460,201
2009	183,213	7,460,201
2010	183,213	7,460,201
Total	**1,832,126**	**74,602,008**

9.1.11 Results, Limitations and Priority Development Areas

The results presented for the FREL/FRL should be considered a demonstration, a 'worked example' of the methodological approach presented in the SOPs. Due to limitations in the data sets, these estimates are useful as part of the step-wise approach to REDD+ development in the context of results based payments. However, the results should not be considered the final figures ready for technical assessment through the UNFCCC processes.

The 2010 land cover classification conducted as part of the FPP was reanalysed by the US Geological Survey in 2014 and suggests that Ghana's forest cover is significantly less than that suggested by the 2010 FPP land cover map. It is recommended that Ghana revisit the land cover classification and increase the years mapped in the time series to ensure that the analysis Ghana relies on is transparent, consistent, complete and accurate.

According to the wall-to-wall land cover change data generated from the FPP process, Ghana experienced an average annual deforestation rate of 2%. At a sub-national level, annual average deforestation rates vary between 1.2–5.3% by ecozone suggesting that some areas are under more pressure than others throughout the country.

Ghana has a relatively low forest cover and high deforestation rate. The available data allows for determining an average annual deforestation rate between two points in time, however the limitations in available wall-to-wall epochs means that a deforestation trend cannot be determined. Therefore a simple historic average approach to estimating rates of change has been applied.

Annual emissions from deforestation at the national level were estimated by summing the emissions from the key pools of aboveground biomass, belowground biomass, deadwood and soil organic carbon. The average annual emission from deforestation between 2000 and 2010 were estimated to be 7,460,201 tCO_2-e.

Forest degradation is likely to be a significant source of emissions within the forest areas of Ghana. In accordance with UNFCCC requirements, filling data gaps to allow the reporting of emissions from forest degradation should be a priority area for Ghana.

The priority development areas for Ghana should be to:

1. Reclassify the 2000 and 2010 remote sensing data due to the questions regarding its accuracy.
2. Complete the wall-to-wall land cover and land cover change assessment for at least one additional year between 2000–2010 and preferably another year closer to 2013 as well to meet the FCPF methodological guidelines.
3. Fill data gaps for estimating forest degradation such as forestry and agriculture plantation boundaries.

10. MONITORING THE STANDARD OPERATING PROCEDURES

The evolution of methods and guidance from the UNFCCC and its subsidiary bodies will continue with specific information emerging ahead of 2020. Additionally there are interpretations of the existing guidance and emerging science to consider as Ghana evolves its Forest MRV system and continuously improves it. In order to ensure appropriate revision and improvement of the SOPs and the recognition of any need to add SOPs to the existing set of guidance for Ghana a Process and Monitoring Cycle has been framed up and is described below.

The SOPs will be monitored at two levels. The first level will be done by RMSC to ensure that all standards set in the SOPs are strictly adhered to. The second level of monitoring will be done by the Climate Change Unit to ensure that new development and new technology (e.g. remote sensing) are communicated to the FC. They CCU should also advise as and when to revise the SOPs.

10.1 The SOP Process and Monitoring Cycle

There will be a series of steps to monitor the SOPs set out below that include descriptions of the process and cycle for monitoring performance and continuous improvement.

1. UNFCCC guidance and advice will need to be monitored and assessed regularly and any relevant material considered for the SOPs which would be updated accordingly.
    a. Some aspects may be technical and some may be policy
    b. The Forest MRV 'owner' the Climate Change Unit of the Forestry Commission; would be responsible for keeping up to date on UNFCCC deliberations and engaging with appropriate institutions and bodies to interpret and incorporate UNFCCC guidance into the relevant SOPs as required.
2. The technical assessment and third party verification of the BUR and National Communications will provide feedback and commentary and suggestions for improvement of the SOPs.
    a. This will be overseen by the EPA. There should be consistent communication with them to ensure the opportunities and challenges are well understood and effectively dealt with.
3. As and when better data sets, methods and new data sets emerge or are generated the SOPs would have to be assessed and revised as appropriate.
    a. While the EPA and the Forestry Commission will have a role to play in this there is also a critical role for research and academic institutions in this process.
4. SOPs to be reviewed each two years in preparation for the BUR. Reviews of SOPs to be carried out so as to be complete and approved in time for their use for the reporting cycle, say 12 months ahead of the report deadline.
    a. The Forest MRV 'owner' will be responsible for this review. The involvement of the relevant Government, Research and Academic actors will be necessary.
5. QA/QC of the data in the SOPs may also trigger revision and change to data.
    a. The contributors to the QA/QC of the Forest MRV include research and academic institutions and private sector actors that are third party and can credibly act as independent agents in the process including KNUST, CERSGIS etc.
6. The third party QA/QC services will have to be contracted and managed.
    a. The agency responsible for an SOP cannot contract or supervise the QA/QC process.

b. The Government of Ghana will have to identify the agency to undertake this role. The EPA might be appropriate having a critical lead role in reporting internationally, being independent of the data collection and handling and separate to the agency with the key mandate on forests, the Forestry Commission.

10.2 SOP Monitoring Plan

10.2.1 Oversight

The monitoring of the SOPS for the Forest MRV for Ghana is a critical role and a national responsibility with international profile and significant accountability. Consequently it is appropriate to utilise the existing framework that has been put in place in Ghana for environment and natural resources in general and REDD+ in particular. Those arrangements are set out below and should be accommodated by the routinely scheduled and facilitated meetings of the entities that have been set up.

- Environment and Natural Resources Advisory Council (ENRAC) - was established as a high level policy coordinating body to provide overall strategic direction to government and relevant stakeholders on environmental and sustainable development issues.
- National REDD+ Working Group (NRWG) - makes policy recommendations to the Minister for Lands and Natural Resources on National REDD+ policy or strategy formulation. They also provide advice and guidance on all national REDD+ processes and serve as the liaison between respective institutions and stakeholder groups. The NRWG is also responsible for advice on institutional roles and mandates for implementation of REDD+ processes. NRWG meets every three months. This Working Group has a lead role in the communications across and within government on the Forest MRV. It has six sub-working groups, one of which is the Working Group on MRV/REL:
- National REDD+ Secretariat (NRS) – is in *practice, the CCU of the FC. It* is responsible for the coordination of the implementation of the R-PP; coordinating and facilitating meetings for the NRWG and maintain working relationships and communicate with relevant corporate, NGO and governmental sectors on REDD/REDD+ issues. The NRS is the key body to create, facilitate and support communications on the Ghana Forest MRV.

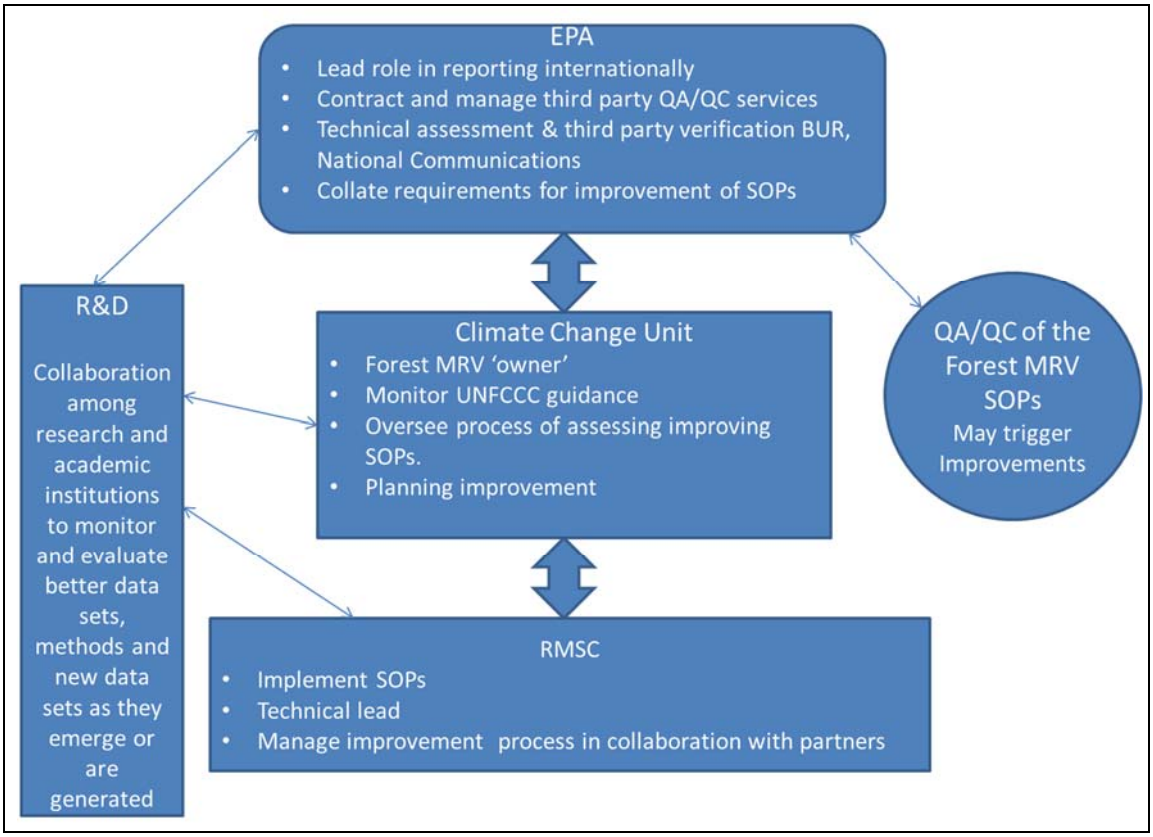
10.2.2 Management and Implementation of SOP Monitoring and Improvement

The roles and requirements identified above can be formulated into a cyclic process for monitoring the SOPs and their ongoing relevance and continuous improvement. These are reflected below and in Figure 10.1.

1. Climate Change Unit, the Forest MRV ‘owner’, would be responsible for keeping up to date on UNFCCC deliberations and engaging with appropriate institutions and bodies to interpret and incorporate UNFCCC guidance into the relevant SOPs as required.
2. The EPA will provide feedback and commentary and suggestions for improvement of the SOPs from the technical assessment and third party verification of the BUR and National Communications. There should be consistent communication with the EPA to ensure the opportunities and challenges are well understood and effectively dealt with.
    a. The process of improvement should be planned and managed by the CCU of the FC.
    b. The RMSC as technical lead would implement the process of improvement.

3. EPA and the Forestry Commission (CCU and RMSC) in collaboration with research and academic institutions will monitor and evaluate better data sets, methods and new data sets as they emerge or are generated.
    a. The CCU will oversee the process of assessing and improving the SOPs.
    b. The RMSC as technical lead would implement the process of improvement in collaboration with its partner institutions.
4. The CCU of the FC as Forest MRV 'owner' will be responsible for oversight of the review of SOPs each two years in preparation for the BUR, with the involvement of the relevant Government, Research and Academic actors.
    a. The CCU will oversee the process of assessing and improving the SOPs.
    b. The RMSC as technical lead would implement the process of improvement in collaboration with its partner institutions.
5. Contributors to the QA/QC of the Forest MRV SOPs, may also trigger revision and change to data.
    a. The EPA will provide feedback and commentary and suggestions for improvement of the SOPs from the QA/QC process.
    b. The CCU will oversee the process of assessing and proposing the improvements to the SOPs.
    c. The RMSC as technical lead would implement the process of improvement in collaboration with its partner institutions.
6. The third party QA/QC services will have to be contracted and managed. The agency responsible for an SOP cannot contract or supervise the QA/QC process.
    a. The Government of Ghana will have to identify and approve the agency to undertake this role.
    b. The EPA might be appropriate having a critical lead role in reporting internationally, being independent of the data collection and handling and separate to the agency with the key mandate on forests, the Forestry Commission.

Figure 10.1 Monitoring Standard Operational Procedures



11. INSTITUTIONAL ARRANGEMENTS

Key points of this section:

- The Forest MRV system is one of the components of the National GHG Arrangements and will provide input through the Task Group for the Land Use Land Use Change and Forestry Sector
- Possible reports and data sets from the Forest MRV System include:
    - Report for REDD+ Activities (markets and national reporting)
    - Multilateral and market efforts such as FIP, VPA, CDM, VCS
    - Project level reporting
    - FAO FRA
    - National Communication to the UNFCCC
    - Biannual Update Reports to the UNFCCC
- There are a very wide range of existing and potential actors and stakeholders for the Forest MRV
- From the analysis carried out of the institutions the main actors for the Forest MRV system are from the relevant government agencies and related research and academic institutions
- The actors involved directly in the Forest MRV are:
    - Forestry Commission
    - CCU of the FC
    - RMSC of the FC
    - Forest Services Division of the FC
        - District Offices (Harvested Wood Products raw data; Charcoal and fuel wood data;)
        - Regional Offices (compilation; quality control and coordination)
- The major 'clients' of the Forest MRV system include the Government of Ghana, EPA and the World Bank.

The Ghana Forest MRV project assessed the capacity gaps and institutions related to the project. This institutional capacity analysis covers the analysis of the mandates and roles of key institutions, other related initiatives, institutional and technical capacity assessment, including training needs assessment, and finally our recommendations for the establishing the sustained MRV capacities within Ghana. This analysis is closely linked to the MRV Communications Plan, and the recommendations we are providing partly overlap.

The approach taken by the Forest MRV Team to evaluate institutional arrangement was to assess the circumstance, review requirements and consider the appropriate arrangements. Specifically, this analysis contributes to the:

- Development of methods and approaches for establishing a national MRV system; following good international practice and established techniques.
- Development of a detailed plan to establish sustained MRV capacities within Ghana

This analysis on Institutional Arrangements undertook the following steps:

1. Compile information on related initiatives
    - Natural Resources and Environmental Governance Programme (NREG)
    - Forest Preservation Programme (FPP)
    - FCFP REDD Readiness Initiatives
    - FCPF Carbon Fund ER-PIN
    - Ghana Forest Investment Plan (FIP)
    - Others
2. Identification of key institutions and their mandates
    - REDD Specific Bodies
    - Stakeholders Related to MRV

3. Conduct an institutional and technical capacity assessment
    - Institutional Capacity
    - Current Situation and Needs
    - Potential Improvements
    - Technical Expertise
    - Current Situation and Needs
    - Potential Improvements
4. Draft an institutional strengthening strategy
    - Sustainability
    - Training/Capacity Building
    - Road Map to Establish MRV Capacities
    - Institutional Setup Design.

11.1 Principles and Characteristics

From the efforts, planning and design processes for creating Forest MRV and MRV systems for the land sector in other countries; such as Tanzania, Kenya, Indonesia and Australia, it has been possible to identify some common requirements, characteristics, attributes and some system user expectations. These are set out below.

The Forest MRV as part of the National Reporting will be used to:

- To meet international treaty obligations such as UNFCCC
- Provide information for domestic policy
- Provide basis for market mechanisms
- Support Ghana's position in the international negotiations
- Provide monitoring capabilities (of emissions and removals)
- Provide the scientific and technical basis to negotiations for Kenya
- Predict future GHG emissions and removals
- Provide the capacity for credible Reference Emission Level
- To improve national Reporting on GHG to UNFCCC

Characteristics of the custodian institution for the Forest MRV may include:

- Transparent, including the publication and availability of data, tools and results
- Able to undertake or supervise Quality Assurance, Quality Control and peer review
- Has capacity to outsource
- Stable and reliable with long term future in government
- Capable of compiling and finalizing Forest MRV outputs to standards and in formats as required
- Can support the Verification and Validation of the outputs by UNFCCC auditors and others
- Can manage the continual improvement of the system

Attributes of the host institution for the Forest MRV may include that it:

- Be an institution with ability (mandate?) to coordinate the development and updating of national reporting
- Be an institution independent of forest/land/project ownership or management
- Be an institution with a credible governance structure
- Government and non-government stakeholders will have confidence.
- Be competent and credible, with the capacity to respond to the needs of global funding mechanisms
- Should have capacity to work with centres of expertise and specialization

Forest MRV System Users:

- Government expects stability, reliability, robustness, policy and political relevance, cost effectiveness
- International community expects consistency, transparency, familiarity and good practice
- Individuals may require accessibility, use of current technology and of good science
- Markets will seek operational efficiency, accessibility, transparency, clarity and consistency across all land

Taken in combination these principles and characteristics provide a means to assess the suitability for roles and responsibilities of the candidate institutions.

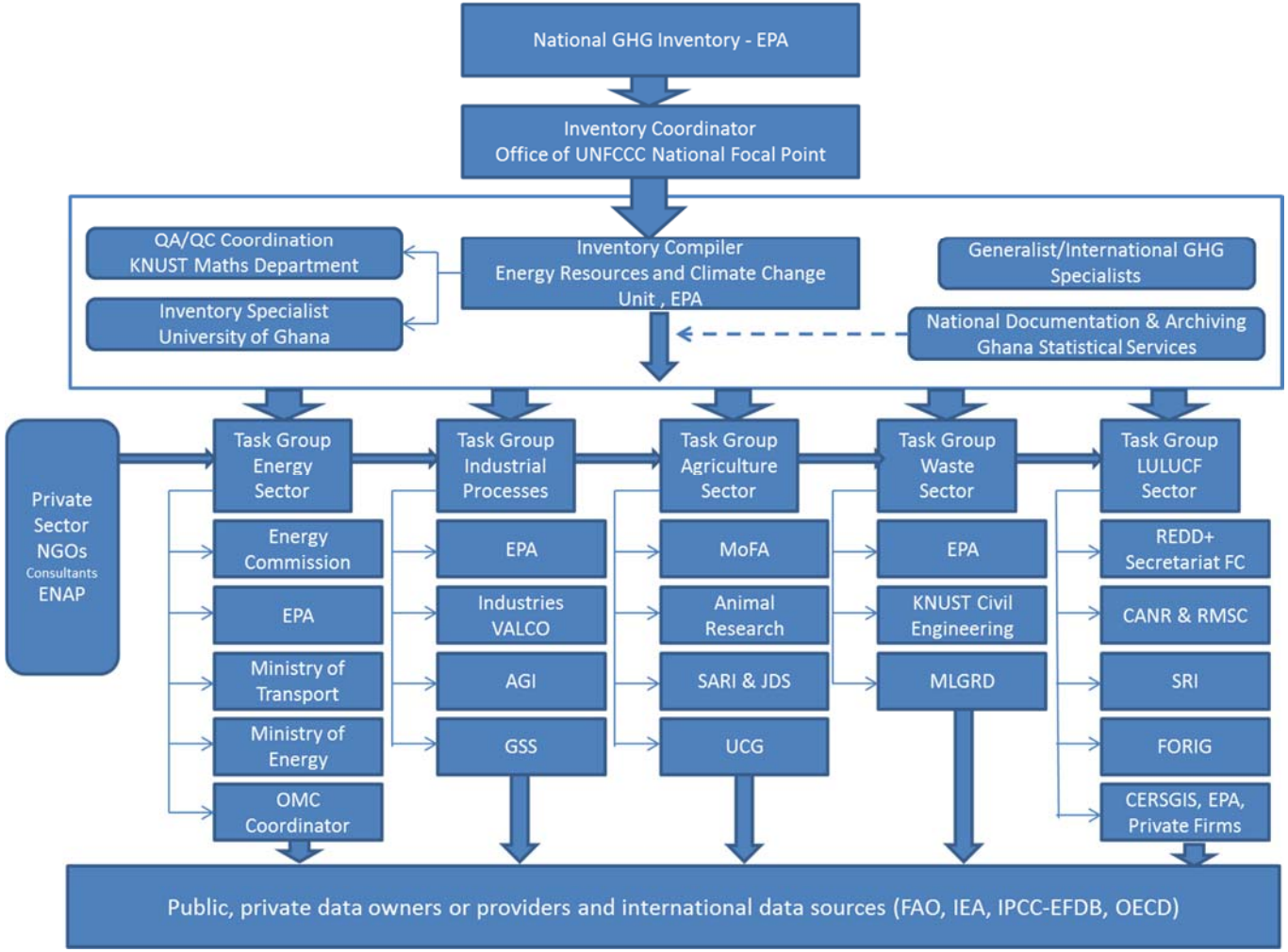
11.2 Key Institutions, Setups and Mandates

11.2.1 Ghana's GHG Reporting Institutional Arrangements

As part of the enhancements and focus on GHG reporting Ghana has discussed and implemented new arrangements at the national level. These arrangements provide the overarching policy guidance and leadership with appropriate levels of engagement from a wide range of stakeholders across the five sectors of Energy, Industrial Processes, Agriculture, Waste and the Land Use Land Use Change and Forestry. The agency and institutional roles are set out in Figure 11.1.

The national roles and responsibilities for the Forest MRV are clearly allocated to the government entities with a role in forest management and forest research and information; with some key institutions also identified for tasks and the recognition of potential private sector involvement.

Figure 11.1 Ghana's National Institutional Arrangements for GHG reporting



The products of the Forest MRV and potential interest in them were discussed in a workshop on Tier 2 Tools and Calculators (17th June 2014). The discussion included consideration of the products, reports and data potential of the Forest MRV and of the possible user group(s) and stakeholders. The participants identified:

- Possible reports and data sets of use from the Forest MRV System included:
  - Report for REDD+ Activities (markets and national reporting)
  - Multilateral and market efforts such as FIP, VPA, CDM, VCS
  - Project level reporting
  - FAO FRA
  - National Communication to the UNFCCC
  - Biannual Update Reports to the UNFCCC
- Potential Users and Stakeholders included:
  - Agriculture and land use planning
  - COCOBOD
  - National Statistics – Ghana Bureau of Statistics
  - Energy – charcoal
  - Ghana Standards Board
  - National Development and Planning Commission
  - Ghana Investment Promotion Centre
  - NDPC
  - Forestry Commission Divisions and Units (including RMSC)
    - RMSC
      - Mapping and GIS Department
      - Natural Forest Production Department (Harvested Wood Products)
      - Plantation Department
      - Environmental Conservation Department (Fire monitoring and reporting)
      - ICT Department (Data storage and handling)
    - Forest Services Division of the FC
      - District Offices (Harvested Wood Products raw data; Charcoal and fuel wood data)
      - Regional Offices (compilation; quality control and coordination)
    - Timber Validation Department – VPA
  - EPA
  - Universities and tertiary institutions
  - Ghana Statistical Service
  - Energy Commission

A further consideration is the linkages, relationships and collaboration required for the inputs and skills needed for the Forest MRV to be functional. This includes capabilities in data (collection, handling, storage, standards and maintenance), software, personnel, systems development and support. No single institution has the complete mandate, full range of data sets, the technical capacity and knowledge to operate the Forest MRV in isolation.

REDD+ Institutional Strengthening Strategy for MRV and the Communications Plan

The REDD+ institutional strengthening strategy will focus on two main tasks:

a) clarification of mandates of the different institutions, oversight committees, working groups, offices and entities that have a role to play in MRV, GHG reporting and other climate change reporting platforms
b) capacity gap assessment and strengthening the capacities of the REDD+ institutions and their affiliates to carry out their mandates.

To assist in analysis and setting out the most useful arrangements a set of principles and characteristics of institutions was prepared based on experience in other countries including Tanzania, Kenya, Cambodia, Indonesia, Papua New Guinea and Australia.

Capacity Gap Assessment and Institutional Assessment

Information has been collected and processed on the current state of technical expertise, institutional capacity and data availability for implementing a REDD+ program, specifically focused on developing forest reference levels and MRV in Ghana. The information in the document is compiled by Indufor and it has been used as a basis for producing an assessment of national capacity and capability for implementing the national forest MRV system. The outputs from the assessment will be used to determine the needs for each entity directly engaged in the reference level development and MRV.

Building on the discussions and ideas accumulated and examined in the design, planning and definition of the MRV System an initial evaluation of institutional mandates and capacities in Ghana was compiled. After discussions with the stakeholders, the roles, responsibilities and accountabilities of the institutions that are engaged in the development, implementation, management and improvement of the national forest MRV system, and their interactions, relationships and organisational linkages are described. Though the design may emerge during these discussions, it is important to note that decisions on institutional arrangements for the MRV System in Ghana are policy decisions.

Development of a Detailed Plan to Establish Sustained MRV Capabilities within Ghana

The requirements and specifications for the national system will enable identification of capabilities, competencies and skills required to establish and support the national MRV. An assessment of existing capacities in relevant institutions and organisations enabled the clarification of gaps, weaknesses and opportunities to establish MRV capabilities for Ghana.

A brief description of the entities, institutions and agencies is provided below.

11.2.2 Other Related Initiatives

The Natural Resources and Environmental Governance Programme (NREG) provided the first broad platform for inter-ministerial coordination in the natural resources sectors.

Project Oversight Committee of the Ghana Forestry Commission (FC) is responsible for the overall donor activity cooperation in the forestry sector. The National REDD+ Secretariat within the FC is coordinating the implementation of all R-PP activities.

Natural Resources and Environmental Governance Programme (NREG)

NREG was designed to provide annual sector budget support and to sustain the implementation of a broad programme of natural resources governance and environmental reforms and innovation for the government of Ghana.

The programme was developed and fully owned by the MLNR and MEST and their sector agencies such as, FC, MC and EPA. The programme focused on a set of policies and reforms in the inter-related sectors of forestry and wildlife, mining and environmental protection. It was a five-year programme that began in 2008. The objective of the NREG programme was to address governance issues as regards to natural resources and environment with the overall objective of ensuring sustainable economic growth, poverty reduction, increasing revenues and improving environmental protection.

The NREG was funded by Agence Française de Développement (AFD), Department for International Development (DFID) of the United Kingdom, the European Commission (EC), the Royal Netherland Government (RNG) and the International Development Association (IDA -

WB). The direct benefits expected at the completion of the programme at the end of five years were amongst others:

- improved management of government revenues and finances in forestry and mining sectors
- reduction of illegal logging
- reduction of social conflict in forestry and mining communities
- integration of environmental considerations into policy formulation and implementation across government, including risks associated with climate change.

One of the main efforts in the programme was the implementation of the Voluntary Partnership Agreement (VPA) between GoG and the EC.

Forest Preservation Programme (FPP)

The Forest Preservation Programme (FPP, 2011-2014) was supported by the Government of Japan and aimed to contribute to forest conservation in Ghana by providing the Forestry Commission with equipment, materials and services. This would allow the FC to access and utilise advanced Japanese technologies and products to map and analyse forestry and land use sectors. The programme was designed with seven key components: land use, land use change and forestry (LULUCF), geographic information systems (GIS), forest inventory system (FIS), light detection and ranging (LIDAR), carbon estimation, a GIS website and capacity building.

Through these elements the programme's focus was on forest land mapping, monitoring and capacity building for forest baseline data, environmental management, and planning for sustainable forest management in Ghana. Plots were measured in a concentrated area in the west of the country that spanned across all eco-zones and monitoring, reporting and verification (MRV) protocols for sub-national demonstration activities were developed. The total budget was USD 8 million.

11.2.3 FCFP REDD Readiness Initiatives

Readiness Preparation Proposal (R-PP)

The REDD R-PP establishes the management arrangements for REDD in Ghana. Presently there are a number of national bodies, committees, working groups and other non-permanent bodies to coordinate, develop and monitor the REDD processes. Many of the representatives of different Government or other organisations participate in several of these bodies.

The REDD components are all being implemented simultaneously with efforts in place to meet the challenges this represents.

The Strategic Environmental and Social Assessment for the REDD+ Mechanism in Ghana (SESA)

SESA is being implemented by a Ghanaian consulting company, SAL Consulting. The SESA contributes to the REDD+ Readiness process in Ghana in two main ways.

(1) It helps to refine the REDD+ strategy options by assessing how they address environmental and social priorities associated with current patterns of land use and forest management. Gaps identified through this assessment would lead to adjustments in the REDD+ strategy options to close the gaps.

(2) SESA would produce an Environmental and Social Management Framework that will outline the procedures to be followed for managing potential environmental and social impacts of specific policies, actions and projects during the implementation of the REDD+ strategy that is finally selected.

A National Validation Workshop is to be held in mid-2014 to discuss the outcome of consultancy assignment on SESA.

The SESA is expected to produce the key environmental and social issues, which will be prioritized by institutional stakeholders and the forest communities based on the participatory

consultations, mapping and analytical work carried out. These will form the criteria in the assessment of the candidate REDD+ strategy options and their finalization. This component's short implementation time makes it a very challenging assignment.

The SESA report is proposed to analyse critical institutional, legal, regulatory, policy and capacity gaps underlying the key environmental and social issues identified.

Development of the National REDD+ Strategy

An indicative list of strategy options for the National REDD+ Strategy has been elaborated under the R-PP process and shall serve as the basis for further dialogue on a REDD+ strategy. The final selection of strategy options and the eventual formulation of the REDD+ Strategy document will require further analytical work, consensus building, prioritization and operationalization.

The formulation of the National REDD+ Strategy will be based on the results of specific analytical studies and inputs received from a multi-stakeholder consultative process. The preliminary strategic options for the REDD+ Strategy will be assessed and validated. The main objective of this assignment is to develop an integrated National REDD+ Strategy, which shall examine the existing policy, legal and institutional framework and propose a way forward for setting up the institutions, norms, processes and procedures for implementing REDD+ in Ghana. The strategy will provide a roadmap for Ghana to implement the REDD+ program. The proposed strategy is being prepared through a participatory process that will elicit and prioritize the strategic options according to a multiple criteria assessment (e.g. economic, social and environmental dimensions).

Benefit Sharing

A local consultant was engaged to propose guidance for setting up national architecture of benefit sharing that can be adopted to support the REDD+ implementation process. The assignment, according to its TOR, includes the identification of main risks and providing concrete suggestions on how the Government can move forward in creating a national framework for sharing benefits from REDD+ (regardless of the source of REDD+ financing) and to suggest locally appropriate types of payments / compensation for REDD programs and projects.

Other components of the REDD+ readiness programme are the Grievance redress mechanisms and dispute resolution and the REDD+ Communication Strategy.

FCPF Carbon Fund ER-PIN

The FC Climate Change Unit submitted a draft of the ER-PIN to the World Bank on 7th of March 2014. This ER-PIN described Ghana's Emission Reductions Program for the Cocoa Forest Mosaic Landscape (Cocoa Forest REDD+ Program). This document described an approach to reducing the cocoa sector impact on deforestation as well as the programs necessary interrelation with the National Forest MRV system to report the benefits of the ER-Program to the FCPF in terms of net greenhouse gas reductions. The ER-PIN included potential net greenhouse gas reduction estimates based on the current best available data largely collated from the FPP. These calculations and subsequent estimates should not be considered as final, formal or official in any way as the design of the MRV system, including the calculation approach has not yet been finalised and therefore the approach used to derive the ER-PIN estimates is subject to change. Once the forest MRV design has been finalised, revised estimates of deforestation and degradation (if possible) will be prepared.

Ghana Forest Investment Plan (FIP)

The Ghana Forest Investment Plan (FIP) deal directly or indirectly with key drivers of deforestation. The objective of FIP is to achieve transformational impact, i.e. reduce carbon emissions, enhance forest carbon stocks, and deliver co-benefits. The FIP, approved in December 2012, has three main projects distinctively supported by WB, AfDB and IFC.

Project 1: Reducing pressure on natural forests through an integrated landscape approach and increasing wood production and carbon stocks through rehabilitation of natural forests (WB).

Project 2: Engaging local communities in REDD+ / Enhancing Carbon Stocks and focusing on promoting climate SMART agriculture including more sustainable cocoa production based on conservation and sustainable management of natural forests (AfDB).

Project 3: Engaging the private sector in REDD+ by developing industrial and fuelwood plantations (IFC).

11.2.4 Other Initiatives

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

The ITTO approved project "Advancing REDD+ in Ghana: Preparation of REDD+ Schemes in Off-Reserve Forests and Agroforests", was implemented in Ghana by FORIG, in collaboration with the Climate Change Unit (CCU) of the FC, partners at Kwame Nkrumah University of Science and Technology (KNUST), and researchers from Bern University of Applied Sciences during 2013-2014.

The project supports Ghana's R-PP and aims at strengthening Ghana's capacities to prevent and reduce deforestation and forest degradation and enhancing carbon stocks (REDD+). The specific objective of the project is to lay out the ground work for the development or enhancement of off-reserve production systems under REDD+ schemes, in line with its efforts to reduce GHG emissions in forests. The project is developing a number of analytical reports and the definition of REDD+ pilots in off-reserve areas. The project is also aimed at developing a framework to guide the implementation of REDD+ from the national to the local level. This will allow Ghana to take stock of existing initiatives that have the potential to be considered under REDD+, as well as to concretely analyse promising REDD+ activities, which will be an integral part of the RPP. The information produced through the project shall prepare the further implementation of agricultural and secondary forest production schemes that feature climate smart practices. The following results were planned:

1. Analysis of possible pilots for REDD+ activities in agricultural and secondary forest systems
2. Identification of effective REDD+ implementation activities in management and governance
3. Capacity building in view of improving the institutional capacities needed for effective resource management under consideration of REDD+ activities;

The results of the analysis above will be fed into the design of a main project document for implementing major REDD+ pilots under the RPP scheme.

Coastal Sustainable Landscapes Project (CSLP)

The US Forest Service (USFS), together with the Government of Ghana and the US Agency for International Development (USAID) are in the process of initiating a coastal landscape conservation project in the six coastal Districts of the Western Region of Ghana. This Coastal Sustainable Landscapes Project (CSLP) will contribute to moving Ghana into a low greenhouse gas emissions, high carbon sequestration development pathway in the land use sector. The project will be embedded within broader and multi-partner food security, biodiversity conservation, climate change mitigation, and environmental governance efforts along the western coast of Ghana.

REDD+ Landscape Restoration Project

With US$6.2 million in funding from Norway's Agency for Development Cooperation (NORAD), Ghana and Mexico are the first of four countries to kick off activities under IUCN's "Advancing

REDD+" project, which focuses on mobilizing private investment for community-based, carbon-intensive landscape restoration.

The aim of this three-year project is to establish practical examples of "community-private sector" partnerships that will make the case for scaling up of landscape restoration activities, consistent with national REDD+ strategies in Brazil, Ghana, Guatemala and Mexico. The project capitalises on growing interest in landscape restoration, and will facilitate strategic cooperation between private investors and land managers in these four countries, where interest and potential capacity already exist. Inception workshops held in Ghana and Mexico have initiated national-level activities. Brazil, Guatemala, Mexico, and Ghana have already, or are in the process of identifying specific opportunities related to REDD+ and restoration, and are open to actively seeking and encouraging community-private sector investments. The pilot landscapes in Ghana are expected to be in Wassa Amenfi District. This national REDD+ pilot site and IUCN's ongoing contribution to the Forest Investment Programme (FIP) process in Ghana will provide the basis for project activities.

11.2.5 REDD Specific Bodies

There are a number of committees, and working groups etc. that have been established for the REDD+ process. These include the following:

Environment and Natural Resources Advisory Council (ENRAC)

ENRAC was established to provide overall strategic direction to government and relevant stakeholders on environmental and sustainable development issues. Its mandate is to be a high level policy coordinating body that will deliberate on critical national issues, priorities, strategies and policies necessary for sustainable development and advise government on appropriate action. A secretariat has been established at the Environment Directorate of Ministry of Environment Science, Technology and Innovation, with technical support from EPA and the Minerals Commission (MC).

Natural Resource and Environmental Governance (NREG) Technical Coordination Committee (TCC+)

The NREG Technical Coordinating Committee is the main coordinating mechanism. . It also coordinates the Forest Investment Program (FIP) and other new environment and natural resources programmes. These include the REDD+, the Voluntary Partnership Agreement (VPA), National Forest Forum (NFF), and Non-Legal Binding Instruments (NLBI). The TCC+ coordinates these initiatives through their respective Technical Working Groups. It is chaired by the Ministry of Finance and Economic Planning (MOFEP).

National REDD+ Working Group (NRWG)

NRWG makes policy recommendations to the Minister for Lands and Natural Resources on National REDD+ policy or strategy formulation. Another scope of their work is to provide advice and guidance on all national REDD+ processes and serve as the liaison between respective institutions and stakeholder groups. The NRWG is also responsible for advice on institutional roles and mandates for implementation of REDD+ processes. It provides both technical and policy support to the TCC+ on REDD+ issues. NRWG meets every three months. This Working Group has a lead role in the communications across and within government on the Forest MRV. It has six sub-working groups:

1. Policy and Legislation
2. Strategic Environmental and Social Assessment (SESA)
3. National REDD+ Consultations and Participation
4. Demonstration Projects
5. MRV/REL
6. Monitoring and Evaluation (M&E)

National REDD+ Secretariat (NRS)

The National REDD+ Secretariat (*in practice, the CCU of the FC*) is responsible for the coordination of the implementation of the R-PP. Among other things, it is also responsible for coordinating and facilitating the organization of meetings for the NRWG, identify potential opportunities in Ghana to apply the REDD/REDD+ mechanism, and maintain working relationships and communicate with relevant corporate, NGO and governmental sectors on REDD/REDD+ issues.

The NRS is the key body to create, facilitate and support communications on the Ghana Forest MRV.

National Climate Change Committee (NCCC)

NCCC was originally established to formulate a National Climate Change Policy for Ghana, and to Envision Mitigation and Adaptation Strategies for implementing and monitoring the Climate Change Policy. Now its mandate is to implement and support the policy, and draw up sectorial strategies. In general, the distribution of responsibilities between these bodies is not clear, and their terms of reference do seem to overlap.

The Forestry Commission

The Forestry Commission has a mandate and key leading role in the Forest MRV. The Divisions of the Forestry Commission with a direct role in Forest MRV are briefly described below.

Structure and Divisions

The Forestry Commission of Ghana is responsible for the regulation of utilization of forest and wildlife resources, the conservation and management of those resources and the coordination of policies related to them. The Commission's bodies implement the protection, management, and regulation on forest and wildlife resources. They are:

- Climate Change Unit (CCU)
- Resource Management Support Centre (RMSC)
- Forest Services Division (FSD)
- Wildlife Division
- Timber Industry Development Division (TIDD)
- Timber Validation Department (TVD)
- Donor Relations Unit

The Project Oversight Committee of the Ghana Forestry Commission (FC) is responsible for the overall donor activity cooperation in the forestry sector.

The Climate Change Unit

The Climate Change Unit acts as the main focal point for REDD+ in Ghana. The CCU coordinates all REDD+ activities and acts as the REDD+ Secretariat. The personnel should have an understanding of both the technical and policy aspects of REDD+ and the participatory methods needed to effectively engage a wider audience on REDD+. CCU is responsible for overseeing the implementation of each activity described in the components of the RPP, working with the NRSC and other decision makers.

Resource Management Support Centre

RMSC monitors and reports on Ghana's forest and wildlife resources, they develop standards for forest management (and wildlife), carry out the forest inventories, and map forest reserves. All mapping for the FC – for Forest Service Divisions' Districts is carried out by the RMSC. RMSC assists forest districts to prepare management plans for all forest and wildlife resource areas, and supports the formulation of forest and wildlife policy, including training.

RMSC has a critical role in the production of data for the MRV. Forest inventory data provided by the RMSC is utilized in the biomass estimation, and the GIS unit of RMSC provides GIS

support, ground survey data and remote sensing (satellite, aerial photographs, LIDAR) for the stratification of the forest resource.

Forest Services Division

Forest Services Division is responsible for the management of the forest resources of the country, including the wildlife on the forest reserves. Their mandate covers regulation of harvesting, monitoring, and plantation development. It is the Division responsible for the implementation of the forestry activities, and it covers both on and off reserves.

In Ghana, the administrative units related to forestry are 10 forestry regions and 45 forestry districts. Total staff in these is 3,500 persons, and the activities are divided between natural forests and plantations.

Forest Districts and Regions

Forest Districts, administered under Regions, are further divided in to Ranges. Districts are responsible, under the management of the FSD, for the protection, management and development of the forest resources. They regulate harvesting in on and off-reserve forests, collect stamping revenues, maintain forest reserve boundaries, prevent and report fires, and control and report illegal felling, as well as other illegal activities (mining, farming). The Districts are required to prepare Annual Progress Maps for each Range. At present, these are drawn by hand, and sent to RMSC, where they are digitised.

11.2.6 Stakeholders Related to MRV

A large number of stakeholders are dealing with REDD+ in Ghana. In the table below, we have listed the institutions and agencies, which have a direct role in the national MRV system development or a mandate in its sustainable operation and maintenance in the long term.

Table 11.1 Stakeholders Related to MRV and Their Roles

Institution	Responsibilities/Roles
Ministry of Lands and Natural Resources (MLNR)	The sector ministry to which the Forestry Commission reports. Responsible for Ghana's Forest Investment Programme (FIP) and will serve as the program's Coordination and Management Committee to ensure integration with FIP projects and related activities.
Forestry Commission (FC)	The government institution responsible for the sustainable management of Ghana's forest and wildlife resources.
Districts and Regions of the Forestry Services Division (FSD, of the FC)	Key data are captured and submitted by District Offices of Forest Services Division of the Forestry Commission. Data on fires, illegal activities and plantations are provided to RMSC.
Climate Change Unit (CCU, of the FC)	Management of forestry-sector initiatives related to climate change mitigation, including REDD+; hosts the National REDD+ Secretariat and serves as the National REDD+ focal point.
Resource Management Support Centre (RMSC, of the FC)	Compiling of the MRV data from different units and submitting it to Chief Executive of FC for forwarding to the EPA as agreed in a MoU.
Lands Commission (LC)	Land title registration, etc.
Survey Department (of MLNR)	Production of topographic base maps and the custodian of the base map for Ghana.
Forestry Research Institute of Ghana (FORIG)	Specializes in forestry research, under MESTI. Forest inventory methodology, supervision of inventory survey, tree sampling, physical analysis of samples and allometric modelling.
Soil Research Institute (SRI)	Physical and chemical analysis of the soils for the Forest MRV.
Center for Remote Sensing & Geographic Information Services (CERSGIS), University of Ghana	Third party review of forest stratification data (SOP)
Geological Survey Department of Kwame Nkrumah University of Science and Technology KNUST	Third party review of forest stratification data (SOP)

Environmental Protection Agency (EPA, under MESTI)	The National Focal Point for Climate Change and is responsible for all National Communications to the UNFCCC.
Cartographic Division, Ghana Statistical Service	Provision of statistical data relating to Ghana such as population.
Ghana Energy Commission (under MoE)	Keeps statistics on annual charcoal production/consumption.
National Development Planning Commission	Responsible for coordinating national development activities; including land use and mining. FC is providing data to the NDPC.
Ghana Cocoa Board (COCOBOD)	The national institution responsible for the regulation and management of the cocoa sector.
Ministry of Environment, Science, Technology and Innovation (MESTI)	Ministry which contains and oversights the EPA.
Ministry of Food and Agriculture (MOFA)	MoFA will sit on the (ER-PIN) program's Coordination and Management Committee and will be responsible for ensuring that extension services and interventions related to food and cash crops, as well as cattle breeding align with the goals of Ghana's Cocoa Forest REDD+ Program.
Ministry of Finance and Economic Planning (MOFEP)	MoFEP is the sector ministry to which Cocoa Board answers and it is the Chair of the NREG Technical Coordination Committee- Plus (TCC+), MoFEP will be responsible for the overall financial administration of the planned Ghana's Cocoa Forest REDD+ Program (ER-PIN).

With such a diverse range of interest groups, some with direct roles and relevant mandates, communications of the Forest MRV is critical. It should provide effective means and methods to support clear understanding and mobilise participation and continuing contributions as required.

11.3 Design of Institutional Set Up

It should be noted that at the time of writing there does not yet seem to be an example of a developing country that has put in place a national MRV system in a clear, concise and deliberate form. Forests are the initial, dominant focus of efforts. The tendency in most countries has been that traditional forest management in the past has focused on only the forest and forest resources, and consequently forest related agencies take the lead initially in MRV processes. This overlooks the requirement for all lands and all pools to be evaluated in the national accounts. Few administrations have progressed to the stage of considering the institutional and governance arrangements in any depth or fully integrating them across government.

The Forest MRV team is familiar with the capacities and requirements for the Forest MRV and on that understanding is proposing an institutional setup to provide:

- A starting point for discussion among stakeholders
- Address in the first instance the key role of the Forestry Commission and the Divisions of the FC in the Forest MRV
- Defining the roles of institutions outside the Forestry Commission on the Forest MRV.

11.3.1 SOP Data Sets and Contributors

The SOPs set out the data sets and source and identify institutions relevant to the Ghana Forest MRV. A collation of the Institutions and their contribution is listed below. This provides a clear basis for identifying the government agencies, other institutions and in time possibly the private sector service providers that have a role in the implementation of the Forest MRV or might support implementation.

Required data sets for processing of satellite data by name and source are:

1. RMSC
    a. Land use map 1990, 2000, 2010
    b. Land use Change Map (1990/2000, 2000/2010, 1990/2010)
    c. Forest Reserves shapefiles
    d. Forest Inventory Data (1990 – 2000)
    e. Digital Elevation Model
    f. Plantation shapefile
    g. Ground Control Points(GCP) and Rudan Engineering Survey Department
2. Carbon Map: NCRC
3. Topographical Maps (i.e. roads/rivers/settlements): Survey Department 1970
4. Shapefiles of rubber plantations: Ghana Rubber Estates Limited(GREL)
5. Shapefiles from Cocoa plantation: Cocoa Board

To develop the biomass stock and stock change estimates the following key data sources are used:

1. National specific allometric equations for all the major ecological zones to estimate both above and below ground biomass (Ghana FPP Manual 5-4)
2. 600 one ha permanent sample plots located in forest reserves within the high forest zone (HFZ). The plots are spread in all the six ecological zones and have been measured at least once. The plots were established between 1986 and 1992 (RMSC)
3. Static inventory of 1989 within Forest Reserves (FR) of the HFZ. About 3200 0.5 ha plots were established. All tree species above 5 cm dbh were measured.
4. 2001 Multi Resource Inventory of timber and non-timber species within FR of HFZ, carried out only in timber production areas of the forest reserves.
5. 1986 off reserve inventory conducted to capture all timber trees outside the permanent forest reserve.

For Forest Stratification:

1. National Forest Inventory plot data from RMSC
2. Multi resource inventory report
3. Savanah resource management report
4. National definition of forest
5. The statutory categorization of forest based on management regimes
6. The revised forest and wildlife policy of Ghana
7. The legal definition of forest.
8. The ecological zone map of Ghana
9. The state of the forest (degraded, planted, pristine) records from FC.
10. Static inventory of 1989 report
11. 2001 Multi Resource Inventory of timber and non-timber species within FR of HFZ report
12. 1986 off reserve inventory reports
13. Forest protection in Ghana
14. Prepared by FPP and used to test SOPs
    a. 2010 Landuse map of Ghana prepared by FPP.
    b. 2000 Landuse map of Ghana prepared by CERSGIS
    c. Landuse change map of Ghana prepared by FPP
    d. Biomass and carbon map prepared by NCRC and FPP.

For National Forest Inventory (NFI) SOP:

1. 2001 Multi Resource Inventory of timber and non-timber species within FR of HFZ, carried out only in timber production areas of the forest reserves.
2. Forest Preservation Program of 2013 with about 270 plots.

For the Reference Emissions Level (REL) SOP the following data sources were relied upon:

1. Time series consistent remotely sensed activity data (i.e., land use change data) for 1990-2000 and 2000–2010.
2. Carbon stock lookup tables developed as a result of the Forest Preservation Project 2012.
3. GIS datasets including:
    a. Classified data of forest land based on canopy cover (CC) (2010)
    b. Regional Ecological Zones (REZ) - RMSC
    c. Primary Designated Use (PDU) - RMSC.

For Soil Organic Carbon:

1. Field sampling and laboratory determination of Soil organic carbon of the sample in g C/100 g soil.

11.3.2 Forest MRV Institutional Mandates and Roles

From the analysis carried out of the institutions the main actors for the Forest MRV system are unsurprisingly from the relevant government agencies and related research and academic institutions. Based on these institutional arrangements the roles for the Forest MRV can be attributed as set out below. The actors involved directly in the Forest MRV are:

- Forestry Commission
    - CCU of the FC
    - RMSC of the FC – most of the role is dictated by the sops and is technical. RMSC is also the setting of standards and data collection for the FC
        - Mapping and GIS Department
        - Natural Forest Production Department (Harvested Wood Products)
        - Plantation Department
        - Environmental Conservation Department (Fire monitoring and reporting)
        - ICT Department (Data storage and handling)
    - Forest Services Division of the FC
        - District Offices (Harvested Wood Products raw data; Charcoal and fuel wood data;)
        - Regional Offices (compilation; quality control and coordination)

The major ‘clients’ of the Forest MRV system include the EPA and the World Bank. Though vitally interested in the Forest MRV, and dependent upon it, they do not have any direct role in the operation of the system.

Climate Change Unit

The CCU role then encompasses the guidance and overall management and supervision of the Forest MRV System, including its continuous improvement:

- Communicating the emissions estimates and reporting to the UNFCCC focal point, the EPA.
- Administration and Management of the Forest MRV, formal arrangements (MOUs), for the Forest MRV with contributors (RMSC), service providers (possibly Soil Research Institute, FORIG, perhaps others) and QA/QC processes (Third Party Providers).
- Monitor UNFCCC and other multi-lateral (World Bank etc.) Agencies and report on any new guidance and advice considered relevant for the revision of the SOPs in collaboration with RMSC. Provide feedback, on the third party review of the BUR and

National Communication for improvement of the SOPs. Monitor the development of new and improved data sets, and revised methods to inform the revision of the SOPs Facilitate biannual review of the SOPs at least 12 months ahead of the BUR reporting deadline.

- Facilitate the sourcing out of QA/QC to a third party.
- Support communications relating to the Forest MRV, both formal and public.

RMSC

RMSC will play both direct and indirect roles in the Forest MRV. The direct role involves:

- Implementing the SOPs that RMSC is responsible for
- Integrating the data collected by the Forest MRV to generate the emissions estimates for the national reporting
- Preparing Forest MRV data to meet other reporting requirements
- Carry out training of SOP contributors on the methods and procedures
- Facilitate the QA/QC process
- Manage the delivery of data and information from the Forest MRV for various stakeholders, including for the national reporting
- Lead the review of SOPs as required
- Maintain the capacity to operate the Forest MRV and implement continuous improvement in the system
- Design and implement forest inventory programs
- Develop base and resource maps.

The RMSC indirect roles are:

- Data collection design to guide Districts
- Data handling, storage, backup and metadata management.
- Undertake professional development and training required for SOPs
- Provide analysis and advice on policy decisions related to the Forest MRV
- Manage Remote Sensing and GIS infrastructure
- Training of Field teams and management of equipment
- Management of ICT hardware and software
- Administration and Management of the Forest MRV, including contracting and contract management for data sets and SOPs that are not within the capacity or mandate of RMSC; such as for soils data (Soil Research Institute), some aspects of biomass (FORIG)
- Support communications relating to the Forest MRV, both formal and public.

Forest Services Division

The role of Forest Services Division concentrates on:

- District Office: Collection of raw data on harvested wood products, charcoal, and woodfuel
- Regional Office: Coordination of raw data collection on harvested wood products charcoal and wood fuel by the District Office including quality control, data compilation and submission to RMSC.

ICT Department

The ICT Department has an ongoing service and support role:

- Handle all data including storage
- Provision of data backups when required
- Develop programs to handle Forest MRV issue
- Advice on procurement of ICT software and equipment.

The outputs and products of the SOPs have to be brought together and put into the calculation process that generates the estimates for the Forest MRV. This data integration role is technical and would logically sit with RMSC for forests. As full coverage of the land sector is extended the integration role may logically transfer to another entity of Government.

11.4 Institutional Capacity

11.4.1 Current Situation and Needs

In Ghana, the institutions related to development of a national forest MRV system appear to have sound policies, international engagement, and official organisational structures. Level of management and leadership in different organisations varies. The processes are not always spelled out, but people tend to manage, sometimes improvising. Some sustainability risks exist, document management is not ideal, and official cooperation and coordination between different actors and projects/programmes could be improved. At present, in the FC, all divisions and departments report to the CEO. The Executive Management Team (Heads of Wildlife, TIDD, CC, TVD, RMSC, Finance, HR, and Corporate Planning) meets every two months and a Project Oversight Committee meets as required. Cooperation between different projects in practice seems to be rather informal and should be improved.

Overall awareness of REDD+ exists but technical expertise and profound understanding of the implications of decisions made is limited to some individuals. This may contribute to delays in decision-making.

Compounding this issue is a limit in local capacity (both in numbers and qualifications) to understand clearly and manage what is required, which leads to programme implementation and coordination that is less effective. The international donor community contributes to this as it promotes international initiatives to governments; sometimes in parallel and lacking sound coordination. Inputs and performance are not consistently aligned with capacity and may lead to overloading institutions and individuals.

Table 11.2 Staff Situation in Key Units of the Forestry Commission

Institution	Staff	Needs
CCU, FC	5 professionals: 4 MSc and 1 BSc	- Managerial and leadership training, also at the Forestry Commission level. - Managers and Directors' understanding of RS/GIS is limited. Similarly, the capacity in RS/GIS at the CCU Unit in Accra is limited. - Monitoring of RMSC's work requires some new/additional capacities.
SR/GIS and Mapping Unit, RMSC,	1 MSc, 4 BSc	- Under-staffed - Unit is very small to cater for all FC needs - Regional officers could have their own GIS and training to collect, insert and send data to RS/GIS unit for verification, cleaning and compiling. - More data management capacity needed: the server has all data now, but retrieving data and producing maps and reports is a bottleneck. - GIS and software utilisation knowledge is limited
Natural Production Forest Management Unit	2 MSc, 3 BSc, total 5 key staff + 2 technicians + 6 botanical assistants + 1 driver	- Under-staffed - If a 3rd forest inventory were to be carried out, extra staff would be needed.
FSD	3,500 total staff	- Lacking funding for 500 existing forest guard and 50 rangers posts.

		- Needs professionals, especially in the new **topics**: carbon, PES, ecologists, forest engineers, community experts/sociologists - Logistics: field equipment, vehicles, motor bikes, tents, measuring equipment, GPS.
Forestry District (example Nkawie District)	Manager MSc, 2 Deputies BSc, 14 Range Supervisors in 6 Ranges, technical people and forest guards	- Deadwood estimates, soil sampling, fuelwood information, litter – not enough experience of these MRV-related tasks. - Not sufficiently staffed (see comments on FSD)

11.4.2 Potential Improvements

The R-PP recognises the need for both technical and managerial capacity development:

> *"It is recognized that the Forestry Commission (and the Government of Ghana, more generally) will need to increase their capacity significantly in technical and managerial terms in order to take this (REDD+) strategy forward."*

All actors should have a better general understanding of the REDD+ processes. The FC would benefit from capacity enhancement in general management skills, leadership & communication skills to support the processes of formative guidance and coaching and mentoring of staff. This would create the possibility of further delegation of responsibilities and the required delegation of authority. At the Forestry Commission level, a better management of the project portfolio is required, and official cooperation and coordination between different actors and projects/programmes could be improved, which also applies to the National REDD+ Secretariat, responsible for the management of all the REDD+ projects. The R-PP (2010) recognises this

> *"Enhancement of formal collaboration and cooperation among key ministries, departments and agencies (FC, EPA, MOFA, MESTI, MLNR, MoFEP, etc.) and thus improved sharing of data and information relevant to a REDD+ strategy."*

The enhanced participation of staff in attending and having responsibility for external and internal meetings would promote capacity-building and simultaneously ease the overall workload of those holding managerial positions. The level of participation in different meetings could be framed up to allow more junior staff to participate in technical meetings, and more senior staff in high-level policy meetings as appropriate. This would also contribute to sustainability within the institutions, build capacities and improve the flow of information.

At the National REDD+ Secretariat a deeper understanding of the requirements, interactions and implications of the different REDD+ programs should be achieved. At present, the Secretariat is heavily committed, probably over-committed, with projects and programmes, and there is hardly any time to digest the materials, plan strategically and apply sound management to the many activities. The R-PP (2010) established the need for increased capacity:

> *"The REDD+ Secretariat will require increased capacity if it is to play its role in coordinating REDDplus activities within Ghana. It is proposed that an extra two persons join the team and take full time positions dedicated to REDDplus. The additional personnel should have an understanding of both the technical aspects of REDDplus and the participatory methods needed to effectively engage a wider audience on REDDplus. They will be the staff responsible for overseeing the implementation of each activity described in the components of the RPP, working with the NRSC and other indicated decision makers."*

The positions noted are understood to have been filled. Currently there is a review of Climate Change Unit needs for additional skills and capacity to be added. The Ghana Forest MRV project has been consulted on the review and provided input.

11.5 Technical Expertise

11.5.1 Current Situation and Needs

Ghana already has a pool of skills and competencies in the area of forest inventory, GIS and remote sensing. These skills are already being applied as far as practical in the execution of the activities.

The Forest Preservation Project (FPP) funded by JICA and implemented by PASCO has in effect trialled or conducted most of the tasks that will go to make up the Forest MRV system. This included capacity building and training in GIS, Remote Sensing and Carbon Modelling. Required hardware as well as GIS and other software for forest resource management and image processing for remotely sensed data were procured and installed both in Kumasi (RMSC) and Accra (one set with the ITC Unit), and in the Brong Ahafo regional office. In addition, the required field survey equipment was purchased. Main servers are in FC/Accra, and RMSC/Kumasi is providing the VPA backup. ICT capacities are sufficient.

Training was provided in GIS/Image Processing and LiDAR/Forest Inventory and Biomass Estimation, GIS Forest Resource Management Software, system administration, image processing software for ALOS and other satellite imagery for forest resource mapping and change detection, as well as forest inventory and biomass estimation. Some of the key staff of RMSC were core team members of the FPP project.

In additional ASTRIUM Implemented a GIZ Capacity Building Project and ITC provided Remote Sensing Training for selected RMSI and Forest Region staff.

GIS/Remote Sensing capability, including hardware and software exists mainly in the Resource Management Support Centre (RMSC) in Kumasi. RMSC's main units have a professional staff of 4-5 persons each, most of them with a M.Sc. Technical gaps exist in the understanding of the UNFCCC/IPCC requirements.

This project has been carrying out on-the-job capacity-building on the understanding of the UNFCCC/IPCC reporting requirements, through the preparation of SOPs, roundtable discussions among the whole team and mentoring support by e-mail and during the drafting of materials.

Data Acquisition, Availability and Storage

The experts, data providers and other key contributors have been made aware of the needs, and a considerable share of the data has already been collected for other purposes. A lot of data is readily available for the national forest MRV reporting, mainly through the RMSC. The existing arrangements for obtaining data of various types held in RMSC seem to function relatively well. During this process, for the Forest MRV Project, the data was well compiled, however possibly not reviewed as there are many questions and inconsistencies with it when the data is interrogated. It appears that the FPP developed capacity in how to obtain and compile inventory data; capacity that will be relied upon on in the MRV system design.

Data collected by the Districts is still provided in paper form and entered into databases in the RMSC. However, the formal channels for data flows are not often respected, and there are shortcomings in the documentation of events. Design of the forest MRV database will be done by RMSC for the districts to do data collection, as is the case for other operations and practices. RMSC will also follow up for quality control. The data from the districts is then compiled and analysed by RMSC.

General Filing Systems

The Forestry Commission has a conventional and traditional central filing system. There is a central filing registry that creates and maintains hard copy files on relevant topics for the Forestry Commission.

The Climate Change Unit runs its own filing system for internal management and to have easy access to useful, commonly accessed or important documentation. This is not formal. It is

intended to facilitate ready access to materials and documents for the purposes of the CCU and its staff. The CCU is improvising with one computer allocated to REDD+ documents only.

There appears to be no formal procedure for capturing, retaining and maintaining electronic documents, materials and e-mails. The Forestry Commission has a central server system and ICT architecture that could facilitate this, but it is understood that currently the filing systems are not connected to the server. Many of the staff use public e-mail providers such as Yahoo and Gmail which may carry risks.

The organisation, management and security of electronic documents at present appear to be a matter for individuals. The reliability, accessibility and structure of electronic materials is likely to vary with the approach, attitude and capacity of each Forestry Commission staff member.

The reporting, monitoring and auditing requirements for Ghana under technical and review processes proposed by the UNFCCC necessitate a systematic and coherent approach to documentation of all types of data, information, decisions and operations related to the Forest MRV.

11.5.2 Potential Improvements

Technical expertise requires not only knowledge, but equally good management and leadership to be fully useful to the organisations. The data, capacities, experience, and systems need to be in place so that Ghana can be reporting for the coming decades.

Some training for forest carbon inventories has been carried out under the FPP project and under this assignment (the MRV project). For establishing the REL, training on the following issues has been carried out with key persons in RMSC:

- Alternative approaches to landscape stratification and sampling plans
- Developing emission factors for deforestation and forest degradation
- Assessing uncertainties in historic emissions estimates
- Linkages to IPCC Guidelines and understanding their requirements
- Establishing national conversion/expansion factors
- Different reference level approaches and methodologies

Training for GIS and Remote Sensing to focus on remote sensing methods in reference levels development, spatial analyses and modelling for land use land use change detection is necessary. Training already carried out under FPP and others include:

- Remote sensing methods for establishing a credible baseline/reference level
- Deforestation rate estimation using spatial analysis
- Spatial modelling of future emission projections
- Spatial methods for estimation of forest carbon stocks

For creating, maintaining and improving the Forest Monitoring, Reporting, and Verification System:

- Data collection and protocols at the local and national levels for defined carbon pools
- Systematic measurement e.g. Permanent Sample Plots Forestry Districts
- Creating a national GHG information system
- Guidance on reporting
- National and subnational stratification
- Remote sensing methods for monitoring forest deforestation
- Remote sensing methods for monitoring degradation

There is urgent need to establish GIS hardware and software training to all Forest Regions and some, if not all Forest Districts. Further training in GIS software in RMSC Kumasi would be also needed to ensure sustainability.

District Officers should be trained in the MRV data collection on deadwood estimates, soil sampling, fuelwood, and litter estimations. Ideally, the Districts should be able to collect, enter and process data digitally, as they will most likely be responsible for the data collection. This

would, however, require significant investments in hard and software and training. While transferring data in paper form, formal channels of data flows should be documented and respected.

Document management system should be all on-line and in electronic formats in central servers.

Table 11.3 Potential Improvements in the Technical Expertise and Data Management

Institution	Strengths	Potential Improvements / Training Needs
FC CCU		Deeper understanding of the UNFCCC/IPCC requirements.
SR/GIS and Mapping Unit, RMSC, Kumasi	GIS Licenses for ERDAS and ERGIS paid by FPP until 2017/18	Sustainability risk: only one person fully on top of the work. *Creating the Monitoring, Reporting, and Verification System* Data collection and protocols at the local and national levels for defined carbon pools Systematic measurement e.g. Permanent Sample Plots Forestry Districts
Forestry Districts and Regions	Reporting as part of normal work already generates MRV data. MRV data collection business as usual.	Lack funding for personnel. If services required for deadwood estimates, soil sampling, fuelwood information, and litter estimations, further training must be carried out. GPS coordinates on all data to be submitted to RMSC. More accurate data (re plantation statistics) Increased utilisation of GIS & production of maps, hardware & software, training.
Soil Research Institute (SRI)	Data gives a solid basis	The available data for the soils has a high level of uncertainty (due to spatial variability and relatively low number of samples). Additional data/research is required and a model approach may be used.
Forestry Commission in general	Certain very good expertise exists	A sustainable system should be developed for the document management, including sharing, circulation, and archives. All documents should be archived in electronic format and on-line access should be ensured on a common server or a cloud service.

11.6 Sustained MRV Capabilities in GHANA - REDD+ Institutional Strengthening Strategy

The analysis above supports the position that strengthening institutional capacity for MRV in Ghana should involve an emphasis on organisational development. The strategy will of necessity create opportunities for individuals and their professional development but do so in the context of contributing to the reinforcement of overall institutional capacity. The Strategy is to put in place the systems and processes for continuous improvement so that the organization can efficiently meet its mission and goals in a sustainable way.

To aid the REDD+ relevant MRV institutions in forming sound policies, organizational structures, and effective methods of management and system control the Ghana Forest MRV Project describes:

1. Institutional Setup and Design;
2. A Road Map to Establish MRV Capacities; training and capacity-building needs; and, critically
3. Sustainability of Institutions for consistent Forest MRV performance.

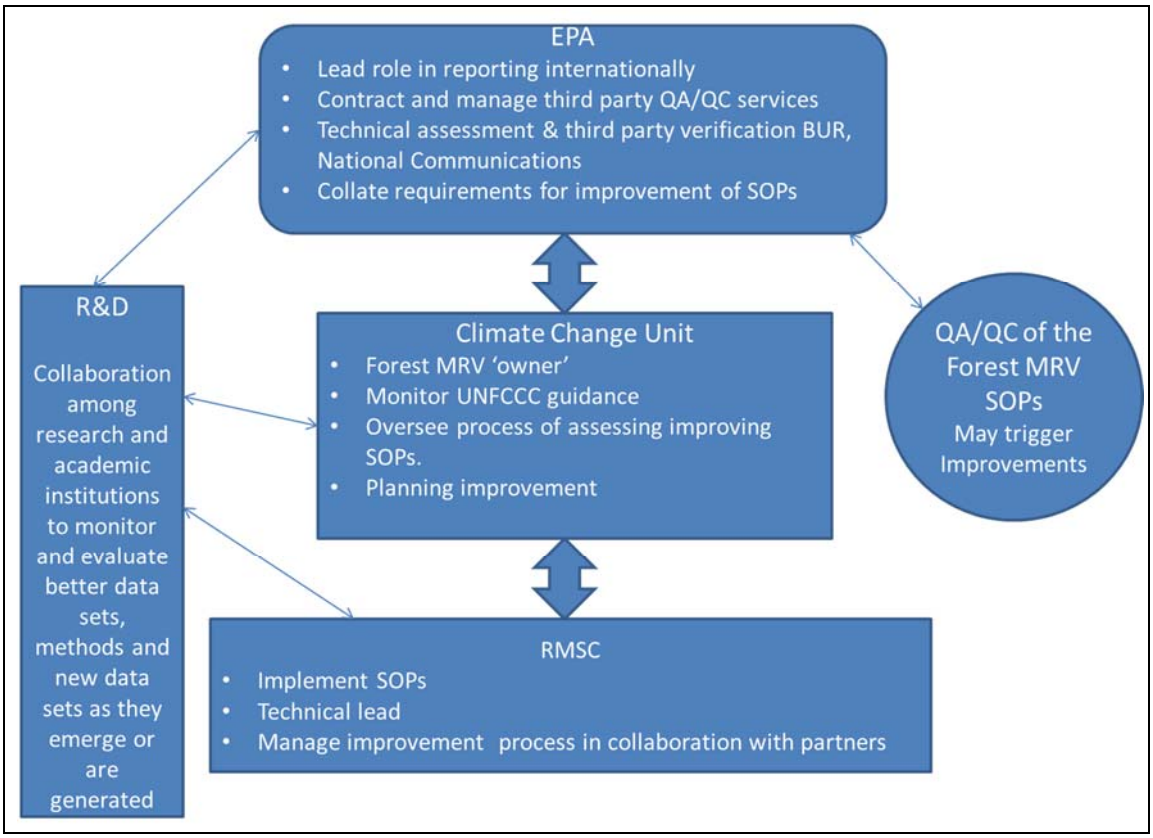
Each of these is described below.

11.6.1 Institutional Setup and Design

The EPA is in charge of the national MRV reporting as the National Designated Agency. The Forestry Commission has signed a MoU with the EPA to engage in delivering the national forest MRV data for the National Communications. The FC Climate Change Unit is the Inventory Coordinator as the UNFCCC Focal Point in Ghana. The data collection is decentralized in line ministries, and data providers are either project or sector based. Data is then compiled at national level for EPA and national communications.

Based on the mandates mapped out in the analysis, a model is suggested for the appropriate institutional arrangements based clearly in existing arrangements. As Ghana extends its reporting of GHG emissions to all lands, including agricultural land grassland and coastal land, and considers other gases (methane and oxides of Nitrogen) the institutional arrangements will need to also expand to include agencies and entities that have the relevant mandate, technical skills, data sets and monitoring capacity. This is a question for Ghana to consider and make a decision on which institution will be the host/manager of the forest MRV system.

Figure 11.2 Institutional Arrangements for Forest MRV system



11.6.2 Road Map to Establish MRV Capacities

Key points of this section:

- The training provided was through a combination of modes; workshops, roundtable discussion, mentoring, learning by doing (the preparation of the SOPs).
- The adequacy can only be confirmed as the system is implemented and the additional core tasks are undertaken.
- The complexity of the requirements and the level of understanding needed suggest that further training, skills development and capacities (planning, management, contracting, etc.) will be needed; both in terms of numbers of people and the depth of insight and understanding that is needed for the Forest MRV system to be built, managed, operated and improved over time.

The Forest MRV is part of the machinery of government of Ghana and the institutional mandates and an assessment of capacity (Section 11) is the starting point for identifying the agencies with key and core roles. This institutional capacity analysis covers the analysis of the mandates and roles of key institutions, other related initiatives, institutional and technical capacity assessment, including training needs assessment, and finally our recommendations for the establishing the sustained MRV capacities within Ghana.

The project team has prepared a Road Map of Ghana MRV training needs by organisation, contents, scheduling and means. An important role was played by Ghana officers in preparing the SOPs, with this approach giving them experience and understanding as well as ownership of the SOPs. The road map identifies the means to ensure succession and sustain the system.

The road map is a coordinated plan for setting up of institutional structure, identification of people and skill-set for augmenting existing capabilities and other important ingredients required for building the required human capital. As set out the institutional arrangements for Forest MRV are reasonably clear, and seem an appropriate fit to the national circumstances.

The road map to establishing MRV capacities is based on the description of key institutions, the evaluation of their institutional and technical capacities, training and capacity-building needs, and identification of gaps between the existing other programmes, all dealt with earlier in this report.

Capacity building road map lays down the plan for developing institutional mechanisms, acquiring the technical expertise within and outside the government, sets plan for training on specific areas and projects the need for outsourcing activities which require specialized skills.

The establishment of Forest MRV capacities requires developing and strengthening understanding, insight, discussion, decisions and documentation. The same modes and mechanisms as have been identified for Forest MRV communications are relevant and apply.

The focus of the actions and interventions should cover the following:

- Enhancement of leadership capacities
  - Building the Climate Change Cohort - Enhanced participation of staff
  - Stronger understanding among the policy-makers and senior staff of the ‘Design Decisions’ required for the Forest MRV system
  - Management of systems and delegations, the institutional processes, staff supervision internal communication and supporting professional development and mentoring of staff
  - Evaluation of capacity development
- Enhancement of management capacities
  - Improved management of the project portfolio
  - Data management options and electronic document filing

Figure 11.3 Ghana MRV Road Map; identified training needs by organisation, contents, urgency and means

What	Whom	How	When	Month 1	2	3	4	5	6	7	8	9	10	11	12	Year 2	Year 3	Year 4	Year 5	Internal/ external
Enhancement of leadership capacities																				
Building the Climate Change Cohort - Enhanced participation of staff	Forestry Commission, all units	Expand the level of participation in different meetings (both external and internal, national and international) to allow more junior staff to participate in technical meetings, and more senior staff in high-level policy meetings as appropriate.	Immediate, continuous																	Internal decision, some costs involved
Stronger understanding among the policy-makers and senior staff of the 'Design Decisions' required for the Forest MRV system	Forestry Commission	Roundtable Thematic Discussions. MRV Sub-working Group as the core participation with some additional attendees. Discussions, briefings on international meetings attended sharing Summaries of domestic, international and peer reviewed publications that are relevant to Forest MRV.	Immediate, monthly																	Internal
Management of systems and delegations, the institutional processes, staff supervision internal communication and supporting professional development and mentoring of staff	Climate Change Unit, FC	Further management training, Internal procedures. Training needs assessment, personal training plan & plan implementation.	Short-term (1-2 years)																	External, direct costs involved
Evaluation of capacity development	Forestry Commission	Establishment of criteria for capacity development and performance. Baseline and changes in performance in institutional arrangements, leadership, knowledge, and accountability.	Long-term, continuous																	Internal
Enhancement of management capacities																				
Improved management of the project portfolio	FC all units, Donor Relations/ Projects	Inventory of the present systems, SWOT analysis, written improvement plan & its implementation.	Immediate																	Internal, possibly using external consultant or peer contacts in other ministries/countries.
Data management options and electronic document filing	FC all units, decision central by the FC.	Presentations of options by commercial service companies. Process to be managed by the ITC department.	Short-term (1-2 years), after policy decision																	Internal decisions, external service provider and training.

What	Whom	How	When	Month 1	2	3	4	5	6	7	8	9	10	11	12	Year 2	Year 3	Year 4	Year 5	Internal/ external
Enhancement of knowledge																				
Improved information sharing and communication on updates on the Ghana MRV	Climate Change Unit	Formal Meetings of Working Groups, briefing to the Environment and Natural Resources Advisory Council (ENRAC) and the NREG Technical Coordination Committee (TCC+) or other bodies as necessary	Immediate, quarterly			★			★			★			★					Internal, but can involve external parties, such as consultants.
Deeper understanding of the UNFCCC/IPCC requirements	RMSC	Self-studying and Roundtable Thematic Discussions. Possible participation in international technical meetings.	Immediate																	Internal and external
Managers and Directors' deeper understanding of RS/GIS	Climate Change Unit	2-3 training sessions by RMSC mapping unit	Immediate																	Internal
Building the Climate Change Cohort – Strengthened understanding of REDD+ issues	FC, all units	Presentations from Ghanaian and International experts on the key discussion topics. Short presentations from each participant about the work they are undertaking.	Immediate, monthly																	Internal and some external with possible limited costs
Deeper understanding of the requirements, interactions and implications of the different REDD+ programs	Climate Change Unit, FC	Roundtable Thematic Discussions. MRV Sub-working Group as the core participation in with some additional attendees	Immediate, monthly																	Internal
Systematic measurement e.g. Permanent Sample Plots in Forestry Districts	Mapping Unit, RMSC	The trained inventory teams to train new staff and teams that need further training.	Short-term, annual							★						★	★			Internal
MRV data collection on deadwood estimates, soil sampling, fuelwood, and litter estimations.	District Officers	Training materials and training plan to be prepared by RMSC and then plan carrying out the training by Region. Training-of-trainers approach.	Short-term																	Internal by RMSC
GIS hardware and software training, production of maps (implementation pending financial commitments for hardware and software)	All Forest Regions and some, if not all Forest Districts.	Regional officers to have their own GIS and training to collect, insert and send data to RS/GIS unit for verification, cleaning and compiling	Short-term but urgent																	External with purchases, supported by RMSC.
Further GIS software training	RMSC staff and future recruits	Detailed technical training needs assessment and training plan per person	Long-term																	External commercial services. University studies abroad. Direct costs involved.
Knowledge in sustainable forestry, specialising in forest inventory, remote sensing/GIS and other climate change related issues	FC young staff and trainees	Entering into Master's programs in Ghana and/or abroad, with support from Managers and Heads in applying.	Long-term																	External, donor funding or scholarships to be applied.

- Enhancement of knowledge
  - Improved information sharing and communication on updates on the Ghana MRV
  - Deeper understanding of the UNFCCC/IPCC requirements
  - Managers and Directors' deeper understanding of RS/GIS
  - Building the Climate Change Cohort – Strengthened understanding of REDD+ issues
  - Deeper understanding of the requirements, interactions and implications of the different REDD+ programs
  - Systematic measurement e.g. Permanent Sample Plots in Forestry Districts
  - MRV data collection on deadwood estimates, soil sampling, fuelwood, and litter estimations.
  - GIS hardware and software training, production of maps (implementation pending financial commitments for hardware and software)
  - Further GIS software training
  - Knowledge in sustainable forestry, specialising in forest inventory, remote sensing/GIS and other climate change related issues

These topics, themes and skills can be increased in some cases through specific activities, such as for technical skills. To a great extent the areas listed are 'softer' skills that require exposure and creation over time. The modes of intervention to achieve this include the following:

Formal Meetings

Briefings and Updates as part of formal meetings that should be held to a schedule. The information communicated to include specifically the developments and implications for the Forest MRV through:

- Presentation of domestic policy and management decisions that influence or impact the Ghana Forest MRV
- Reports of activities, workshops and fora
- Briefings on international meetings attended that include analysis of the implications for the Ghana Forest MRV of any requirements, guidance or decisions and options for addressing the implications identified
- Summaries of domestic, international and peer reviewed publications that are relevant to Forest MRV
- Updates on progress and refinements of the Forest MRV

The Working Groups are intended to meet quarterly and this cycle is appropriate for regular communication of information and updates on the Ghana Forest MRV. This would create the opportunity for cross-discipline and cross-institutional interaction and in plenary look for synergies, conflicts and ensure that planning is in place and coherent. Key insights and concepts would be identified and prepared for communication via a briefing to the Environment and Natural Resources Advisory Council (ENRAC) and the NREG Technical Coordination Committee (TCC+) or other bodies as necessary.

This process would also enable the attendance of other projects, visiting scientists, donors and country representatives from the region and elsewhere at a time and place where they could listen, observe, participate, form links, contact and present aspects of relevance to the Forest MRV.

Roundtable Thematic Discussions

Interactions with stakeholders and the Forestry Commission have identified that one important requirement to be addressed is to strengthen the understanding among the policy-makers and senior staff of the 'Design Decisions' required for the Forest MRV system. The design and specifications for the Forest MRV need to be clear, well documented and comply to be complete, coherent, consistent with UNFCCC guidance and meet Ghana's requirements. The "Design Decisions" identified in the Forest MRV development process can be complex, based on

indicative negotiated guidance from international processes, involve highly technical methods, require strong scientific understanding and have varying impacts dependent on the options that are possible and the decisions that are taken.

The Ghana Forest MRV Project proposes to build on the multiple pathway approach it has been using to date to address this capacity building and communications need through Roundtable discussions. One forum that has been suggested is the MRV Sub-working Group as the core participation in with some additional attendees that bring specific skills and relevant experience or perspectives to the process. The roundtable would be 'tutorial' style on the 'Design Decisions' required for the Forest MRV. The approach would be to prepare short 'notes' on each topic and consider the design decision in plenary with open discussion. Each roundtable would only deal with one or two 'Design Decisions' per session. Roundtables would ideally be held regularly to work systematically through the design decisions and other critical aspects of the Forest MRV and to facilitate strengthening the linkages and relationships between institutions and individuals.

Topics for Roundtable Thematic Discussions may include:

- The Forest Definition for Ghana
- Consider forest in the savannah
- Consider forest in cocoa landscapes
- Can some of the eco-zones be combined?
- Does Ghana seek to ensure that most lands that contain tree cover will be classified as forest?
- Identification of Cropland in Ghana
- Stratification of Forest into managed and un-managed land
- Stratification of Forest into natural and plantation
- Will there be further stratification by characteristics such as eco-zone?
- Degradation is defined as long term loss of carbon stock within forest land. Ghana must describe how they will report degradation.
- Data Acquisition requirements
- What Accounting Rules will Ghana apply?
- What are the reporting demands these decisions will create? Can those demands be met effectively to the standard required at acceptable cost?

Building the Climate Change Cohort

There is a need to build Ghana's broader capacity to tackle climate change. Within the Forestry Commission there are young professionals, interns and student that should be assisted to develop an understanding of climate science and impacts from a range of disciplines and to appreciate how this locks into the policy framework in Ghana and Internationally.

A program to provide this capacity building should be considered. It will build the capacity of young professionals to engage proactively and productively in climate change policy and also junior staff from different backgrounds so they learn more about the work their peers are undertaking. The program might be structured around two core components:

- Presentations from Ghanaian and International experts on the key discussion topics
- Short presentations from each student about the work they are undertaking

Sessions might be held say monthly in an appropriate office at a time that is mutually convenient for participants. Speakers will be invited to give a 30–45 min presentation followed by discussion. One of the young professionals could then give a 15 min presentation of their work, followed by questions. It is in anticipated that the session will run for 1 ½ to 2 hours. Possible Topics could include:

- What is the Ghana Forest MRV? Why does Ghana want or need the system?
- Introduction to the physics of climate change
- What is the likely impact of climate change on Africa and Ghana?

- Introduction to the basic international climate framework (UNFCCC, REDD+, CDM)
- How does the IPCC work?
- Can we adapt to climate change while progressing Ghana's development goals?
- How can scientists engage with the media?
- How science can influence public policy making?

11.7 Capacity Building Requirements - Summary

The reporting, monitoring and auditing requirements for Ghana under technical and review processes proposed by the UNFCCC necessitate a systematic and coherent approach to documentation of all types of data, information, decisions and operations related to the Forest MRV.

Technical expertise requires not only knowledge, but equally good management and leadership to be fully useful to the organisations. The data, capacities, experience, and systems need to be in place so that Ghana can be reporting for the coming decades.

Within the Climate Change Unit, the National REDD+ Secretariat, a deeper understanding of the requirements, interactions and implications of the different REDD+ programs should be achieved. At present, the Secretariat is heavily committed, probably over-committed, with projects and programmes, and there is hardly any time to digest the materials, plan strategically and apply sound management to the many activities. The R-PP (2010) established the need for increased capacity.

RMSC has a critical role in the production of data for the MRV. Forest inventory data provided by the RMSC is utilized in the biomass estimation, and the GIS unit of RMSC provides GIS support, ground survey data and remote sensing (satellite, aerial photographs, LIDAR) for the stratification of the forest resource.

The enhanced participation of staff in attending and having responsibility for external and internal meetings would promote capacity-building and simultaneously ease the overall workload of those holding managerial positions. The level of participation in different meetings could be framed up to allow more junior staff to participate in technical meetings, and more senior staff in high-level policy meetings as appropriate. This would also contribute to sustainability within the institutions, build capacities and improve the flow of information.

The organisation, management and security of electronic documents at present appear to be a matter for individuals. The reliability, accessibility and structure of electronic materials is likely to vary with the approach, attitude and capacity of each Forestry Commission staff member.

There is urgent need to establish GIS hardware and software training to all Forest Regions and some, if not all Forest Districts. Further training in GIS software in RMSC Kumasi would be also needed to ensure sustainability.

District Officers should be trained in the MRV data collection on deadwood estimates, soil sampling, fuelwood, and litter estimations. Ideally, the Districts should be able to collect, enter and process data digitally, as they will most likely be responsible for the data collection. This would, however, require significant investments in hard and software and training. While transferring data in paper form, formal channels of data flows should be documented and respected.

12. FOREST MRV COMMUNICATIONS STRATEGY

Key points of this section:

- Communication Specialist already engaged for the REDD+ process so the MRV Communication is only for the MRV system.
- The Forest MRV Communications Strategy is focused on the requirements for communicating about it to the relevant stakeholders with appropriate levels of communication products to be prepared for wider communication within the REDD+ Communication Strategy.
- The "key stakeholders" for a technical system such as the Forest MRV are those that will have roles and responsibilities to contribute (data, inputs, advisory, QA/QC, contract management, supervision and so on).
- MRV communication Plan addresses the presentation of information in an accurate but easy-to-understand format to enhance community engagement.
  The Forest MRV Communications Strategy identifies "Public Information Products" that would provide descriptive material on the Forest MRV for general and public information by communities.

12.1 The Communications Context for Ghana Forest MRV

A “Communications Strategy” is being prepared for the overall REDD+ effort in Ghana by a consulting company. They have conducted a range of consultations and some analysis. Among the findings reported to the Oversight Committee on 3rd April 2014 were:

- Lack of a well-coordinated effective communication on REDD and REDD+. In some cases traditional authorities knew of REDD and REDD+ as did some FC Staff but in many cases local communities and other FC staff were not well informed about it.
- Overall REDD+ has a low profile and there is significant scepticism about it.

The REDD+ Communications Strategy being formulated by the consultant uses a conventional communications approach suitable to the purpose including; branding, appointing REDD+ ambassadors, organizing various fora and field trips for media and other interventions suitable to a public communication process. The REDD+ Communications Strategy will identify the requirements for REDD+. This includes

- What is to be communicated,
- Who are to be targeted ,
- How should it be communicated

The goals and objectives of the Communications Strategy make no mention of MRV. This is appropriate because an MRV being an ‘underpinning system’ is technical in nature and supports REDD+ and other reporting systems. The data sets should be technically handled to produce reports according to standards and required formats. These are not a set of topics for communication to the general public as such.

Notably many of the critical numbers and figures that the REDD+ and other initiatives will use originate from the Forest MRV in the first instance. The communications strategy for the Forest MRV needs to focus on the institutions, individuals and recipients of the information that the Ghana Forest MRV will generate. A core requirement is a description of the sources, processes and standards that underpin the information generated by the system. This confirms that the communications strategy required for the Forest MRV is one that seeks to:

- Ensure that system contributors understand their role and requirements
- Ensure that system users understand the basis and processes of the Forest MRV and therefore there is the need for consistency, transparency and certainty of the reports emanating from the system
- Provides descriptive material on the Forest MRV for general and public information

12.1.1 Forest MRV Products and Stakeholders

The products of the Forest MRV and potential interest in them were discussed in a workshop on Tier 2 Tools and Calculators (17th June 2014). The discussion included consideration of the products, reports and data potential of the Forest MRV and of the possible user group(s) and stakeholders. The participants identified:

- Possible reports and data sets of use from the Forest MRV System included:
  - Report for REDD+ Activities (markets and national reporting)
  - Multilateral and market efforts such as FIP, VPA, CDM, VCS
  - Project level reporting
  - FAO FRA
  - National Communication to the UNFCCC
  - Biannual Update Reports to the UNFCCC
- Potential Users and Stakeholders included:
  - Agriculture and land use planning
  - COCOBOD
  - National Statistics – Ghana Bureau of Statistics
  - Energy – charcoal
  - Ghana Standards Board
  - National Development and Planning Commission
  - Ghana Investment Promotion Centre
  - NDPC
  - Forestry Commission Divisions and Units (including RMSC)
    - RMSC
      - Mapping and GIS Department
      - Natural Forest Production Department (Harvested Wood Products)
      - Plantation Department
      - Environmental Conservation Department (Fire monitoring and reporting)
      - ICT Department (Data storage and handling)
    - Forest Services Division of the FC
      - District Offices (Harvested Wood Products raw data; Charcoal and fuel wood data;)
      - Regional Offices (compilation; quality control and coordination)
    - Timber Validation Department – VPA
  - EPA
  - Universities and tertiary institutions
  - Ghana Statistical Service
  - Energy Commission

A further consideration for communication is the linkages, relationships and collaboration required for the time and skills needed for the Forest MRV to be available. This includes capabilities in data (collection, handling, storage, standards and maintenance), software, personnel, systems development and support. No single institution has the complete mandate, full range of data sets, the technical capacity and knowledge to operate the Forest MRV in isolation.

12.2 Communications Requirements

It is highly desirable for the GoG agencies to interact and work together to optimise the application of the data sets, tools and calculators to national purposes. The structure in place sees EPA as the coordinator for GHG reporting under the Ministry of Environment Science, Technology and Innovation (MESTI). The existing relationships that surround the preparation of the National Communications (reporting cycle, MOUs, etc.) is a model that could be used to stimulate wider engagement on the broader potential of the data sets, tools/calculators and

outputs from the national MRV system. The same modality could be used as the basis for technical communications for the Forest MRV.

To accommodate the wide range of system contributors and users as well as meet the complexity and demands of the Forest MRV the communications strategy needs to concentrate on methods and means that will suit the institutions. The elements of the strategy should be formulated to ensure continuity and consistency of engagement and to lead to strong understanding of the Forest MRV and continuous improvement in the systems and institutional contributions to it.

A critical role of the participants in the Ghana Forest MRV will be networking to find, engage with and enable projects, agencies, institutions and individuals that have potential interest in, may benefit from or can contribute to the system. The communication coverage will be needed:

- Within government in Ghana
- Across donors and multilateral organisations in Ghana
- For the information of international institutions and resources

This suggests the need for:

1. Formal interaction between institutions that is routine and maintains records of meetings, actions to be taken and reports upwards and outwards as appropriate
2. Internal communication for institutions to ensure that within each agency awareness and understanding of the Forest MRV is fully realised. This at present is the Forestry Commission.
    a. Include in the annual colloquium of RMSC
3. Professional interaction on topics, subjects and themes relating to the Forest MRV through appropriate means
    a. Seminars, high level training, targeted mentoring, specialist technical discussions
4. External communication products that provide explanation and insight into the realities of the Forest MRV System and how it functions and interpretation of the products.

12.2.1 Communications Process

The communications required for the Forest MRV needs to create an effective mix of modes and frequency that supports the enhancement of the understanding, engagement and use of the Forest MRV by stakeholders. The opportunities and means of communication should be routine and regular to build a body of interest in the Forest MRV.

The modes and mechanisms for capacity building and for communications for Forest MRV are proposed in common. The use of formal meetings, roundtable thematic discussions and steps to build the climate change cohort are set out in 11.6.2 (Road Map) and are not repeated in detail here but are briefly described below.

Formal Meetings

Briefings and Updates as part of formal meetings that should be held to a schedule. The information communicated to include specifically the developments and implications for the Forest MRV. The Working Groups are intended to meet quarterly and this cycle is appropriate for regular communication of information and updates on the Ghana Forest MRV.

This process would also enable the attendance of other projects, visiting scientists, donors and country representatives from the region and elsewhere at a time and place where they could listen, observe, participate, form links, contact and present aspects of relevance to the Forest MRV.

Roundtable Thematic Discussions

The Ghana Forest MRV Project proposes to build on the multiple pathway approach it has been using to date to address this communications need through Roundtable discussions. One forum that has been suggested is the MRV Sub-working Group as the core participation in with some

additional attendees that bring specific skills and relevant experience or perspectives to the process. The roundtable would be 'tutorial' style on the 'Design Decisions' required for the Forest MRV.

Building the Climate Change Cohort

There is a need to build Ghana's broader capacity to tackle climate change. Within the Forestry Commission there are young professionals, interns and student that should be assisted to develop an understanding of climate science and impacts from a range of disciplines and to appreciate how this locks into the policy framework in Ghana and Internationally. A program to provide this communication should be considered. It will build the capacity of young professionals to engage proactively and productively in climate change policy. The program might be structured around two core components:

- Presentations from Ghanaian and International experts on the key discussion topics
- Short presentations from each student about the work they are undertaking.

Public Information Products

Ghana Forest MRV "Fact Sheets" (or similar name) could be produced to 'speak' to the potential and implications of the Forest MRV and 'paint' the fuller picture of the implications for Ghana of the system. This form of communication product would also provide the sort of information for media and public consumption that has been prepared in an engaging, easy to read format but still be rigorous in terms of content (and particularly figures and numbers relating to emissions).

To optimise their usefulness and contribution:

1. The Fact Sheets should be 'live' – be reviewed and revised regularly, printing off only what is needed for an event or for distribution to an interest group.
2. Sign off for external distribution to be decided and documented, formally if required
3. Each version to be clearly dated, noting if it replaces an earlier version
4. Their preparation to ensure consistent application of standards, style, logos etc.

The "The Insider" the quarterly newsletter of the Forestry Commission could be used for internal communication of a general and informative nature.

13. GLOSSARY

ABOVEGROUND BIOMASS

All living biomass above the soil including stem, stump, branches, bark, seeds, and foliage. Note: In cases where forest understorey is a relatively small component of the aboveground biomass carbon pool, it is acceptable for the methodologies and associated data used in some tiers to exclude it, provided the tiers are used in a consistent manner throughout the inventory time series.

ACCOUNTING

The rules for comparing emissions and removals as reported with commitments.

ACCURACY

Accuracy is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, so far as can be judged, and that uncertainties are reduced so far as is practicable. Appropriate methodologies conforming to guidance on *good practices* should be used to promote accuracy in inventories. (FCCC/SBSTA/1999/6/Add. 1)

Accuracy is a general term which describes the degree to which an estimate of a quantity is unaffected by bias due to systematic error. It should be distinguished from precision as illustrated below.

ACTIVITY DATA

Data on the magnitude of human activity resulting in emissions or removals taking place during a given period of time. In the LULUCF sector, data on land areas, management systems, lime and fertilizer use are examples of activity data.

ANTHROPOGENIC

Man-made, resulting from human activities. In the *IPCC Guidelines*, anthropogenic emissions are distinguished from natural emissions. Many of the greenhouse gases are also emitted naturally. It is only the man-made increments over natural emissions which may be perturbing natural balances.

In this *LULUCF-GPG*, all emissions and removals of managed lands are seen as anthropogenic.

BELOWGROUND BIOMASS

All living biomass of live roots. Fine roots of less than (suggested) 2mm diameter are sometimes excluded because these often cannot be distinguished empirically from soil organic matter or litter.

CANOPY COVER

The percentage of the ground covered by a vertical projection of the outermost perimeter of the natural spread of the foliage of plants. Cannot exceed 100%. (Also called crown closure) Same as *crown cover*.

CARBON POOL

The reservoir containing carbon.

CARBON RESERVE

Prefer to use carbon stock. See *carbon stock*.

CARBON STOCK

The quantity of carbon in a pool.

CARBON STOCK CHANGE

The carbon stock in a pool can change due to the difference between additions of carbon and losses of carbon. When the losses are larger than the additions, the carbon stock becomes smaller, and thus the pool acts as a source to the atmosphere; when the losses are smaller than the additions, the pools acts as a sink to the atmosphere.

CLOSED FORESTS

Forests characterised by canopy cover higher than 60%.

CARBON DIOXIDE EQUIVALENT

A measure used to compare different greenhouse gases based on their global warming potentials (GWPs). The GWPs are calculated as the ratio of the radiative forcing of one kilogramme greenhouse gas emitted to the atmosphere to that from one kilogramme CO2 over a period of time (usually 100 years).

COMPARABILITY

Comparability means that estimates of emissions and removals reported by Parties in inventories should be comparable among Parties. For this purpose, Parties should use the methodologies and formats agreed by the Conference of the Parties (COP) for estimating and reporting inventories. 2 'Coefficient of variation' is the term, which is frequently replaced by 'error' in a statement like 'the error is 5%'.

COMPLETENESS

Completeness means that an inventory covers all sources and sinks for the full geographic coverage, as well as all gases included in *the IPCC Guidelines* in addition to other existing relevant source/sink categories which are specific to individual Parties (and therefore may not be included in the *IPCC Guidelines*).

CONFIDENCE

The term 'confidence' is used to represent trust in a measurement or estimate. Having confidence in inventory estimates does not make those estimates more accurate or precise; however, it will eventually help to establish a consensus regarding whether the data can be applied to solve a problem. This usage of confidence differs substantially from the statistical usage in the term confidence interval.

CONFIDENCE INTERVAL

A confidence interval is the range in which it is believed that the true value of a quantity lies. The level of belief is expressed by the probability, whose value is related to the size of the interval. It is one of the ways in which uncertainty can be expressed (see *estimation*, statistical definition). In practice a confidence interval is defined by a probability value, say 95%, and confidence limits on either side of the mean value *x*. In this case the confidence limits L1 and L2 would be calculated from the probability density function such that there was a 95% chance of the true value of the quantity being estimated by *x* lying betweenL1 and L2. Commonly L1 and L2 are the 2.5 percentile and 97.5 percentile respectively.

Example: 'An emission is between 90 and 100 kt with a probability of 95%.' Such a statement can be provided when the confidence interval is calculated (the numerical values in this example are arbitrarily chosen).

CONFUSION MATRIX

The conventional technique that establishes a matrix showing, for any given classification of land, the probability of misclassification by one of the other candidate classifications.

CONSISTENCY

Consistency means that an inventory should be internally consistent in all its elements over a period of years. An inventory is consistent if the same methodologies are used for the base year and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. Under certain circumstances referred to in paragraphs 10 and 11 of

FCCC/SBSTA/1999/6/Add.1, an inventory using different methodologies for different years can be considered to be consistent if it has been recalculated in a transparent manner taking into account any *good practices*.

A statistical estimator for a parameter is said to be consistent, if the estimator tends towards the parameter as the size of the sample used for the estimator increases – i.e., precision is improved by an increasing number of observations.

CONVERSION

Change of one land use to another.

COUNTRY-SPECIFIC DATA

Data for either activities or emissions that are based on research carried out on domestic sites.

CROPLAND

This category includes arable and tillage land, and agro-forestry systems where vegetation falls below the threshold used for the forest land category, consistent with the selection of national definitions.

CROPLAND MANAGEMENT

The system of practices on land on which agricultural crops are grown and on land that is set aside or temporarily not being used for crop production.

DEAD WOOD

Includes all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.

In the context of the Kyoto Protocol, as stipulated by the Marrakesh Accords, cf. paragraph 1 of the Annex to draft decision -/CMP.1 (Land use, land-use change and forestry) contained in document FCCC/CP/2001/13/Add.1, p.58.

DECISION TREE

A decision tree is a flow chart describing the specific ordered steps which need to be followed to develop an inventory or an inventory component in accordance with the principles of *good practice*.

DEFORESTATION

The direct human-induced conversion of forested land to non-forested land.

DISTURBANCES

Processes that reduce or redistribute carbon pools in terrestrial ecosystems.

EMISSIONS

The release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time.

EMISSION FACTOR

A coefficient that relates the activity data to the amount of chemical compound which is the source of later emissions. Emission factors are often based on a sample of measurement data, averaged to develop a representative rate of emission for a given activity level under a given set of operating conditions.

ESTIMATION

The process of calculating emissions.

Estimation is the assessment of the value of a quantity or its uncertainty through the assignment of numerical observation values in an estimation formula, or estimator. The results of an estimation can be expressed as follows:

- a point estimation which provide a number which can be used as an approximation to a parameter (such as the sample standard deviation which estimates the population standard deviation), or
- an interval estimate specifying a confidence level. Example: A statement like 'The total emission is estimated to be 100 kt and its coefficient of variation is 5%' is based upon point estimates of the sample mean and standard deviation, whereas a statement such as 'The total emission lies between 90 and 110 kt with probability 95%' expresses the results of estimation as a confidence interval.

EXPERT JUDGEMENT

A carefully considered, well-documented qualitative or quantitative judgement made in the absence of unequivocal observational evidence by a person or persons who have a demonstrable expertise in the given field.

FOREST

Forest is a minimum area of land of 0.05 – 1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10 – 30 per cent with trees with the potential to reach a minimum height of 2 – 5 metres at maturity *in situ*. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high portion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10 – 30 per cent or tree height of 2 – 5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.

Remark: Forests are not defined for reporting under the Convention. The *IPCC Guidelines* encourage countries to use detailed ecosystem classifications in the calculations and in reporting broad specified categories to ensure consistency and comparability of national data across countries. 5 In the context of the Kyoto Protocol, as stipulated by the Marrakesh Accords, cf. paragraph 1 of the Annex to draft decision -/CMP.1 (Land use, land-use change and forestry) contained in document FCCC/CP/2001/13/Add.1, p.58.

FOREST INVENTORY

System for measuring the extent, quantity and condition of a forest, usually by sampling.

FOREST LAND

This category includes all land with woody vegetation consistent with thresholds used to define forest land in the national GHG inventory, sub-divided at the national level into managed and unmanaged and also by ecosystem type as specified in the *IPCC Guidelines.*6 It also includes systems with vegetation that currently falls below, but is expected to exceed, the threshold of the forest land category.

FOREST MANAGEMENT

A system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner.

GOOD PRACTICE

Good Practice is a set of procedures intended to ensure that greenhouse gas inventories are accurate in the sense that they are systematically neither over nor underestimates so far as can be judged, and that uncertainties are reduced so far as possible.

Good Practice covers choice of estimation methods appropriate to national circumstances, quality assurance and quality control at the national level, quantification of uncertainties and data archiving and reporting to promote transparency.

GRASSLAND

This category includes rangelands and pasture land that is not considered as cropland. It also includes systems with vegetation that fall below the threshold used in the forest land category

and is not expected to exceed, without human intervention, the thresholds used in the forest land category. This category also includes all grassland from wild lands to recreational areas as well as agricultural and silvo-pastoral systems, subdivided into managed and unmanaged, consistent with national definitions.

GRAZING LAND MANAGEMENT

The system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

GROUND TRUTH

A term used for data obtained by measurements on the ground, usually as validation for, e.g., satellite data.

KEY CATEGORY

A category that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both.

KEY SOURCE

See key category.

LAND COVER

The type of vegetation covering the earth's surface.

LAND USE

The type of activity being carried out on a unit of land. In *GPG-LULUCF* this term is used for the broad land-use categories defined in Chapter 2. It is recognized that these land categories are a mixture of land cover (e.g. Forest, Grassland, Wetlands) and land use (e.g. Cropland Settlements) classes.

LITTER

Includes all non-living biomass with a diameter less than a minimum diameter chosen by the country (for example 10 cm), lying dead, in various states of decomposition above the mineral or organic soil. This includes litter, fumic, and humic layers. Live fine roots (of less than the suggested diameter limit for belowground biomass) are included in litter where they cannot be distinguished from it empirically.

MANAGED FOREST

All forests subject to some kind of human interactions (notably commercial management, harvest of industrial round-wood (logs) and fuelwood, production and use of wood commodities, and forest managed for amenity value or environmental protection if specified by the country), with defined geographical boundaries.

MANAGED GRASSLAND

Grasslands on which human-induced activities are carried out, such as grazing or hay removal.

METADATA

Information about data; i.e., the description of which parameters and variables are stored in a database: their location, time of recording, accessibility, representativeness, owner, etc.

MODEL

A model is a quantitatively-based abstraction of a real-world situation which may simplify or neglect certain features to better focus on its more important elements.

Example: the relationship that emissions equal an emission factor times an activity level is a simple model. The term 'model' is also often used in the sense of a computer software realisation of a model abstraction.

OPEN FORESTS

Forests characterised by crown cover between 10 and 40% (FAO), or below the canopy cover threshold as adopted by the Party.

OTHER LAND (AS A LAND-USE CATEGORY)

This category includes bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories. It allows the total of identified land areas to match the national area, where data are available.

PASTURE

Grassland managed for grazing.

POOL/CARBON POOL

A reservoir. A system which has the capacity to accumulate or release carbon. Examples of carbon pools are forest biomass, wood products, soils and the atmosphere. The units are mass.

QUALITY ASSURANCE

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the quality control (QC) programme.

QUALITY CONTROL

Quality Control (QC) is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

(i) Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
(ii) Identify and address errors and omissions;
(iii) Document and archive inventory material and record all QC activities.

QC activities include general methods such as accuracy checks on data acquisition and calculations and the use of approved standardised procedures for emission calculations, measurements, estimating uncertainties, archiving information and reporting. Higher tier QC activities include technical reviews of source categories, activity and emission factor data, and methods.

REFORESTATION

Direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

REMOTELY SENSED DATA

Data generally acquired by means of scanners or cameras on board aircraft or satellites.

REMOTE SENSING

Practice of acquiring and using data from satellites and aerial photography to infer or measure land cover/use. May be used in combination with ground surveys to check the accuracy of interpretation.

REMOVALS

The sequestration of greenhouse gases and/or their precursors from the atmosphere over a specified area and period of time; from the atmosphere by sinks.

REPORTING

The process of providing estimates to the UNFCCC.

RESOLUTION

Smallest unit of land about which land cover or use can be determined. High resolution means the resolvable land units are small. 9 In the context of the Kyoto Protocol, as stipulated by the Marrakesh Accords, cf. paragraph 1 of the Annex to draft decision -/CMP.1 (Land use, land-use change and forestry) contained in document FCCC/CP/2001/13/Add.1, p.58.

RESERVOIRS

Water bodies regulated for human activities (energy production, irrigation, navigation, recreation etc.) where substantial changes in water area due to water level regulation occur. The term should not be used in the context of a carbon reservoir.

REVEGETATION

A direct human-induced activity to increase carbon stocks on sites through the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of afforestation and reforestation contained here.

SAMPLE

A sample is a finite set of observations drawn from a population.

SEQUESTRATION

The process of increasing the carbon content of a carbon pool other than the atmosphere. It is preferred to use the term “sink”. 10 In the context of the Kyoto Protocol, as stipulated by the Marrakesh Accords, cf. paragraph 1 of the Annex to draft decision -/CMP.1 (Land use, land-use change and forestry) contained in document FCCC/CP/2001/13/Add.1, p.58.

SETTLEMENTS

This category includes all developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories. This should be consistent with the selection of national definitions.

SHIFTING AGRICULTURE

Agriculture that is not permanent or involves an extended fallow period.

SINK

Any process, activity or mechanism which removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas from the atmosphere. Notation in the final stages of reporting is the negative (-) sign.

SOIL ORGANIC MATTER

Includes organic carbon in mineral and organic soils (including peat) to a specified depth chosen by the country and applied consistently through the time series. Live fine roots (of less than the suggested diameter limit for belowground biomass) are included with soil organic matter where they cannot be distinguished from it empirically.

SOURCE

Any process or activity which releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere. Notation in the final stages of reporting is the positive (+) sign.

TIME SERIES

A time series is series of values which are affected by random processes and which are observed at successive (usually equidistant) points in time.

TOP-DOWN MODELLING

A modelling approach which aims to infer processes and parameters at a smaller scale from measurements taken at an aggregated scale (regional/national/continental/global).

TRANSPARENCY

Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information.

TREND

The trend of a quantity measures its change over a time period, with a positive trend value indicating growth in the quantity, and a negative value indicating a decrease. It is defined as the ratio of the change in the quantity over the time period, divided by the initial value of the quantity, and is usually expressed either as a percentage or a fraction.

TROPICAL

Mean annual temperature (MAT) is more than 20oC.

UNCERTAINTY

An uncertainty is a parameter, associated with the result of measurement that characterises the dispersion of the values that could be reasonably attributed to the measured quantity (e.g., the sample variance or coefficient of variation).A general and imprecise term which refers to the lack of certainty (in inventory components) resulting from any causal factor such as unidentified sources and sinks, lack of transparency, etc.

UNCERTAINTY ANALYSIS

An uncertainty analysis of a model aims to provide quantitative measures of the uncertainty of output values caused by uncertainties in the model itself and in its input values, and to examine the relative importance of these factors.

VALIDATION

Validation is the establishment of sound approach and foundation. In the context of emission inventories, validation involves checking to ensure that the inventory has been compiled correctly in line with reporting instructions and guidelines. It checks the internal consistency of the inventory. The legal use of validation is to give an official confirmation or approval of an act or product.

VERIFICATION

Verification refers to the collection of activities and procedures that can be followed during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of that inventory. Typically, methods external to the inventory are used to check the truth of the inventory, including comparisons with estimates made by other bodies or with emission and uptake measurements determined from atmospheric concentrations or concentration gradients of these gases.

WALL-TO-WALL MAPPING

Complete spatial coverage of a land area, e.g., by satellite data.

WETLANDS

This category includes land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland or settlements categories. This category can be subdivided into managed and unmanaged according to national definitions. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.

WOOD PRODUCTS

Products derived from wood harvested from a forest, including fuel-wood and logs and the products derived from them such as sawn timber, plywood, wood pulp, paper.

14. REFERENCES

Angelsen, 2008. Moving ahead with REDD. Issues Options and Implications. Available from: http://www.cifor.org/publications/pdf_files/Books/BAngelsen0801.pdfLast Accessed: 29 May 2014.

Angelsen et al. 2012. Analysing REDD+; Challenges and Choices. CIFOR, Bogor, Indonesia, pp. 279–299. Available from: http://www.cifor.org/publications/pdf_files/Books/BAngelsen1201.pdfLast Accesses: 29 May 2014

FAO, (2006). Global Forest Resources Assessment 2005. Progress towards Sustainable Forest Management. FAO Forestry Paper 147, Rome 2006

FAO, (2010). Global Resources Assessment 2010. Country Report, Ghana. FRA 2010/077, Rome 2010

FIP, 2012. Ghana Investment Plan for the Forest Investment Program (FIP) - October 2012

Forestry Commission, MLNR, Ghana, (2011). National Forest Plantation Development Programme. Annual Report, 2011, pp. 5

Geist H., Lambin E., 2001. What drives tropical deforestation? A meta-analysis of proximate and underlying causes of deforestation based on subnational case study evidence. Land-Use and Land-Cover Change (LUCC) Project, International Geosphere-Biosphere Programme (IGBP). LUCC Report Series: 4.

Geist H., Lambin E., 2002. Proximate causes and underlying driving forces of tropical deforestation. BioScience 52: 143–150.

GFOI (2013) Integrating remote-sensing and ground-based observations for estimation of emissions and removals of greenhouse gases in forests: Methods and Guidance from the Global Forest Observations Initiative: Pub: Group on Earth Observations, Geneva, Switzerland, 2014.

Ghana Forest and Wildlife Policy 2012

GOFC-GOLD Sourcebook (2012); http://www.gofcgold.wur.nl/REDD+/sourcebook/GOFC-GOLD_Sourcebook.pdf

Intergovernmental Panel on Climate Change (IPCC) (2003). Penman J., Gytarsky M., Hiraishi T., Krug, T., Kruger D., Pipatti R., Buendia L., Miwa K., Ngara T., Tanabe K., and Wagner F (Eds*). Good Practice Guidance for Land Use, land- Use Change and Forestry* IPCC/IGES, Hayama, Japan.

Intergovernmental Panel on Climate Change (IPCC) (2006). Eggleston, S., Buendia L., Miwa K., Ngara T., and Tanabe K.,(Eds*). 2006 IPCC Guidelines for National Greenhouse Gas Inventories* IPCC/IGES, Hayama, Japan.

Martin Herold, Erika Romijn, Sandra Brown, 2014. GOFC-GOLD Sourcebook training materials for REDD+ monitoring and reporting - Country Examples - Module 3.1 Data and guidance on developing REDD+ reference levels.

UNFCCC, 2012.Decision 12-II/CP.17. Modalities for forest reference emission levels and forest reference levels. http://unfccc.int/resource/docs/2011/cop17/eng/09a02.pdf#page=16

UNFCCC, 2014.Decision -/CP.19. Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels.
http://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_frl.pdf

World Bank, 2013. Carbon Fund Methodological Framework, Forest Carbon Partnership Facility.

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Appendix 1

Inception Report

Indufor ...forest intelligence

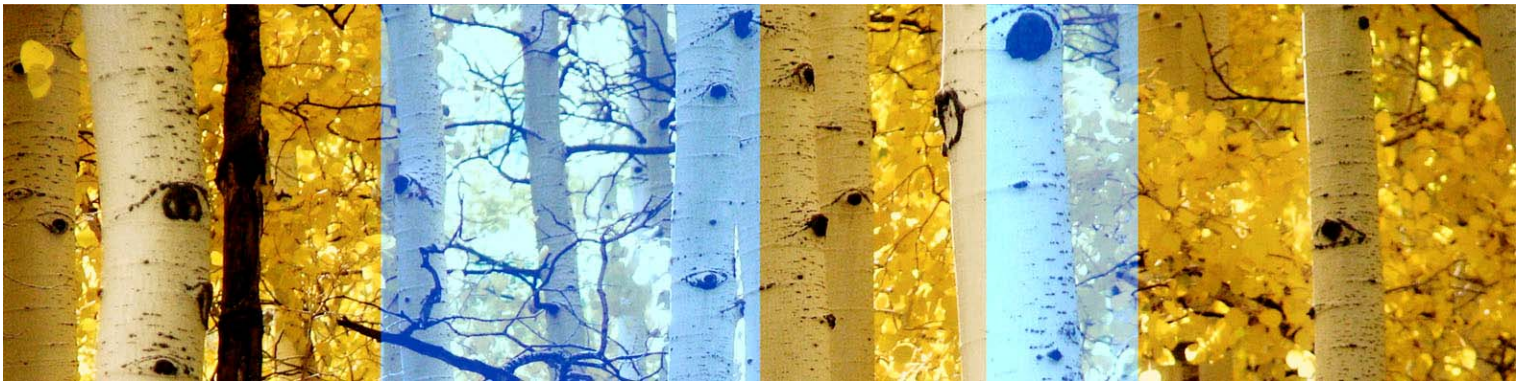
Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Forestry Commission, Republic of Ghana

Development of Reference Emissions Levels and Measurement, Reporting and Verification System in Ghana FC/FCPF/MRV/REL/RFP/01/2013

Inception Report



Document Control Record

Date	Version	Changes	Author
1/12/2013	1	• N/A	PfM
2/12/2013	2	• Edits and formatting	AB
4/12/2013	3	• Additions, circulation to partners	PfM
9/12/2013	4	• Revised DRAFT sent to Robert Bamfo	PfM
16/12/2013	5	• Revised DRAFT sent to Oppon Sasu	PfM
18.12.2013	6	• Formatting	AB
19/12/2013	7	• Submitted to Forestry Commission CEO	PfM
17/2/2014	8	• Added revised Annex I work plan and submitted to Forestry Commission CEO	AB

TABLE OF CONTENTS

LIST OF APPENDICES

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

PREFACE

This report was prepared at the request of the Forestry Commission of Ghana (the Client) by Indufor Oy and its partners Forest Consult and Geo-Info Systems Developers (GISD). The intended users of this study/report are the Client, and the Client's auditors and accountants. No other third party shall have any right to use or rely upon the report for any purpose.

The project involves the development of reference emissions levels and measurement, reporting and verification system forest carbon stocks in Ghana. This report covers the inception of the project and contains the work plan, a summary of initial meetings and discussions.

This report may only be used for the purpose for which it was prepared and its use is restricted to consideration of its entire contents. The conclusions presented are subject to the assumptions and limiting conditions noted within.

We thank the Forestry Commission of Ghana for the opportunity to carry out this project and look forward to working with them on the development of the Forest Monitoring Reporting and Verification (MRV) system for Ghana.

Indufor Oy

Name	Dr Peter F. Moore
Job Title	Project Team Leader

Contact:

Majella Clarke
Indufor Oy
Töölönkatu 11 A, 3rd Floor
FI-00100 Helsinki
FINLAND

Tel. +358 50-5763042
Fax +358 9 135 2552

indufor@indufor.fi
www.indufor.fi

EXECUTIVE SUMMARY

The Ghana Forest MRV Project will seek to create a firm basis for embarking on activities to establish reference emission levels, emission factors, and develop a framework for measuring, reporting and verifying emissions reductions resulting from REDD+ activities. The project is focused on forest in Ghana only and will not deal with other land management sectors.

The extent of deforestation and forest degradation is a matter of national concern, with major implications for national income and employment as well as environmental integrity and services, and for social welfare. The major driving forces are illegal logging, unsustainable farming, annual bushfires, surface mining and infrastructural development. The work to be performed on RL and MRV in Ghana has to build directly on these drivers and the associated losses of forest and forest degradation.

In 2010, Ghana received approval from the Participants Committee of the FCPF to implement its REDD+ Readiness Preparation Proposal (R-PP) expected to span a period of three years. The R-PP is a roadmap towards achieving REDD+ Readiness. The initiative will require the development of reference levels and capacities for measurement, reporting and verification (MRV) of forest carbon stocks and changes – this project addresses those needs.

The main objective of the assignment is to support Ghana in the development of REDD+ reference levels and systems for measurement, reporting and verification (MRV) of REDD+ impact using suitable approaches based on careful analyses of forest inventory, remote sensing and other monitoring capacities and historical data, and thereby strengthen national capacities.

Following negotiations held in July 2013 the Forestry Commission of Ghana and Indufor finalised contracting in October. Indufor then formalised the contractual arrangements with its partners; Forest Consult and Geo-Info Systems Developers (GISD). The Project Team Leader arrived in Ghana and held meetings with the Forestry Commission in association with its partners.

With the assistance of the Forestry Commission and their support the Project Team was able to meet with the Project Oversight Committee of the Ghana Forestry Commission and the MRV Sub-Working Group. Consequently attendance at meetings between the Forestry Commission and the consultant for the Strategic Environmental and Social Assessment (SESA) (SAL Consulting) and the consultant for the National REDD+ Strategy Options Price Waterhouse Cooper (PWC) was also facilitated. These meetings enabled the Project Team to engage with the other consultants and under the guidance of the committees and working groups a meeting between consulting teams to identify synergies and dependencies and explore the timing and linking of the various Project deliverables.

The Indufor/GISD/ForConsult Project Team met to initiate and discuss detailed work planning, which is attached and will be finalised at the Inception Workshop. The Inception Workshop has been discussed with the Forestry Commission, including during the meetings held in the inception week. Potential dates in the week of 16th December are Tuesday 17th or Wednesday 18th.

The Ghana Forest MRV Project Team expresses its appreciation of the efforts of the senior staff and staff of the Forestry Commission in assisting us to initiate this important national project for Ghana.

LIST OF ACRONYMS

FCPF	Forest Carbon Partnership Facility
FPP	Forest Preservation Programme
GISD	Geo-Info Systems Developers
HFZ	High Forest Zone
ICT	Information Communication Technology
ITC	Faculty of Geo-Information Science and Earth Observation of the University of Twente
JICA	Japan International Cooperation Agency
MRV	Monitoring Reporting and Verification
PWC	Price Waterhouse Coopers
REDD+	Reducing Emissions from Deforestation and Degradation
RFP	Request for Proposals
RLs	Reference Levels
R-PP	Readiness Preparation Proposal
SESA	Strategic Environmental and Social Assessment

1. BACKGROUND

The Ghana Forest MRV system will seek to create a firm basis for embarking on activities to establish reference emission levels, emission factors, and develop a framework for measuring, reporting and verifying emissions reductions resulting from REDD activities. It is currently neither practical nor efficient to measure and report the stocks and changes for the whole terrestrial carbon reservoir with the level of detail and certainty to address all drivers and processes that have a carbon impact on the land. It is therefore expected that the REDD+ readiness activities in Ghana would be phased in a manner which builds incrementally on the level of detail by testing carbon measurement, accounting and MRV procedures, prior to the full implementation of REDD+. As appropriate, and where feasible, this will include the consideration of the five terrestrial carbon pools; above ground biomass, below ground biomass, litter, dead wood and soil organic carbon,.

Ghana's land area is 24 million ha. The natural landscape comprises four major ecological zones with tropical moist forest in the south and south west (the high forest zone); transitional zone in the middle belt between north and south; savannah woodlands in the north; and the Accra coastal plain. The greatest above-ground carbon stores are in the high Forest Zone (HFZ).

Despite the heavy historical dependence of the country on its forests, their exploitation is increasingly becoming unsustainable. The extent of deforestation and forest degradation is a matter of national concern, with major implications for national income and employment as well as environmental integrity and services, and for social welfare. The major driving forces are unsustainable logging, unsustainable farming, annual bushfires, surface mining and infrastructural development. Underlying these driving forces are forest policy challenges, population growth, weak institutional coordination, and lack of stakeholder participation in forest management.

1.1 Drivers of Forest Loss

Outside the Forest Reserves logging has been on the increase mainly due to lack of effective control. In recent times, logging activity has been intensified more in the semi-deciduous zones than in the evergreen forest due to greater densities of desirable timber species. These drier zones are now in critical conditions partly due to logging.

In the forest reserves boundaries are largely intact when identified from satellite imagery however there is some levels of degradation as a result of some the following factors:

- Over exploitation of timber especially by illegal chainsaw operators as a result of high demand for timber for domestic construction;
- Frequent wildfires, in parts of the dry forest and forest savannah transition zone;
- Encroachment by farmers especially the Illegal extension of admitted rights (admitted farms, admitted settlements) in forest reserves;
- Surface mining; and
- Inadequate enforcement of policies and regulations,

The above may partly account for the decrease in closed forest cover and the increase in open forest as observed in the Forest Preservation Programme (FPP) Study.

The area of land under agriculture increases every year due to the extensive system of farming being practiced in the country, which also involves cutting of vegetation. With increasing national population over the last two decades, demand pressure on land has been considerable. Demand for subsistence agricultural cultivation has been compounded by demand for cash crops like cocoa, oil-palm, and for urbanization and infrastructural development. The trend of forest resources under persistent encroachment by agriculture is partially due to the absence of a national land use plan.

Open cast mining activities for gold and diamond, especially those by the small-scale operators and large-scale mining for bauxite, manganese and gold, also pose serious threat to forests in Ghana.

Forest fire has been the cause of most forest degradation in the country over the last few years. Significant forest areas are burnt by bushfires annually in the dry season usually from November to March.

The work to be performed on Reference Levels (RL) and MRV in Ghana has to build directly on these drivers and the associated losses of forest and forest degradation.

1.2 Ghana's Response

The Government of Ghana has therefore embarked on a national programme to protect and maintain its forests in an effort to reduce carbon emissions and at the same time attract resources to foster growth and development along a low carbon emission path.

Ghana is engaging in preparation activities to develop emission reduction programs as a contribution to climate change mitigation, and to eventually receive payments through a financial mechanism for performance in the land use sector. The government has received grant support from the Forest Carbon Partnership Facility (FCPF) of the World Bank to support preparation activities.

In 2010, Ghana received approval from the Participants Committee of the FCPF to implement its REDD+ Readiness Preparation Proposal (R-PP) expected to span a period of three years, until 2013. The R-PP is a roadmap towards achieving REDD+ Readiness. It indicates what and how activities could be undertaken and what resources will be needed, with the objective to align development objectives of Ghana with the global need to combat climate change. The initiative will require the development of reference levels and capacities for measurement, reporting and verification (MRV) of forest carbon stocks and changes – this project addresses these needs.

1.3 Objective

The main objective of the assignment is to support Ghana in the development of REDD+ reference levels and systems for Monitoring, Reporting and Verification (MRV) of REDD+ impact using suitable approaches based on careful analyses of forest inventory, remote sensing applications and other monitoring capacities and historical data, and thereby strengthen national capacities.

1.4 Terms of Reference

The Ghana Forest MRV project will undertake the following tasks in close consultation with the national REDD+ Secretariat and key national and international stakeholders:

1. Review the existing national land use and land cover classification scheme, the accuracy of existing land-use assessments, and of carbon stock and inventory data;
2. Develop reference levels for emissions associated with the key drivers of deforestation and forest degradation; the used methods and approaches follow established international protocols
3. Develop methods and approaches for establishing a national MRV; following good international practice and established techniques.
4. Develop a detailed plan to establish sustained MRV capacities within Ghana

Ghana already has a pool of skills and competencies in the area of Forest inventory, GIS and Remote Sensing. These skills will be applied as far as practical in the execution of the activities, to maximize local capacity-building.

A strong focus of the assignment is towards building the capacity of the REDD Secretariat and other relevant stakeholders involved in REDD+ implementation in Ghana (Detailed Terms of Reference were annexed to the RFP for this assignment).

2. GHANA FOREST MRV PROJECT INCEPTION

2.1 Mobilisation

Following negotiations held in July 2013 the Forestry Commission of Ghana and Indufor finalised contracting in October. Indufor then formalised the contractual arrangements with its partners; Forest Consult and Geo-Info Systems Developers (GISD). The Project Team Leader arrived in Ghana and held meetings with the Forestry Commission in association with its partners.

The Indufor and its partners have confirmed the following experts for the team:

- Dr Peter F Moore — Team Leader
- Dr Carly Green — Carbon Modelling Specialist Int
- Dr Emmanuel Amamoo-Otchere — Remote Sensing & GIS Specialist
- Kofi Affum-Baffoe — Forest Inventory Specialist
- Anni Blasten — Socio-Economic Specialist & Project Manager
- Yakubu Mohammed — Remote Sensing & GIS Specialist

Arising from the contract negotiations the tasks for the National Socio-Economic Specialist will not be undertaken and the International Socio-Economic role has been reduced and refocused on the institutional assessment. Ms Anni Blasten has been brought into that role.

We appreciate that the national 'Carbon Modelling Specialist' must be allocated for the ongoing success of the MRV system. The team is working to identify the National Carbon Modelling Specialist and will advise the Forestry Commission as soon as the role is confirmed.

Mr Edward Obiaw has been added to the team as the National Team Leader and Forest Management Specialist and a key resource for facilitating and guiding the project in relation to Ghana partners, stakeholders and the client. His role is accounted for by applying the days unallocated for N-7 National Specialist.

With the assistance of the Forestry Commission the Project Team was able to meet with the Project Oversight Committee of the Ghana Forestry Commission and the MRV Sub-Working Group. Attendance at meetings for the Strategic Environmental and Social Assessment (SAL Consulting) and the National REDD+ Strategy Options (PWC) was also arranged by the Forestry Commission.

2.2 Project Oversight Committee Meeting

On Monday 25th November the whole team, GISD and For Consult, met with the “Project Oversight Committee” to present the Forest MRV Proposal and seek their input, guidance and answer questions. From that meeting it was noted:

- The Project Oversight Committee manages the projects that are being implemented under the guidance of the Forestry Commission
- Robert Bamfo, Head of the Climate Change Unit and the contact for the Ghana Forest MRV Project, had just returned from the COP19 in Warsaw and provided some of the relevant material relating to REDD, which now has a framework and a commitment for resolution in Paris in 2015
- A presentation was made using the key diagrams and related text from the proposal to inform the Project Oversight Committee of the intention for the work as set out in the proposal that has been accepted as the basis for the work.

- The suggestion was made that the Forest MRV efforts should interact with other efforts under the R-PP/FCPF; particularly the National REDD+ Strategy Options and the Strategic Environmental and Social Assessment (SESA), which is also under Robert Bamfo's supervision. There are some points of cross-over and the work of the team on the Forest MRV will be a significant support to some aspects of the work of the other consultants.
- There has been a lot of relevant effort on Forest MRV already carried out in Ghana and the core MRV needs probably already exist. With the support and facilitation of the Forestry Commission obtaining a full set of the documentation is under way and a careful review of it will be the first major activity.
- The inception workshop will be scheduled in the week of 16th December, probably 17th or 18th.
- Office accommodation and local travel support to the project from the Forestry Commission will be provided.

2.3 MRV Sub-Working Group Meeting

On Tuesday 26th November we met with the MRV Sub-working Group, who have significant technical experience and interest. This Sub-working Group will be a useful consultation fora as the project is implemented. Points from the meeting included:

- There was good attendance of the members with short notice. This was very much appreciated by the Forestry Commission and the Team.
- It was noted, as in the Project Oversight Committee Meeting, that the Forest MRV is not being developed in isolation and the FCPF, and other efforts, are integrated. The Forest Investment Program (FIP) prioritising Western and Northern Ghana was identified and also funded by the World Bank.
- There are seven REDD Pilot sites and contact with them will be provided to identify potential synergies and interactions. In this discussion it was made clear that the Forest MRV is a national system and will not geographically focus on specific sites or locations.
- The Sub-working Group was interested to identify the scope of the Forest MRV. Agriculture was noted as a big interest for Ghana but confirmed as not being within the scope for the Ghana Forest MRV system.
- The questions of cocoa farms was raised and opens up consideration on the distinction between 'tree crops', 'timber plantations' and 'forest'. It may be that Ghana will have to develop an understanding of the implications of tree crops and their inclusion or exclusion from forests. This could be a point of discussion in the forest definition work but the issue is a policy one and can not be decided by the team.
- A concern was expressed that above ground biomass only was being estimated. This is not the case and Robert Bamfo assisted in clarifying that the inclusion or not of any carbon pool would be dependent on the data available and the validity of the means for estimating emissions from each carbon pool in the first instance. The consideration of which pools are of importance to Ghana would trigger the requirement to prepare a plan to improve the capacity to estimate the carbon stock for those pools. While the identification of those needs may arise in the Forest MRV work the preparation of a 'plan' was outside the scope of the project.

2.4 Strategic Environmental and Social Safeguards Meeting

At the invitation of Robert Bamfo the Team Leader attended the SESA Meeting held on Wednesday 27th November at the Forestry Commission. This was very useful, enabling contact with the SAL Consulting team and gaining an understanding of their work and the planning for it. During the meeting it was noted:

- Safeguards under REDD+ is a critical aspect with high profile. The core interest is to avoid negative social and environmental impacts. This is a key element of REDD+ and access to resources and income will only be available to countries that have effective safeguards in place.
- SAL Consulting has submitted their Inception Report on 15th November and will be holding a validation workshop for the work plan in December. This workshop was originally to be "national" but the working group was confirmed as being sufficient to undertake work plan validation.
- The point that the FCPF elements should be "working closely" together was raised, as it had been in the Project Oversight Committee and the MRV Sub-working Group. A proposal that the Project Oversight Committee be convened to hear a short presentation from each of the four teams working on aspects of the R-PP was accepted. This would provide the Project Oversight Committee with a 'one-stop' view of the elements and enable the elements to interact and respond individually and collectively to questions, guidance and opportunities for interaction as the work progresses.
- The 7 REDD+ pilots were also noted to the SESA team.
- The timeline for the SEAS work is 18 months and the meeting suggested that it should be shortened to 12 months if feasible as there had been work done already that was relevant. Additionally the other elements had approximately 12 month timeframes and being on similar timing would strengthen collaboration and synergies.
- The SESA ToR notes that there will be some relevant mapping undertaken during the work. This will be the mapping of forest cover, river basins, water bodies and salient biodiversity characteristics (including biodiversity hotspots), economic activities in forest areas and surrounds, existing infrastructure and proposed road, rail and power projects; communities in and around forest areas; poverty and vulnerability; access and land tenure rights. This product has direct relevance to the Forest MRV work and is scheduled to be delivered in February 2014 in a report that will:
    - Identify environmental and social hotspots and discuss their main characteristics
    - Discuss a sample of key forest areas land use trade-offs with alternative land uses such as mining or agriculture
    - Analyse critical institutional, legal, regulatory, policy and capacity gaps underlying the key environmental and social issues identified.

2.5 Strategic Options Meeting – Price Waterhouse Coopers and Stakeholders

At the invitation of the Forestry Commission and to ensure interaction and connection/collaboration between the four elements under the R-PP funded by FCPF the Team Leader attended a progress meeting where Price Waterhouse Coopers (PWC) presented and discussed their approach to the tasks set out in the TOR.

The "kick-off meeting" for this project was held in November with a preliminary work plan presented that was recognised as requiring revision. PWC has considered the multi-criteria assessment methodology and a review of the legal and regulatory framework. They are considering what multi-criteria analysis to apply. In the discussion it was noted:

- The stakeholders present were concerned that the Strategic Options should have been identified and provided ahead of the work of the other elements; SESA and Forest MRV. They also recognised that the work on Beneficiaries and Dispute Resolution was related as well.
- All elements are commencing more or less simultaneously, with the SESA having an 18 month timeframe, the others 12 months. There is an opportunity to convene and rationalise, synergise and sequence between the Strategic Options (PWC), SESA (SAL Consulting) and Forest MRV (Indufor, ForConsult, GISD). A meeting between the consultants was proposed and agreed
- The Forest MRV Team Leader made the points that:

- There were few or no National REDD+ Strategies formulated arising from the FCPF process, so this Ghana Forest MRV was 'new' even if arising from existing relevant work and projects.
- The R-PP was a single document that contained four or five elements that have been separated for the purposed of contracting. Consequently no single consultant has the whole process within their view.
- There needs to be interaction to ensure that Strategic Options do not run counter to the SESA (have negative social or environmental impacts) and are able to be Monitored, Reported on and Verified.

The meeting closed with agreement on a date for a meeting of the consultants, Monday 9th December; and a proposed date for a Project Oversight Committee Meeting with the consultants to present the results of their shared discussions reflected as appropriate in their work plans.

2.6 Meeting between Consultants on SESA, Strategic Options and MRV

PWC has confirmed the date of Monday 9th December at 10:00 am in their offices for the Meeting between consultants. The agenda to be:

1. Present and share TORs and identify synergies and dependencies
2. Discuss how we can create synergies in our various methodologies
3. Explore how we can chronologically link our various deliverables

The MRV Team Leader suggested it would be important to prepare notes from the meeting for the information of the Forestry Commission and the Project Oversight Committee. Key points under each of the agenda Items only would be required.

2.7 ASTRIUM Implemented GIZ Capacity Building Project & ITC Remote Sensing Training

Through the suggestion of Robert Bamfo, the Information Communication Technology (ICT) section of the Forestry Commission provided full sets of materials from two remote sensing training courses one by ASTRIUM based in Germany and the other by Faculty of Geo-Information Science and Earth Observation of the University of Twente (ITC) in the Netherlands, held 11-20 November 2013. An initial scan of the material suggests that the courses were very much providing the same skills as proposed for the training listed in the Forest MRV Project. Discussion with Yakubu Mohammed and Emmanuel Amamoo-Otchere indicates that there have been:

- Significant numbers of Forestry Commission and other agency staff trained in GIS, Remote Sensing and Carbon Calculation
- GIS/Remote Sensing capability, including hardware and software is mainly in the Resource Management Support Centre (RMSC) in Kumasi (ForConsult sits with the RMSC).
- The Forest Preservation Project funded by JICA and implemented by PASCO has in effect trialled or conducted much of the work that will go to make up the Forest MRV system. This included capacity building and training in GIS, Remote Sensing and Carbon Modelling.

2.8 A Note on Cocoa

Cocoa is an important crop in Ghana and how to deal with the 'trees' that bear a crop but may or may not be 'forest' under the national definition is a significant discussion and decision. There has recently been a multistakeholder meeting on cocoa, its management and future strategies for sustainability. One proposal is to return to cocoa growing under shade trees, which is more sustainable, better for the environment, good for production and was the usual method until a trend of "sun-grown" cocoa arose. The trees are by law owned by the state,

though there is some interpretation required of that, consequently reducing the incentive to implement shade cocoa and potentially undermining the chance to improve carbon sequestration rates.

Forest MRV as it develops will have to frame the capacity to Monitor and Report change in cocoa production in a Verifiable way as an input to the policy options discussion.

2.9 Work Planning

The Indufor/GISD/ForConsult Project Team met to initiate and discuss detailed work planning. The spreadsheet developed for scheduling purposes was used as the starting point. This spreadsheet was updated with the full text of the Terms of Reference wording for the relevant tasks so that the focus is set out based on what was required by the ToR. The team discussed various aspects and have set out sub-tasks within the work plan and identified lead staff, time required, duration and a product for each sub-task.

The key staff identified from Forest Consult were Yakubu Mohammed and Kofi Affum-Baffoe with Edward Obiaw as the lead and main contact for Indufor. Other staff of Forest Consult would be involved working under the guidance of Edward, Yakubu and Kofi. Similarly Emmanuel will be the lead and the contact for Indufor and supervise any staff involved from GISD.

The draft work plan is attached as DRAFT Ghana Forest MRV Project Work Plan in Appendix 1 and will be finalised following the joint meeting of consultants and the Project Oversight Committee meeting; then endorsed at the Inception Workshop.

2.10 Inception Workshop

The team discussed the Inception Workshop with the Forestry Commission, including during the meetings held in the inception week. It was confirmed that holding the Inception Workshop before Christmas was preferred to enable work to continue through the holiday period. Potential dates in the week of 16th December are Tuesday 17th or Wednesday 18th. Draft Inception Workshop Objectives, the agenda and participant list for it were prepared. The invitation list will likely include: MRV Sub-working Group; FORIG; Environmental Protection Authority; Ministries; Cocoa Board; World Bank, Representative of the Netherlands, DFID, EU, GIZ, Soil Research and IUCN.

A draft Agenda, Invitation Letter and Budget for the Inception Workshop have been prepared and will be finalised in discussion with the Forestry Commission.

The Inception Workshop will be a larger group to enable wider stakeholder exposure and input. Subsequent workshops will be more technically focused and can be based on the MRV Sub-working Group with additional invitees depending on the major topic of the workshop.

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Appendix 1

Ghana Forest MRV Project Work Plan

Deliverables	Whom	Days	Steps	Products	Duration (weeks)	Month: Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
					Week of Monday	25	2 9 16 23 30	6 13 20 27	3 10 17 24	3 10 17 24 31	7 14 21 28	5 12 19 26	2 9 16 23 30	7 14 21 28	4 11 18 25	1 8 15 22 29	6 13 20 27	3 10 17 24
Assignment in-country																		
Dr Peter F Moore																		
Dr Carly Green																		
Anni Blasten																		
TOTAL DAYS		**655**																
PROJECT MANAGEMENT - Indufor		40					40											
1. Inception																		
1.1. Inception Report with Detailed Work Plan (end of week 1)	PfM, EA, E0, AB,	7.5		**Report**	2													
1.2 Program stakeholder groups consolidated	PfM, EA, EO	7			5													
1.3 Inception Workshop (end of week 3)	PfM, CG, EA, EO, KAB, N-4, YM	8		**Workshop Report**	1													
2 Review the existing national land use and land cover classification scheme and the accuracy of existing land-use assessments, and of carbon stock and inventory data																		
2.1 National definition on forests reviewed and respective recommendations				**Standard Operating Procedure**	9													
Literature Review of materials' FPP report, Katoomba, REDD Readiness Plan et al - current definition and implications	EA, EO, KAB, N-4, YM	11	Literature Review															
Design parameters for field test to be measured and identification of sites to visit	EA, KAB, N-4	4	Field Test Design															
Short field visit to assess forest types in respect of the definition application to Forest Types in Ghana; Method to be developed in relation to crown density (northern savannah before end of January), method of measurement, GPS, timing vis-à-vis satellite and vegetative states, locations and	PfM, CG, EA, KAB, N-4, YM	12	Field Test Plan															
Structured interview with FSD on the topic	PfM, EA, EO	3	Interview Notes															
Review paper produced	PfM, EA, EO, KAB, N-4, YM	9	Review Paper															
2.2 Existing national land use and land cover classification scheme reviewed				**Standard Operating Procedure**	9													
Literature Review of materials' FPP report, Katoomba, CERSGIS Report, REDD Readiness Plan, Landscape Mapping et al - current use and cover classification and implications	PfM, EA, EO, KAB, N-4, YM	15	Literature Review															
Consider against IPCC Standards, including any refinement from COP 19	PfM, CG, KAB, N-4, YM	9	Analysis Report															
Structured discussion with NCRC/Katoomba Group, IUCN, CERSGIS, Cocoa Board (Dr Kwapo)	PfM, CG, EA, EO	4	Interview Notes															
Review paper produced	PfM, CG, EA, EO, N-4, YM	11	Review Paper															
Consolidate to identify the gaps in Land Use and Classification with respect to the IPCC guidance, identify options to address the gaps where they exist	PfM, CG, EA, EO, KAB, N-4, YM	11	Gap Analysis & Options Report															
2.3 Optimum forest definition and land use land cover classification, the basis of the historical Reference Level Assessment		0		**Standard Operating Procedure**	8													
Paper with basis, background and options set out and including options to address gaps (the basis of presentations to the Land Use Land Cover Workshop)	CG, EA, EO, KAB, N-4, YM	13	Background & Options Report															
2.4 Land use Land Cover Workshop (end of week 6); presentations and proceedings	PfM, CG, EA, EO, KAB, N-4, YM	7		**Workshop Report**	1													
Prepare Draft Agenda for the Workshop	PfM, CG, EA, EO, KAB, N-4, YM	0	Agenda															
Identify participants	PfM, CG, EA, EO, KAB, N-4, YM	0	Participant List															
Prepare presentations on Forest Definition; Land Use and Land Cover - Description of Process; Conclusions; Gaps - Options - Policy Implications	PfM, CG, EA, EO, KAB, N-4, YM	7	Presentations (4)															

Deliverables	Whom	Days	Steps	Products	Duration (weeks)	Month: Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
					Week of Monday	25	2 9 16 23 30	6 13 20 27	3 10 17 24	3 10 17 24 31	7 14 21 28	5 12 19 26	2 9 16 23 30	7 14 21 28	4 11 18 25	1 8 15 22 29	6 13 20 27	3 10 17 24
3 Develop methods and approaches following established international protocols for establishing reference levels associated with the key drivers of deforestation and forest degradation																		
3.1 National carbon stock inventory system planned		0		**Standard Operating Procedure**	4													
Review and Assessment of past Forest Surveys; FPP relates - includes BGB destructive sampling; NCRC/Katoomba?;	CG, EA, KAB, N-4	11	Forest Survey Review															
Report and Gap analysis of forest data	CG, EA, KAB, N-4	8	Forest Data Gap Analysis Report															
Draft Plan to put in place an appropriate carbon stock inventory system	CG, EA, EO, KAB, N-4, YM	14	Carbon Stock Inventory System Plan															
EXCLUDED UNDER THE CONTRACT 3.2 Analysis of drivers of deforestation and degradation																		
3.3 Appropriateness of various methodologies and approaches examined		0			4													
Literature review and analysis; NCRC/Katoomba; FPP; EPA (Daniel Benefo)	CG, KAB, N-4, YM	11	Literature Review															
3.4 Determine and recommend approaches and methodologies most suitable to Ghana's national circumstance taking the full scope of REDD+ into consideration to establish its national RL	CG, KAB, N-4, YM	8		**Standard Operating Procedure**	4													
Present approaches and methodologies to the MRV Sub-committee	CG, EO, EA, PfM	1	Presentation & Meeting Notes															
Discuss recommendations and obtain decision on method to be adopted - Executive Management Team of FC	CG, EO, EA, PfM	0	Presentation & Meeting Notes															
3.5 Guidelines and criteria for the establishment of RELs in keeping with UNFCCC discussions to: Contribute to the mitigation of climate change; Use historical emissions and removals for national baselines; Ensure overall environmental integrity; Adjusted as required by national circumstance to improve accuracy	CG, EO, KAB, N-4, YM	19		**Standard Operating Procedure**	9													
3.6 Historical trend reference scenarios and models to reflect future development plans for Ghana	CG, EO, KAB, N-4, YM	21		**Standard Operating Procedure**	9													
3.7 REL Workshop (end of week 20); presentations and proceedings	CG, EO, KAB, N-4, YM	5		**Workshop Report**	1													

Deliverables	Whom	Days	Steps	Products	Duration (weeks)	Month: Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
					Week of Monday	25 2 9 16 23 30	6 13 20 27	3 10 17 24	3 10 17 24 31	7 14 21 28	5 12 19 26	2 9 16 23 30	7 14 21 28	4 11 18 25	1 8 15 22 29	6 13 20 27	3 10 17 24
4 Develop methods and approaches for establishing a national MRV; following good international practice and established techniques																		
4.1 Credible MRV system for LULUCF designed to: Account for CO2 emissions and removals due to changes in carbon stocks on a timely basis; use relevant methodology to build successive carbon stocks scenarios to calculate the net change of carbon stocks at a point in time by subtracting the previous scenario from the scenario related to the relevant point in time; Use GIS for archiving and analysing data coming from land-uses and carbon stocks	PfM, CG, EA, EO, KAB, N-4, YM	28		**Standard Operating Procedure**	25													
Integrate the forest definition and classification, the technical methods and data into the design of an MRV system	PfM, CG, EA, EO, KAB, N-4, YM	23																
Consider integration with the national system being conceived by the EPA	PfM, KAB, N-4, YM	7	Options Report															
Draft a System Manual for the MRV	PfM, CG, EA, EO, KAB, N-4, YM	31	System Manual															
4.2 Plan for integrating sub-national REL and MRV systems into a national system		0		**Standard Operating Procedure**	9													
Frame up the policy and technical implications for sub-national REL and MRV system integration into the national system	PfM, CG, EA, EO, KAB, N-4, YM	19	Policy & Technical Implications Review															
Discuss issues and aspects with the MRV Sub-working Group	PfM, CG, EA, EO	4	Presentation & Meeting Notes															
Prepare scoping paper on the implications	PfM, CG, EA, EO, KAB, N-4, YM	20	Scoping Paper															
Prepare a draft plan	PfM, CG, EA, EO, N-4	19	Draft Plan															
4.3 Required level of accuracy for MRV and related costs defined in relation to available remote sensing imagery and related costs		0		**Standard Operating Procedure**	9													
To include review of the RS options, their costs and consider supplementary data collection (field and other); FPP has some costs identified in the work that was conducted	PfM, EA, N-4, YM	18	MRV System Accuracy/Cost Review Report															
4.4 Institutional set up designed encompassing all relevant national stakeholders involved in MRV and REDD implementation and mechanisms to ensure transparent and open exchange and management of data		0			9													
Review of examples and concepts from other countries	PfM	5	Case Studies Report															
Map the Mandates of stakeholder agencies from government	PfM, EA, EO, N-4	10	Report on Agency Mandates															
Present case studies and mandate review to stakeholder forum	PfM, EA, EO	3	Presentations & Meeting Notes															
Write up the ideas and issues into a design for the institutional setup for the Forest MRV	PfM, EA, EO, N-4	16	MRV Institutional Design Report															
EXCLUDED UNDER THE CONTRACT 4.5 Possibility of integrating socio-economic data linked to safeguard system explored																		
4.6 Training on Tier 2 carbon calculation tools	CG,	15		**Agenda, Training Materials & Course Assessment**	9													
4.7 MRV Workshop (end of week 41); presentations and proceedings	PfM, EA, EO, KAB, N-4	22		**Workshop Report**	1													

Deliverables	Whom	Days	Steps	Products	Duration (weeks)	Month: Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep / Oct / Nov — Week of Monday: 25 2 9 16 23 30 6 13 20 27 3 10 17 24 3 10 17 24 31 7 14 21 28 5 12 19 26 2 9 16 23 30 7 14 21 28 4 11 18 25 1 8 15 22 29 6 13 20 27 3 10 17 24
5 Establish carbon modelling and MRV capacities						
5.1 Capacity gap and institutional assessment based on the state of the existing national forest monitoring technical capabilities and the requirements for the MRV system	PfM, EA, EO, AB	17.5		**MRV Institutional Design Report**	4	
5.2 Detailed plan to establish sustained MRV capacities that includes the capacity gap assessment (5.1) and "a road map and foster its implementation through a sustained and efficient institutional framework including competence in measuring and monitoring at different levels, support of national policies and REDD+ actions, international reporting and verification, and linking of MRV actions and MRV transactions"	PfM, EA, EO, AB	17	MRV Capacities Road Map		4	
Develop the capacity of relevant national stakeholders involved in MRV and REDD implementation in the following areas: Processing and interpretation of satellite data sets at national level for forest area change and forest degradation using remote sensing and GIS; designing a national and sub-national stratification (4.6); Designing protocols and implementing measurements in defined carbon pools (4.6); Targeted sampling and surveys to establish national conversion/expansion factors (4.6); Establish capacities and implement systematic national forest carbon measurement and monitoring system, i.e. through permanent sample plots (3.1); Development and implementation of an accuracy and uncertainty assessment for MRV (4.3)		0				
5.3 Training on remote sensing and carbon modelling for REL development	CG, EA, N-4, YM	23		**Agenda, Training Materials & Course Assessment**	5	
5.4 Training on remote sensing and carbon modelling for MRV development	CG, EA, N-4, YM	23		**Agenda, Training Materials & Course Assessment**	5	
5.5 Communication mechanism on MRV developed via a communication plan and outreach materials	PfM, CG, EA, EO	15		**Communication Plan; Outreach Materials**	4	
Include Professional Development for sustainability	PfM	0				
International and National audiences	PfM	0				
6 Final report	PfM, CG, EA, EO, KAB, N-4, YM	43		**Final Report**	**4**	

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.

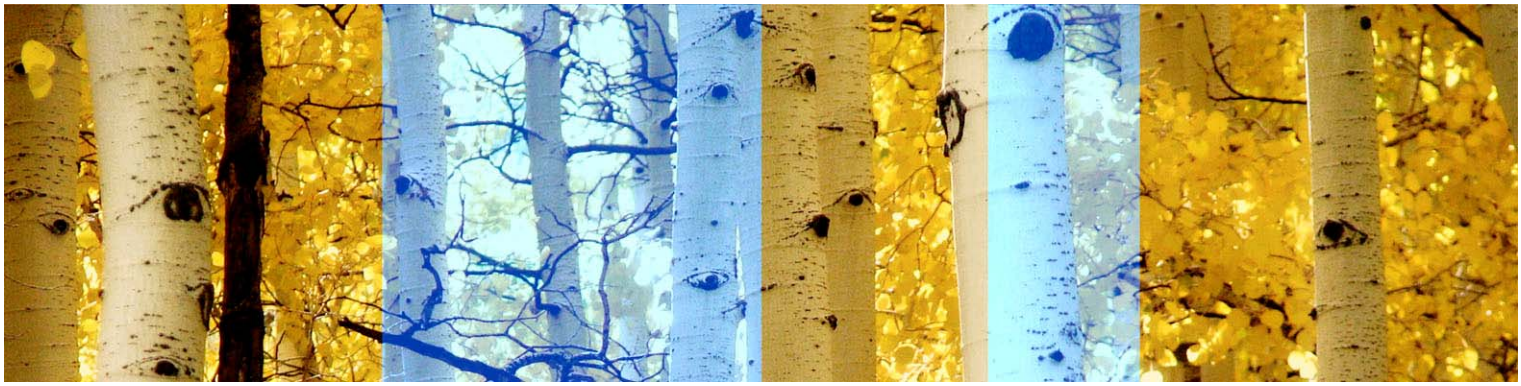
human, business, environment management with geo-ict

NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Indufor Oy
Töölönkatu 11 A
FI-00100 Helsinki
Finland
Tel. +358 9 684 0110
Fax +358 9 135 2552
www.indufor.fi
indufor@indufor.fi

Indufor Asia Pacific Ltd
7th Floor, 55 Shortland St
PO Box 105 039
Auckland City 1143
New Zealand
Tel. +64 9 281 4750
Fax +64 9 281 4789
www.indufor-ap.com



Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Appendix 2

REL Workshop Report

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

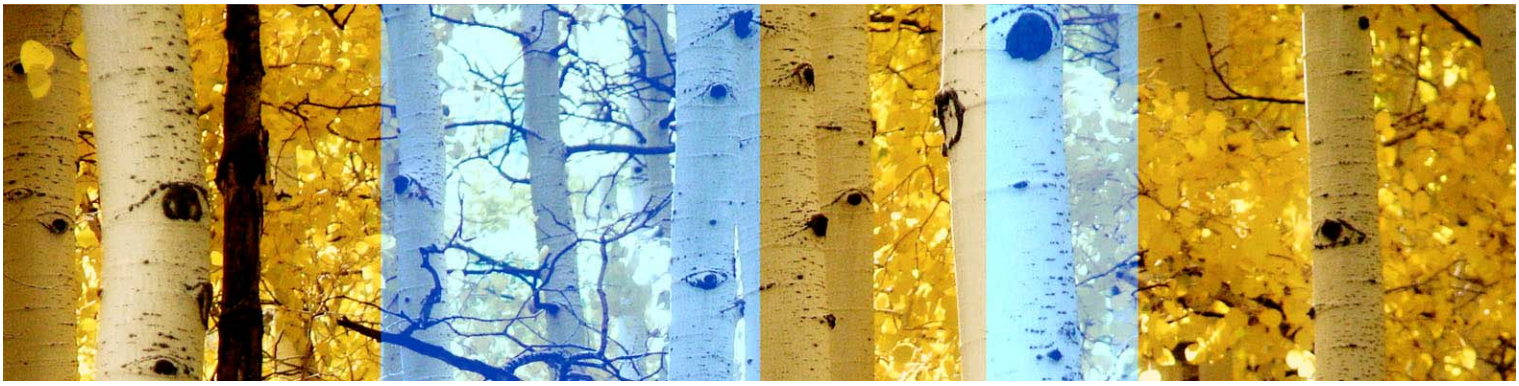
Forestry Commission of Ghana

Ghana Forest MRV Report – Reference Emission Level Workshop

FINAL

Helsinki, Finland
August 1, 2014

6947
ID 31198



Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

DISCLAIMER

Indufor makes its best effort to provide accurate and complete information while executing the assignment. Indufor assumes no liability or responsibility for any outcome of the assignment.

Document Control Record

Date	Version	Changes	Author
23 June 2014	1	• Initial draft based on agenda and notes	PfM
27 June 2014		• Presentations added in, Attendees	PfM
02 July 2014		• Review comments and edits included	PfM
01 August 2014		• Report Finalised	PfM

TABLE OF CONTENTS

LIST OF APPENDICES

PREFACE

This report was prepared as part of the Development of a Forest MRV for Ghana and at the request of the Forestry Commission of Ghana (the Client) by Indufor Oy and its partners Forest Consult and GISD. The intended users of this study/report are the Client, and the Client's auditors and accountants. No other third party shall have any right to use or rely upon the report for any purpose.

The project involves the development of reference emissions levels and measurement, reporting and verification system in Ghana. This report sets out a summary of a Reference Emission Level Workshop and related discussions for the Ghana Forest MRV system.

This report may only be used for the purpose for which it was prepared and its use is restricted to consideration of its entire contents. The conclusions presented are subject to the assumptions and limiting conditions noted within.

We thank the Forestry Commission of Ghana for the opportunity to carry out this project and look forward to working with them on the development of the Forest MRV for Ghana.

Indufor Oy

Name	Dr Peter F. Moore
Job Title	Project Team Leader

Contact:

Anni Blåsten
Indufor Oy
Töölönkatu 11 A, 3rd Floor
FI-00100 Helsinki
FINLAND

Tel. +358 50 528 6715
Fax +358 9 135 2552

indufor@indufor.fi
www.indufor.fi

1. BACKGROUND

The project team of Indufor Oy, Geo-Information Systems Developers and Forest Consult have been working to design and document the MRV systems to enable REDD+ reporting for Ghana.

This workshop aims to build capacity and increase understanding of Reference Levels/Reference Emission Levels with Ghanaian MRV stakeholders. It aims to present the concepts, requirements and approaches to developing Reference Levels and present the current approach suggested for developing a Reference Emission Level for Ghana.

1.1 Objectives

- To give a brief update of the MRV design team progress
- To explain Reference Levels / Reference Emission Levels and give an overview of the development approach
- To explain the steps to develop Ghana's Reference Emission Level
- Answer questions on Reference Levels/Reference Emission Levels.

2. WELCOME AND OPENING INTRODUCTIONS – ALEXANDER BOADU OPERATIONS DIRECTOR – FOREST SERVICES DIVISION

The Chairman in opening remarks noted that for some time now Indufor and partners have been working to document the forest measuring, reporting and verification (MRV) system for Ghana. This is a technical presentation and so participants should pose questions as they occur and not wait for presentations to progress in order to be sure to identify and discuss aspects and issues as we work through the agenda.

3. WORKSHOP AIMS AND OBJECTIVES - EDWARD OBIAW

Participants introduced themselves. The facilitator introduced the agenda and noted again the preference for questions to be posed as the presentations progressed. This workshop was in part to build capacity and was focused on the development of reference emissions levels.

It was noted that the content of the workshop was 'technical' and presentations include complex concepts and detailed requirements, making understanding an effort. It is essential for the Ghana Forest MRV to be implemented effectively and sustained in the very long term, decades, including continuous improvement. Consequently exposure to the complexity inherent in the Forest MRV system that responds to guidance, advice and reporting requirements provided by the UNFCCC, World Bank and others is essential.

The presentations are included in Appendix 3.

4. UPDATE ON DESIGNING AND DOCUMENTING GHANA'S MRV SYSTEM - KOFI BAFFOE

An update on the progress of the design and documentation of the MRV system included the schematic of policy, design decisions, reporting requirements and operations, each of which were described. The differentiation between policy settings and technical functionality was discussed. The standard operating procedures (SOPs) were noted and introduced with brief descriptions of each.

The IPCC concept of tiers was described along with the reporting requirements for REDD+.

The strengths of Ghana with respect of Forest MRV were listed as were the Forest MRV priority needs, of which there are two key ones;

1. Improve data gaps to address time series; and

2. Development of an 'integration tool' to bring the data together into a report of estimations.

The timing for the remaining work for the Ghana Forest MRV was set out. The presentations are included in Appendix 3.

4.1 QUESTIONS & NOTES

1. The scope of the work is restricted to the technical aspects of Forest MRV and the policy discussions and decisions are a matter for the Government of Ghana (GoG). These issues and aspects are topics that need attention and deliberation towards decision.
2. Ghana will also be seeking to report degradation as well as deforestation.
3. Could/should fire, fuelwood and harvested wood products be combined as "biomass removed"?
    a. This is in effect what happens through the reporting. The labels used by the SOPs relate to the IPCC guidelines and the data and outputs they produce are combined at the integration to produce an estimate of emissions.

5. REQUIREMENT AND GUIDELINES FOR RELS – DR CARLY GREEN

The information being presented was quite technical since the task is technical and complex and requires consistent attention to be understood and applied. An outline of the presentation was provided setting out the seven topics to be covered, including recommendations and options on the approach Ghana could take to developing its Reference Level /Reference Emission Level.

The presentations are included in Appendix 3.

5.1 QUESTIONS & NOTES

4. There was significant interest and discussion on the Financial Incentives Benchmark (FIB) and the rationale for not selling all of the emissions reductions a country may generate.
5. How does FIP fit in?
    a. The RL is about reporting deforestation and degradation and will inform the FIP in that respect.
    b. If there are particular reporting requirements for FIP they would have to be prepared specifically. The FIP component is to promote investment and implementation of REDD activities. The program is designed to support to assist Ghana to realise the benefits of REDD+.
    c. The Forest MRV is dealing only with the emissions, not the non-carbon benefits.
6. If Ghana decides to conserve forests to arrest deforestation how will we adjust the Reference Level?
    a. No need to as the BAU would be not to conserve the forest and the change would be monitored and reported.
7. Need a Ghana context for the Reference Level, an explanation or narrative of the drivers and decisions included in the formulation of the Reference Level.
    a. This will be provided through the SOP process, including the SOP on System Design.
8. There are synergies with national activities. Ghana is about to publish the historical emissions from 1990 for the AFOLU sector so this should be considered and ensure the Forest MRV to be consistent with the National Communication.
    a. This will be the case as the Ghana Forest MRV will be the source of the figures provided to the National Communication – therefore completely consistent.

   b. It is likely that the Forest MRV will need to recalculate the emissions from 1990. There is a well-founded set of reasons for this and the improvement in the procedures can be communicated to the UNFCCC and others as required.
9. Under the NAMAs are there Reference Levels constructed and how are they to be ensured consistent?
   a. The Forest MRV should inform the NAMAs. There should be cross-checking on the data sources and settings.
10. The Forest MRV is adhering clearly to the IPCC guidance and also paying attention to the FCPF requirements.

11. There are not too many stakeholders in this workshop. It is not very diverse, so need to carefully review the document via circulation to relevant and selected stakeholders. The MRV Sub-working group has been the main stakeholder consultation body for the Forest MRV.
12. A reference emission level was produced for the R-PP proposal document submitted to the World Bank. Where are we now in relation to this?
    a. The counterparts from Ghana need to be sure to understand the progress very well so that the questions that will arise in the future, say in respect of FIP, can be effectively answered. This is not something that will be put down once the project is finished, it is an ongoing system for use by Ghana.
    b. The figures produced for the R-PP and by the FPP were explained to be preliminary and in the course of developing these figures the shortfalls in the FPP data were identified. These figures should be treated with caution until the wall-to-wall land cover is conducted again.

In the next sessions one of the SOPs was worked through for the information of the participants (Harvested Wood Products).

13. Are the national communications using similar equations and calculations for their calculations?
    a. There is a need for sharing and exchange on the methods being used. The SOPs seek to document the best approaches, methods and data sets available to Ghana. There was agreement on the need to share and exchange, noting that there is a sub-working group to do this and it should be directed to this end.
14. There is the issue to be recognised of the interface with other land uses, particularly the interaction between agricultural land and forest land. It was identified that there should be consistent thinking on this across all lands. To a major extent this is predominantly a policy setting question but will need to be informed by the data and its implications for policy options.
15. As the Forest MRV is developed it will incrementally inform the various products and outputs Ghana is required to create in relation to emissions and reporting.
    a. The efforts and methods being used in Ghana should be synchronised.

6. DEVELOPING THE APPROACH TO GHANA'S REL - CARLY GREEN

The presentation worked through the Reference Level /Reference Emission Level process based on the description and content provided. Guidelines published by the World Bank in January 2014 identify two particular requirements that have an impact on Ghana's Reference Emission Level development. The Reference Emission Level may be adjusted upward by a limited amount above average annual historical emissions only if the historical deforestation rate has been minimal AND is likely to increase in comparison to historical rates. This is not the likey case for Ghana so the Reference Emission Level for Ghana can not be adjusted and must be a simple historical average. At a minimum ER programs must account for emissions from deforestation and emissions from degradation should be accounted where they are significant.

A suggested approach for Ghana to Reference Emission Level based on the analysis and work undertaken by the Forest MRV team to date was presented:

- Decide on a forest definition
  - In place: All lands with canopy cover 15%, tree height 5m and minimum area of 1ha.
- Determine the scope of activities to be included in the Reference Emission Level
  - Deforestation and forest degradation initially,

  - forest conservation, sustainable management of forests, enhancement of forest carbon stocks may be added later

- Decide which C pools to include in RL
  - Using key category analysis
    - Above- and belowground biomass
    - Deadwood
    - Soil Organic Carbon
    - Harvested Wood Products
- Prepare the historical reference time period (>10 years, at least 3 points in time)
  - End Date: most recent since 2013
  - Start Date: min 10 / max 15 years before 2013
  - Minimum of 3 years – between 2000 and 2013
  - Scale: national / sub-national
  - National with the ability to report sub-national (nested programs)

Confirming that historical emissions and removals are a combination of Activity data and Emission factors; compile the requirements:

- Activity data, based on time series analysis of historical data
  - Rates of deforestation
  - Rates of forest degradation
  - Rates of tree planting
  - Rates of enhancement by activity type
- Emission factors
  - Deforestation
  - Forest degradation (available for harvested areas only)
- Removal factors
  - C stock enhancement

Note and accommodate Ghana's National Circumstances:

- Stage of Forest Transition
  - High historical deforestation
- Drivers of Deforestation and Degradation
  - Population pressure
  - Land tenure
  - Shifting agriculture practices
  - Wood harvesting for timber and fuelwood.

The data gap of land cover and land cover change was set out. The data needs for the Forest MRV was described in terms of availability, suitability and being sufficient. Priority needs for the system were described.

7. FACILITATION OF QUESTIONS AND ANSWERS - EDWARD OBIAW

An extended question, answer and discussion session was then held. There was significant interest and energy in the topics that had been presented and efforts were made by participants to examine, explore and understand them.

16. Explain wall to wall mapping
    a. The expression means that all land in Ghana, from border to border, is mapped in terms of land cover. For REDD+ FCPF purposes Ghana needs three maps of land cover for all of Ghana border to border.
17. What is activity data?
    a. The "Activity Data" is the data on the extent of human caused emissions and removals, it is often expressed as area or changes in area.
18. In terms of the "gaps" identified in the Forest MRV work are we suggesting recalculation of the three maps already done? These have already been used in national communications.
    a. Yes since the guidance has only been available since January 2014, the existing maps were not prepared consistent with the guidance. The approach taken to the mapping was also inadequate for the purposes of FCPF and REDD+.
    b. The method already used in reporting will be updated by the Forest MRV for the emissions from forest land.
19. Beyond 2010 will there be a new set of data?
    a. Yes it will be and based on appropriate platforms such as Landsat 8. The question also speaks to the potential for recalculating requirements since national communications will have to be revised to be consistent.
20. Land cover/land use definitions used in previous mapping led to some land classes being blocked together. This revision needs to be considered and documented. The land covers in the Forest MRV were combined into "Wet", "Moist" and "Dry" forest to be compatible with the National allometric equations. It should be noted that countries are allowed to recalculate. The crucial issue is that the baseline be clearly documented as it will be relied upon in the future.
21. If a NAMA issues carbon credits based on different method there will be concerns as to conflicts and confusion.
    b. At present the FPP data will be used for the BUR. In the future all recalculations will be conducted with data provided through the Forest MRV.
22. Ghana needs to submit its Reference Level by the end of the year. Is that feasible? Can it be done?
    a. It is possible to produce some figures based on the FPP BUT that work is not consistent with requirements under REDD+ and the requirements set out by the FCPF. The work itself also has some weaknesses in the mapping of forests and the allocation of land cover.
    b. Ghana is not obliged to come up with accurate calculations at this stage so need to carefully characterise the numbers presented, caveated and described with clear indication as to their weakness and the path for their improvement.
    c. Ghana should be very careful with numbers, they tend to gain a credibility they may not have and can have 'lives' of their own and keep being repeated.
23. At the end of the consultancy there has to be a functional system.
    a. The Forest MRV for Ghana will be developed and documented. The SOPs, in combination, set out the data, steps and processes for a functional MRV. The system can not feasibly provide reliable figures for the REL given the data gaps and recalculation that is required.
    b. In other words a system that can work but will still need a 'driver' and 'fuel' for it to operate.

24. It was suggested that the SOPs should be made available to EPA for comparing to the existing procedures and request that they provide their procedure for information.
    a. ACTION - The consulting team should meet with EPA to jointly review and discuss the procedures.
        i. This has been put in process prior to the end of the workshop.

8. WORKSHOP CLOSE - ALEXANDER BOADU OPERATIONS DIRECTOR – FOREST SERVICES DIVISION

It was noted that the presentations and the discussions generated great interest and stimulated discussion. Dr Carly Green was thanked for her efforts in leading the workshop.

We now have a blueprint to work with and move forward. There are some critical issues to be addressed and they should be kept in mind as progress is made.

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Appendix 1

Workshop Agenda

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

19th June 2014

MRV System Development Ghana – Reference Emission Level Workshop

Background

The project team of Indufor Oy, Geo-Information Systems Developers and Forest Consult have been working to design and document the MRV systems to enable REDD+ reporting for Ghana.

This workshop aims to build capacity and increase understanding of Reference Levels with Ghanaian MRV stakeholders. It aims to present the concepts, requirements and approaches to developing Reference Levels and present the current approach suggested for Ghana.

Objectives

- To give a brief update of the MRV design team progress
- To explain Reference Levels and give an overview of the development approach
- To explain the steps to develop Ghana's Reference Level
- Answer questions on Reference Levels

Agenda

10.00am Welcome and Opening Introductions (Executive Director – Forest Services Division)

10.15am Workshop Aims and Objectives (Edward Obiaw)

10.30am Update on designing and documenting Ghana's MRV system (Kofi Baffoe)

11.00am Requirement and Guidelines for RELs (Carly Green)

12.30midday LUNCH

13.30pm Developing the Approach to Ghana's REL (Carly Green)

14.00pm Facilitation of Questions and Answers (Edward Obiaw)

15.00pm Workshop Close (Executive Director – Forest Services Division)

Appendix 2

Workshop Attendees

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

The Ghana Forest MRV REL Workshop was attended by:

1. Alex Boachy – FC FSD
2. Augustine Arthur – FC HQ
3. Awudi Cudjoe – FC HQ
4. Carly Green – Indufor EAS
5. Cletus Nateg – FC WD
6. Daniel Benefor – EPA
7. Edward Obiaw – FC RMSC
8. Emmanuel Amamoo-Otchere – GISD
9. Ernest Foli – FORIG
10. Foster Mensah – CERSGIS
11. Gene Biriikorang – Consultant
12. Kofi Affum-Baffoe – FC RMSC
13. Kwabena Akyeampong Boakye – Forest Consult
14. Kwabena Asubentong – UN University
15. Mohammed Yakubu – FC RMSC
16. Oppon Sasu – FC HQ
17. Paul Amamoo-Otchere – GISD
18. Peter Moore – Indufor MWH
19. Robert Bamfo – FC CCU
20. Selase Adanu –CERSGIS
21. Tabi Agyarko – MLNR
22. Victor Agyeman – FORIG
23. Winston Asante – KNUST
24. Yaw Kwakye – FC CCU

Appendix 3

Workshop Presentations

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.

human, business, environment management with geo-ict

NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

REDD+ Reference Levels Ghana

Workshop – 19th June 2014

Aims and Objectives

- To give a brief update of the MRV design team progress
- To explain RELS and give an overview of the calculation approach
- To explain the steps to develop Ghana's REL
- Questions and Answers

Indufor ...forest intelligence

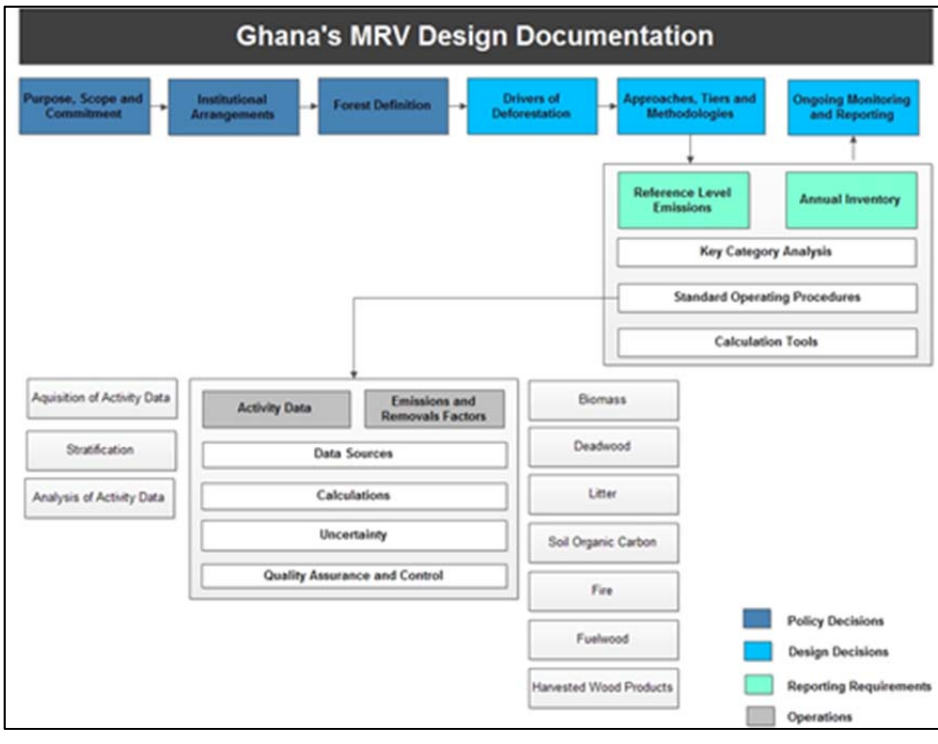
Geo-Info Systems Developers [GISD] Ltd.

human, business, environment management with geo-ict

NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

Aims and Objectives

- **To give a brief update of the MRV design team progress**
- To explain RELS and give an overview of the calculation approach
- To explain the steps outlined to develop Ghana's REL
- Questions and Answers



Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Standard Operating Procedures

- Designed to meet IPCC Approaches and Tiers to meet REDD+ reporting requirements
- Document the calculation approach and any justifications
- Explains the use of available national data and the identifies priority areas for new data collection

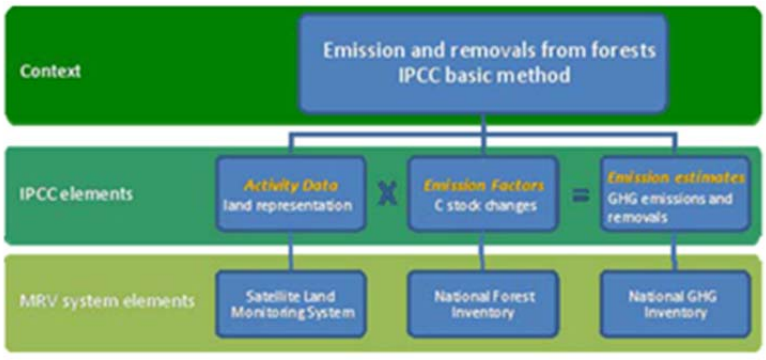
Table of Contents of SOPS

- Sources
- Summary Description
- Definitions
- Applicability Conditions
- UNFCC Specific Requirements (REDD+ and National Communications)
- Procedures (IPCC calculation approach)
- Data and Parameters
- Quality Assurance / Quality Control
- References
- Glossary

List of Standard Operating Procedures

No	Name
001	Ghana MRV Design Document
002	Key Category Analysis
003	Acquisition of Remote Sensing Data and Generation of Activity Data
004	Stratification of Lands
005	Field Inventory Protocol
006	Estimation of Above- and belowground Biomass, Deadwood and Litter
007	Soil Organic Carbon
008	Estimation of Emissions from Forest Degradation Caused by Harvested Wood Products
009	Emissions from forest degradation caused by extraction of wood for fuel
010	Estimating National and Sub-National Reference Emission Level
011	Combining and Estimating Uncertainty
012	Calculating Ghana's Annual Forest Emissions and Removals

IPCC Conceptual Approach



IPCC - TIERS

IPCC classifies GHG accounting using three methods called Tier 1, Tier 2 and Tier 3

- Tiers 1 global default factors provided for large eco-regions of the world
- **Tiers 2 country or regional specific data**
  - **Most developed countries report using Tier 2 approaches**
- Tiers 3 including biophysical modeling of GHG processes
  - Only Australia and Canada report using Tier 3 approaches

REDD+ Reporting Requirements

To participate in REDD+ you must have:

- Activity Data developed using Approach 3
  - wall–to-wall mapping (whole of country)
- Tier 2 Emissions Factors
  - National specific emissions factors (biomass stocks, deadwood, timber harvest, charcoal production etc)

Ghana's MRV Strengths

- Strengths
  - Significant body of country specific emissions factors
  - Designed for appropriate Approaches/Tiers for REDD+ reporting (Approach 3, Tier 2)
  - Includes uncertainty assessment
  - Existing in-country experiences of wall-to-wall mapping and capacities gained from FPP process
  - As a result of this project will have a well documented methodology including justification for data and documented areas for priority improvement

Ghana's MRV Priority Needs

- Priority Needs
  - Improve data gaps to address time series consistency requirements of national activity data
  - Develop an integration (Tier 2 calculation tool) to meet forestry reporting requirements

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Timeline

- Circulation Draft Final Report – early August
- Receive comments on Draft Final Report – end August
- Final Forest MRV Workshop – early September
- Submission of final report - mid September

Aims and Objectives

- To give a brief update of the MRV design team progress
- **To explain RELS and give an overview of the calculation approach**
- To explain the steps outlined to develop Ghana's REL
- Questions and Answers

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Outline

1. UNFCCC context on developing REDD+ forest reference (emission) levels
2. Published Approaches of developing REDD+ reference levels
3. Program Guidelines for developing REDD+ reference levels
4. Methods for estimating business-as-usual (BAU) baselines
5. Financial incentives benchmark
6. Technical assessment of RLs
7. Case Studies – Brazil and Guyana
8. Recommendations for Ghana's REL

Outline

1. **UNFCCC context on developing REDD+ forest reference (emission) levels**
2. Types of REDD+ reference levels
3. Guidelines for developing REDD+ reference levels
4. Methods for estimating business-as-usual (BAU) baselines
5. Financial incentives benchmark
6. Technical assessment of RLs
7. Case Studies – Brazil and Guyana
8. Recommendations for Ghana's REL

Importance of REDD+ Forest reference (emission) levels

- Basic concept of REDD+ is to provide economic **incentives for implementing REDD+ activities** and **achieving emission reductions**
- A national forest monitoring system includes the establishment of RL/REL which provide a **benchmark for assessing a country's performance** in implementing REDD+ activities
- The process of establishing RLs (info derived from historic emissions; information of the magnitude, location, and causes of emissions/removals) can **inform development and implementation of (sub)national REDD+ policies**

Difference REL / RL

- Difference forest reference emission level (REL) & forest reference level (RL):
  - REL – benchmark for emissions from deforestation and forest degradation → REDD only
  - RL – benchmark for emissions from deforestation and forest degradation *and* removals from sustainable management of forests and enhancement of forest carbon stocks → for all REDD+ activities
- *The term RL will be used throughout this module, which also encompasses REL*

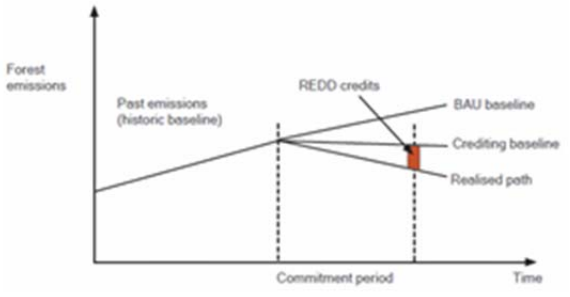
Importance of REDD+ Forest reference (emission) levels

- Two Functions of RLs:
  1) To measure the **effectiveness of REDD+ interventions**
     → RLs depict what the forest emissions scenario would be in the absence of REDD+ implementation

  2) To inform the determination of **results-based payments for REDD+**
     → Results-based support is based on difference between actual forest emissions and a RL/REL

Types of forest reference levels

- Business as Usual Baseline (BAU)
- Financial Incentive Benchmark (FIB) / compensation baseline



(Financial Incentive Benchmark = Compensation baseline)

Source: www.redd-net.org

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Guidance from UNFCCC on developing Forest Reference Levels

(UNFCCC, 2011. COP17 Decision 12-II; UNFCCC, 2010. COP16 Decision 1; UNFCCC, 2009. COP15 Decision 4)

Developing countries participating in REDD+ are requested to develop in accordance with **national circumstances** and **respective capabilities:**

- A *national* **forest reference emission level** (REL) and/or **forest reference level** (RL) or, if appropriate, as an interim measure, *subnational* forest reference emission levels and/or forest reference levels
- Which is done **transparently** taking into account **historic data**, and **adjusted for national circumstances** if applicable

Guidance from FCPF on developing Forest Reference Levels for ER Programs

- The end-date for the historical Reference Period is the most recent date prior to 2013 for which forest-cover data is available to enable IPCC Approach 3
- The start-date for the historic Reference Period is about 10 years before the end-date. An alternative start-date could be allowed...(but) not more than 15 years before the end-date
- Reference Level may be adjusted upward by a limited amount above average annual historical emissions only if the historical deforestation rate has been minimal AND is likely to increase in comparison to historical rates
- At a minimum, ER Programs must account for emissions from deforestation. Emissions from forest degradation also should be accounted for where such emissions are significant

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Modalities for developing forest RLs

- Forest RLs are expressed in t CO_2-e per year
- RLs should be consistent with forest emissions and removals included in the national GHG inventories
- Subnational RLs may be elaborated as an interim measure, with an eventual transition to a national RL
- Countries may use a step-wise approach for developing RLs, thereby using better data and improved methods and incorporating additional carbon pools over time
- Countries should update a RL periodically as appropriate, taking into account new knowledge, new trends and any modification of scope and methodologies

Modalities for developing forest RLs

- Countries should submit information and rationale on the development of their RL and technical assessment of the proposed RLs should be possible using this documentation
- Information on submitted RLs will be made available on the UNFCCC REDD web platform (http://unfccc.int/4531)
- Proposed RLs will be technically assessed in the context of results-based payments, following guidelines and procedures, decided by the COP

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Scope of REDD+ within IPCC categories

RLs correspond to the outcomes of REDD+ activities:

- Deforestation
- Forest degradation
- Conservation of forest carbon stocks
- Sustainable management of forests
- Enhancement of forest carbon stocks (in degraded forests)
- Enhancement of forest carbon stocks (reforestation)

Outline

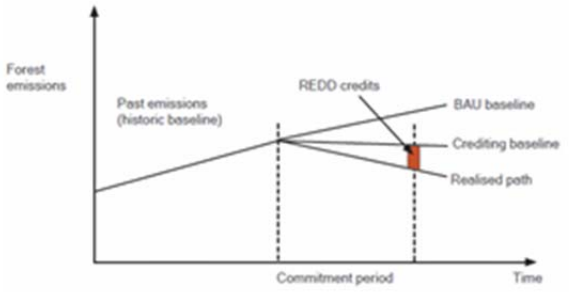
1. UNFCCC context on developing REDD+ forest reference (emission) levels
2. **Types of REDD+ reference levels**
3. Guidelines for developing REDD+ reference levels
4. Methods for estimating business-as-usual (BAU) baselines
5. Financial incentives benchmark
6. Technical assessment of RLs
7. Case Studies – Brazil and Guyana
8. Recommendations for Ghana's REL

Difference REL / RL

- Difference forest reference emission level (REL) & forest reference level (RL):
  - REL – benchmark for emissions from deforestation and forest degradation → REDD only
  - RL – benchmark for emissions from deforestation and forest degradation *and* removals from sustainable management of forests and enhancement of forest carbon stocks → for all REDD+ activities
- *The term RL will be used throughout this module, which also encompasses REL*

Types of forest reference levels

- Business as Usual Baseline (BAU)
- Financial Incentive Benchmark (FIB) / compensation baseline



(Financial Incentive Benchmark = Compensation baseline)

Source: www.redd-net.org

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Types of forest reference levels

- **BAU baseline = *RL***
  - Projection of emissions (in t CO_2 / year) from deforestation and forest degradation in the absence of the REDD action
  - To measure the impact of REDD+ policies and actions and to define emission reductions
- **FIB = compensation / crediting baseline**
  - Benchmark for estimating results-based incentives: direct payments to countries, subnational units or projects for emission reductions
- FIB is not recognized in UNFCCC discussions, however, from an analytical viewpoint it is essential to make the distinction between the two types of RLs

Outline

1. UNFCCC context on developing REDD+ forest reference (emission) levels
2. Types of REDD+ reference levels
3. **Guidelines for developing REDD+ reference levels**
4. Methods for estimating business-as-usual (BAU) baselines
5. Financial incentives benchmark
6. Technical assessment of RLs
7. Case Studies – Brazil and Guyana
8. Recommendations for Ghana's REL

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Establishing REDD+ forest reference levels

- Reference levels are a measure of future forest GHG emissions and removals
- To estimate what might happen in the future we must first know what happened in the past
- Therefore, data on historic activities are needed

Considerations for RL Establishment

- Decide on a forest definition
  - Definition of forest determines which lands will be included
  - Low thresholds ensure that practically all lands that contain trees could be eligible for REDD+ incentives
- Scope of activities to be included in the RL
  - Deforestation, forest degradation, forest conservation, sustainable management of forests, enhancement of forest carbon stocks
- Which C pools to include in RL
- Historical reference time period (>10 years, at least 3 points in time)
- Scale: national / sub-national

Data needs for RL estimation

RLs are based on historical data and adjusted for national circumstances if applicable

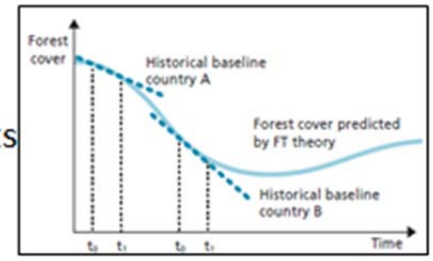
Data and information is needed on:

- Historical emissions and removals
  - Activity data - spatial extent of land cover transition (ha)
  - Emission factors - emissions/removals of greenhouse gases per unit of activity (t CO2-e/ha)
- National circumstances
  - Stage in forest transition
  - Drivers of deforestation and forest degradation

Data needs for RL estimation

National circumstances can influence the deforestation trend and need to be considered for estimating future forest emissions and setting the RL

- General adjustment of RLs to increase reliability
  - Stage in forest transition (forest cover, GDP)
  - Drivers of deforestation and forest degradation (e.g. agricultural commodity prices)
- Case-by-Case adjustments
  - National policies that have major impacts on future forest use



Source: Angelsen 2008

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Guidance from FCPF on developing Forest Reference Levels for ER Programs

- The end-date for the historical Reference Period is the most recent date prior to 2013 for which forest-cover data is available to enable IPCC Approach 3
- The start-date for the historic Reference Period is about 10 years before the end-date. An alternative start-date could be allowed...(but) not more than 15 years before the end-date
- Reference Level may be adjusted upward by a limited amount above average annual historical emissions only if the historical deforestation rate has been minimal AND is likely to increase in comparison to historical rates
- At a minimum, ER Programs must account for emissions from deforestation. Emissions from forest degradation also should be accounted for where such emissions are significant

Outline

1. UNFCCC context on developing REDD+ forest reference (emission) levels
2. Types of REDD+ reference levels
3. Guidelines for developing REDD+ reference levels
4. **Methods for estimating business-as-usual (BAU) baselines**
5. Financial incentives benchmark
6. Technical assessment of RLs
7. Case Studies – Brazil and Guyana
8. Recommendations for Ghana's REL

Approaches for Estimating BAU Baselines

- Strictly historical approach
  - Simple extrapolation using historical forest area estimates – assumes no change in trend
- Adjusted historical approach
  - Uses predictive power of historical deforestation trend,
  - Other factors that represent national circumstances are included to improve predictions, such as stage in the forest transition and deforestation drivers
- Simulation models
  - Basis is usually land rent and the demand and supply of new land for agriculture
  - May include historical deforestation rates

Strictly Historical Approach

- No certain driver data available
- Simple trend projection using national statistics on historical data
- Simple rules (in technical terms)
- Example at sub-national scale:
  - Brazil's forest RL for the Amazon basin

Adjusted Historical Approach

- Retain predictive power of historical trend data but move to more driver-based assessment and predictions
- Include data-driven reasoning for deviations from historical trend (i.e. national circumstances)

Adjusted Historical Approach

- Data needed:
  - Historical data on deforestation / forest degradation
  - Information on national circumstances
  - stage in forest transition
  - driver data for key activities
  - socio-economic factors
- Modelling:
  - To test the importance of historical deforestation and other national circumstances for predicting deforestation
  - To predict future deforestation based on historical data and data on national circumstances (e.g. drivers)

NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

Simulation Models

- Suitable when countries have high-quality data
- To test different methods for RL setting
- To explore the implications of different policy scenarios
- Examples of simulation models:
  - IIASA's GLOBIOM model
  - OSIRIS modeling tool

Some Considerations for RL Development

- Consistency:
  - once pools and/or activities are omitted from the RLs, they cannot be included in REDD+ performance reporting.
  - If additional pools, gases and activities are added, the RL needs to be adjusted.
- Both emissions from deforestation and for forest degradation need to be reported
  - degradation processes can happen on a small-scale and are sometimes not visible in satellite data.
  - Therefore, when establishing degradation RLs, historical activity data limitations for some small-scale, locally driven degradation types should be considered.
- Estimating emissions is generally more important than estimating removals: a country is obliged to report on emissions while reporting on removals is optional

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Outline

1. UNFCCC context on developing REDD+ forest reference (emission) levels
2. Types of REDD+ reference levels
3. Guidelines for developing REDD+ reference levels
4. Methods for estimating business-as-usual (BAU) baselines
5. **Financial incentives benchmark**
6. Technical assessment of RLs
7. Case Studies – Brazil and Guyana
8. Recommendations for Ghana's REL

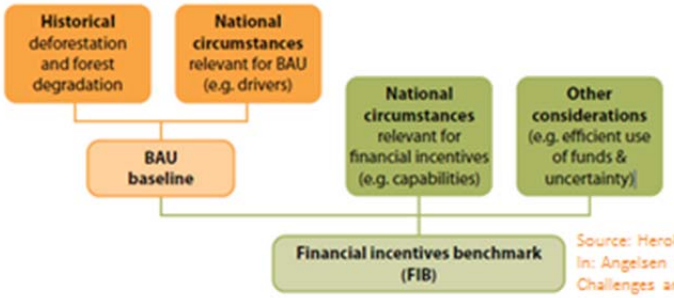
Financial Incentives Benchmark

Financial Incentives Benchmark (FIB) or compensation baseline:

- Needed to determine the eligibility of UNFCCC Parties for international, **results-based support for REDD+**, and to calculate the support on the basis of measured, reported, and verified emission reductions
- FIBs influence the potential effectiveness, efficiency and equity of REDD+ funds
- The financial mechanism is not clear yet: UNFCCC has **not yet decided** on guidelines on how to set the FIB

Linking RLs to Results-based Finance

- How should the FIB be set?
  - Equal to or adjusted from BAU?
  - Equity-based adjustments (e.g. forest cover, GDP) to influence REDD+ financing



Source: Herold et al., 2012, ch. 16. In: Angelsen et al., Analysing REDD+: Challenges and choices

Outline

1. UNFCCC context on developing REDD+ forest reference (emission) levels
2. Types of REDD+ reference levels
3. Guidelines for developing REDD+ reference levels
4. Methods for estimating business-as-usual (BAU) baselines
5. Financial incentives benchmark
6. **Technical assessment of RLs**
7. Case Studies – Brazil and Guyana
8. Recommendations for Ghana's REL

Technical Assessment of Proposed RLs

- The UNFCCC secretariat will prepare a synthesis report on the technical assessment process
- Technical assessment will focus on:
  - Consistency of RL with the forest emissions and removals included in the national greenhouse gases inventories
  - How historical data have been taken into account
  - The extent to which the information provided is transparent, complete, consistent and accurate
  - Whether descriptions of changes to previously submitted RLs have been provided taking into account the stepwise approach

Technical Assessment of Proposed RLs

- *Continued…*
  - Pools and gases, and activities included, and justification of omitting pools and/or activities
  - The definition of forest that has been provided
  - Whether assumptions about future changes to domestic policies have been included
- After technical assessment areas for technical improvement and capacity building needs may be identified

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Outline

1. UNFCCC context on developing REDD+ forest reference (emission) levels
2. Types of REDD+ reference levels
3. Guidelines for developing REDD+ reference levels
4. Methods for estimating business-as-usual (BAU) baselines
5. Financial incentives benchmark
6. Technical assessment of RLs
7. **Case Studies – Brazil and Guyana**
8. Recommendations for Ghana's REL

Developing REDD+ Reference Levels

Country examples:

- Brazil (Amazon fund)
- Guyana (Norway agreement)

Brazil's forest RL for the Amazon forest

- The Amazon rain forest covers almost half of Brazil and is the largest reserve of biological diversity in the world
- 15-20% of the Brazilian amazon has been lost
- The Amazon Fund was created in 2008 with the aim to prevent, monitor and combat deforestation in the Brazilian Amazon
- Strictly historical approach for RL development:
  - Based on average annual deforestation rate for a 10 year period
  - RL is updated every 5 years

Guyana's national forest RL

- Guyana-Norway partnership for reduced forest carbon emissions
- Guyana has high forest cover and low deforestation rates
- The country will be rewarded for maintenance of low deforestation rates
- Combined RL methodology, taking the average of:
  - National annual deforestation rate for 2001-2009, based on Landsat satellite data for 2001-2005 and 2006-2009
  - Mean annual deforestation rate in tropical forested non-Annex I countries, based on FAO FRA data from 2010
- RL = (0.03% + 0.52%) / 2 = 0.275%

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Outline

1. UNFCCC context on developing REDD+ forest reference (emission) levels
2. Types of REDD+ reference levels
3. Guidelines for developing REDD+ reference levels
4. Methods for estimating business-as-usual (BAU) baselines
5. Financial incentives benchmark
6. Technical assessment of RLs
7. Case Studies – Brazil and Guyana
8. **Recommendations for Ghana's REL**

Guidance from FCPF on developing Forest Reference Levels for ER Programs

- The end-date for the historical Reference Period is the most recent date prior to 2013 for which forest-cover data is available to enable IPCC Approach 3
- The start-date for the historic Reference Period is about 10 years before the end-date. An alternative start-date could be allowed...(but) not more than 15 years before the end-date
- Reference Level may be adjusted upward by a limited amount above average annual historical emissions only if the historical deforestation rate has been minimal AND are likely to increase in comparison to historical rates
- At a minimum, ER Programs must account for emissions from deforestation. Emissions from forest degradation also should be accounted for where such emissions are significant

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Considerations for RL Establishment

- Decide on a forest definition
  - All lands with canopy cover 15%, tree height 5m and minimum area of 1ha.
- Scope of activities to be included in the RL
  - **Deforestation, forest degradation,** forest conservation, sustainable management of forests, enhancement of forest carbon stocks
- Which C pools to include in RL
  - Using key category analysis
    - Above- and belowground biomass
    - Deadwood
    - Soil Organic Carbon
    - Harvested Wood Products

Considerations for RL Establishment

- Historical reference time period (>10 years, at least 3 points in time)
  - End Date: most recent since 2013
  - Start Date: min 10 / max 15 years before 2013
  - Minimum of 3 years – between 2000 and 2013
- Scale: national / sub-national
  - National with the ability to report sub-national (nested programs)

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Data Needs for RL Estimation

Historical emissions and removals are a combination of Activity data and Emission factors

- Activity data, based on time series analysis of historical data
  - Rates of deforestation
  - Rates of tree planting
  - Rates of forest degradation
  - Rates of enhancement by activity type
- Emission factors
  - Deforestation
  - Forest degradation (available for harvested areas only)
- Removal factors
  - C stock enhancement

National Circumstances

- Stage of Forest Transition
  - High historical deforestation
- Drivers of Deforestation and Degradation
  - Population pressure
  - Land tenure
  - Shifting agriculture practices
  - Wood harvesting for timber and fuelwood

Approaches for Estimating BAU Baselines

- Strictly historical approach
  - Simple extrapolation using historical forest area estimates – assumes no change in trend
  - Suitable for countries with low forest cover and historically high deforestation rates
  - Consistent with FCPF guidelines and requirements for Emissions Reduction Program

RL Framework Design

- RL developed for each ecozone and the combined into a national REL
- ER Programs will apply the relevant REL/s for the region within the Program is

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.

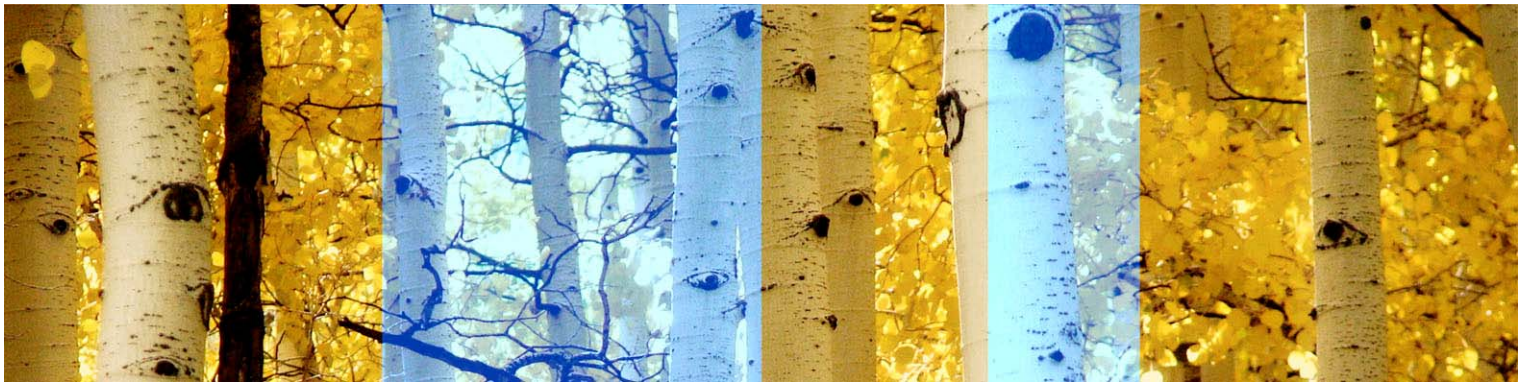
human, business, environment management with geo-ict

NO.05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Indufor Oy
Töölönkatu 11 A
FI-00100 Helsinki
Finland
Tel. +358 9 684 0110
Fax +358 9 135 2552
www.indufor.fi
indufor@indufor.fi

Indufor Asia Pacific Ltd
7th Floor, 55 Shortland St
PO Box 105 039
Auckland City 1143
New Zealand
Tel. +64 9 281 4750
Fax +64 9 281 4789
www.indufor-ap.com



Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Appendix 3

Training on Tier 2 Carbon Calculation Tools – Roundtable Report

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

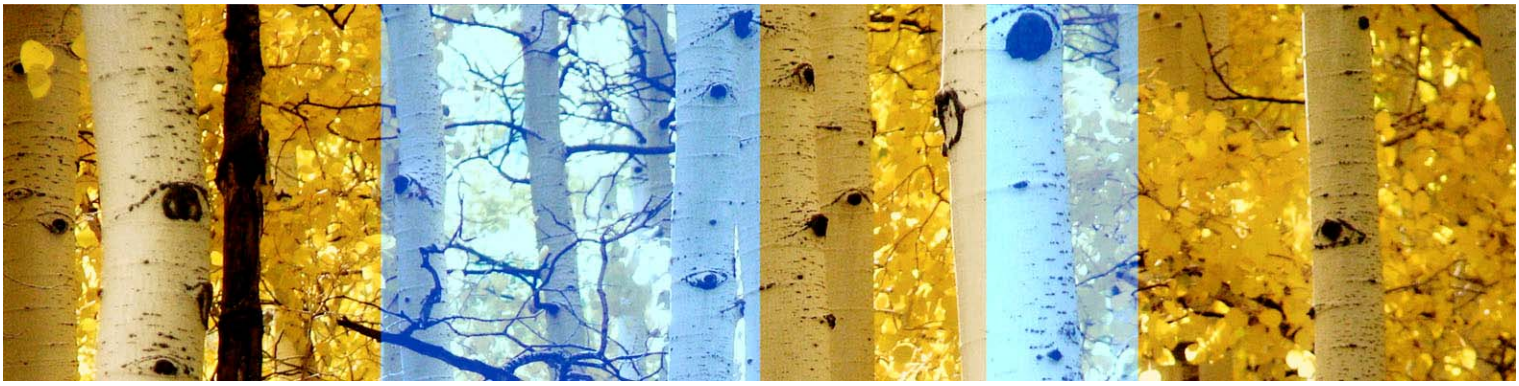
Forestry Commission of Ghana

Ghana Forest MRV Report – Roundtable Discussion on Tier 2 Calculation Tools

FINAL

Helsinki, Finland
June 17, 2014

6947



Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

DISCLAIMER

Indufor makes its best effort to provide accurate and complete information while executing the assignment. Indufor assumes no liability or responsibility for any outcome of the assignment.

Document Control Record

Date	Version	Changes	Author
23 June 2014	1	• Initial draft based on agenda and notes	PfM
27 June 2014		• Presentations and Attendees added	PfM
2 July 2014		• Internal review comments included	PfM
1 August 2014		• Finalise Report	PfM

TABLE OF CONTENTS

LIST OF APPENDICES

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

PREFACE

This report was prepared as part of the Development of a Forest MRV for Ghana and at the request of the Forestry Commission of Ghana (the Client) by Indufor Oy and its partners Forest Consult and GISD. The intended users of this study/report are the Client, and the Client's auditors and accountants. No other third party shall have any right to use or rely upon the report for any purpose.

The project involves the development of reference emissions levels and measurement, reporting and verification system in Ghana. This report sets out a summary of a roundtable discussion on Tier 2 calculation tools/databases and discussions for the Ghana Forest MRV system.

This report may only be used for the purpose for which it was prepared and its use is restricted to consideration of its entire contents. The conclusions presented are subject to the assumptions and limiting conditions noted within.

We thank the Forestry Commission of Ghana for the opportunity to carry out this project and look forward to working with them on the development of the Forest MRV for Ghana.

Indufor Oy

Name	Dr Peter F. Moore
Job Title	Project Team Leader

Contact:

Anni Blåsten
Indufor Oy
Töölönkatu 11 A, 3rd Floor
FI-00100 Helsinki
FINLAND

Tel. +358 50 528 6715
Fax +358 9 135 2552

indufor@indufor.fi
www.indufor.fi

1. BACKGROUND

The project team of Indufor Oy, Geo-Information Systems Developers and Forest Consult have been working to design and document the MRV systems to enable REDD+ reporting for Ghana.

The workshop on Tier 2 calculation tools/software was designed to be an interactive discussion on meeting the needs of Ghana's reporting system to the UNFCCC and also consider how this may assist other reporting requirements.

1.1 Workshop Objectives

The Ghana Forest measurement, reporting and verification (MRV) team identified the following objectives for the Tier 2 Tools Workshop:

- To give an update of the MRV design team progress
- To explain how Ghana is meeting IPCC Approach 3, Tier 2 reporting requirements
- To discuss design requirements for Tier 2 integration/calculation tools
- To assess the capacity within Ghana to develop such a tool.

2. OPENING REMARKS - RAPHAEL YEBOAH EXECUTIVE DIRECTOR FSD

Work has been ongoing on the design and development of the MRV for Ghana Forests, adopted two-tier reporting. This session will look at the tools and approach for the Forest MRV for Ghana, with relevance more broadly to MRV in Ghana for the entire land sector.

3. WORKSHOP AIMS AND OBJECTIVES – DR CARLY GREEN

Dr Carly Green briefly described the workshop aims and objectives which were.

- To give a brief update of the MRV design team progress
- To explain how Ghana is meeting IPCC Approach 3, Tier 2 reporting requirements
- To discuss options for Tier 2 integration/calculation tools
- To assess the capacity within Ghana to develop such a tool

Among the key points made:

- This will be an open forum. The intention is to have discussion around the integration of data that is required and how it can be formulated to meet multiple reporting requirements (UNFCCC, FAO FRA, et al)

The presentations made are included in an Appendix.

4. SUMMARY OUTLINE OF FOREST MRV SYSTEM

Dr Green presented on the development of the Ghana Forest MRV system, the system design documentation, the Standard Operating Procedures (SOPs) and the reporting requirements for Forest MRV. The MRV strengths and opportunities were also described.

Among the key points made:

- Development of the system started in late December 2013. A Diagram of the Design Documentation identified the policy decisions, design decisions, the reporting requirements and operations of managing and maintaining the system and continuous improvement. [see presentation]
- There is a need to understand the needs and requirements for standards and decisions that are sound, policy relevant and clearly documented. Hence the process of developing SOPs has been deliberately adopted to ensure these requirements are met by the Forest MRV for Ghana.

- A key step is the integration of the data from a number of sources, in differing formats and varying quality, some of which has to be transformed for use, into the reporting output for the UNFCCC. Other reports from the data could be feasible as well, adding to the consistency and transparency of reporting.
- Starting point for the design was establishing what is required to meet REDD+. Countries need Approach 3 and Tier 2 reporting as a minimum.
- Dr Green described the outline of the Table of Contents for the SOPs and briefly described each section. Noting that it sets out step-by-step how to do the calculations, including where to source the data and parameters, and QA/QC. All SOPs are complete and include references and a glossary. The 12 SOPs under development that make up the Forest MRV System were listed.
- Approaches and Tiers, their definition and implications were discussed.
- Ghana's MRV Strengths were noted:
    - Significant body of country specific emission factors
    - Setting up to use appropriate Approaches and Tiers
    - Uncertainty Assessment has been designed, can be conducted and will be integrated into the Forest MRV System Design
    - There is in country experience of wall-to-wall mapping in part due to FPP
    - Well documented methodology
- Ghana Opportunities
    - Filling gaps and addressing inconsistencies in national activity data. Currently have two epochs 2000 and 2010 as a result of the FPP. These demonstrate the products of remote sensing but are not suitable for the Forest MRV to meet World Bank requirements and the UNFCCC. In addition more epochs are needed to improve the Reference Emission Level and other gaps should be improved/filled.
    - Need an integration tool to take the data from the system and combine it to prepare and provide the emissions estimates from forests for Ghana.

5. SELECTION OF GHG CALCULATORS FOR THE FOREST MRV - KWABENA AKYEAMPONG BOAKYE

Mr Boakye has undertaken a review of publicly available GHG Calculators for forests. He presented the findings and discussed them with the participants. Notes from the presentation and discussion included:

- There are many GHG tools that have been developed to assess forestry and agriculture practices.
- Calculators can work at landscape/project scale and cover crops, livestock and forests.
- Various reviews have been carried out and it is important for Ghana to continue to evaluate advances and new tools/calculators as they emerge. There is ongoing and active development of calculators and tools.
- Calculators focus on hotspots, areas where change is detected, and can be used to provide estimates where they are needed.
- It is impossible to do a straight comparison between estimates over time for the same area/sector using different calculators. The tool for calculation must be consistent between estimates.
- Mr Boakye worked through a table of GHG Calculators, interacting with the participants and described the steps for choosing a GHG Calculator or tool.

5.1 Notes and Questions

1. Can the strengths of different tools be combined?
    a. In principle yes this is possible, and has been done (eg FullCAM in Australia). Would need to be careful to understand clearly the origins and intent of the tools being considered so that their requirements are understood – for example if some aspects are hard-wired into the tool that can not be adjusted.

2. What gaps and aspects need addressing? Can they be clarified and described so that they can be met?
    a. A key gap is the forest cover mapping. At present Ghana only has land cover and land cover change for 2000 and 2010 that meet the historical period of between 10 and 15 years set by the World Bank guidelines. Ghana also has 1990 which does not qualify and can not be used. The FPP analysis also did not take into account forest degradation, which is key to the REL for Ghana. . Two points in time do not describe a trend they only identify a change. Consequently Ghana needs more time slices of land cover mapping, with annual mapping being ideal but not essential. At least three time slices are required for World Bank purposes.
    b. Additionally, canopy cover has only been assessed in year 2010 therefore it is currently not possible to assess degradation from canopy cover change.
    c. The emission factors for Ghana are quite strong and sufficient for Reference Emission Level development at Tier 2 and for the first technical assessment report.
3. Apart from forestry, other sectors also have emissions – how are they calculated?
    a. They are covered by the national communication prepared by the EPA, This work on the Ghana Forest MRV is for forests. The approach and techniques could equally be applied to other sectors by using them as a template.
4. Can land cover change be detected annually?
    a. It can be done through remote sensing effectively and annually – Australia does, Indonesia is compiling an annual time series from 2000.
5. There has been a forest landscape stratification in Ghana for some time – are we using the old one or the new one?
    a. The ecozones being used are the same ones for the FPP, which are the current ones used by Ghana and is also the basis for the allometrics prepared.
    b. The ecozones have been combined into three broad classes for calculation purposes as “Wet”, “Moist” and “Dry” forests to match the National allometric equations.
    c. Some academics were trying to do a re-classification of ecozones based on current conditions of the landscape to account for some changes that have occurred.
    d. If the boundaries change then the new boundaries could be used. Any change in the designation or description would have to be ‘mapped’ to the existing stratification and to the UNFCCC land categories. If the new stratification were adopted formally and then used the calculations for GHG estimates would have to redone for the whole reporting period.
6. Could it be possible to pilot two (or more) calculators to assess them? Compare them; look at outputs and requirements for suitability and applicability?
    a. Yes, could be a very targeted exercise now that the requirements are known for REDD
    b. There are other reporting requirements that will use the same data sets that need to be consistent with each other for credibility and communication on progress to reduce emissions. So the “integration tool” needs to be adaptable enough to contribute to if not provide the figures for the range of reporting requirements Ghana has both internationally and domestically.
    c. We don’t need to deal with this separately it could be a next step to build on the work of the Forest MRV for Ghana.

6. DISCUSSIONS ON SELECTING A GHG CALCULATOR

There was a facilitated discussion on the steps and process to select the characteristics and requirements for a GHG tool/calculator for Ghana.

- What are the AIMS for the tool/calculator? The list of aims developed included users, institutions involved in development and contributors (of standards and services) as well as stakeholders with potential interests in the data:
    - Reports
        - Report for REDD+ Activities (markets and national reporting)
        - FIP, VPA, CDM, VCS

        - Project level reporting
        - FAO FRA
        - National Communication
        - Biannual Update Report
    - Users and Stakeholders
        - EPA
        - Agriculture and land use planning
        - COCOBOD
        - Ghana Statistical Service
        - Energy – charcoal
        - Ghana Standards Board
        - National Development and Planning Commission
        - Ghana Investment Promotion Centre
- Geographical Parameters – in the context of the work done on tools this is to identify if/where the tools need to be applied to national and sub-national levels and to establish if a tool can do both:
    - Financing is only to be based on a national approach, not a sub-national. The tool will need to be applicable to both to facilitate FIP/ER Program reporting
    - The spatial differentiation might be for tropical, high forest, savannah since the type of tool for calculation will likely need to be different for each.
    - Tool needs to be able to be adapted for national circumstances, not hard-wired to enable Ghana to amend, adjust and adapt the tool to fit to national circumstances.
    - Identification of urban, peri-urban and rural areas. May be useful for policy design in respect of benefit distribution.
    - Ability of scalability of the tool
    - Temperature and Rainfall – may influence tool selection; different tools for rainfall and temperature if they have limitations or bounds on the parameters they apply to
- Activity Scope – the limits or application of the tool
    - Forests for example needs to be able to calculate
        - Deforestation
        - Degradation – timber, charcoal
        - Increases in carbon stock – natural, replanting, forest management
        - Reforestation – natural and assisted regeneration, planting and plantations
    - Other Lands
        - Soil erosion
    - Agriculture
        - Cropland
            - Annual
            - Perennial
            - Tree crops
        - Grassland
            - Pastoralism
        - Agro-forestry landscapes – there is no such class in UNFCCC. Has to be either forest or agriculture, which comes to Ghana's definition of forest. So the discussion comes down to land use or land cover.
    - Mining – land use change but need to then deal with emissions as its new land use. Mining is included in Other Land in Ghana
        - Important to understand this as it is a 'driver' of deforestation
        - In supporting this sort of analysis the tool becomes an input to national decision-making, planning and policy formulation
    - Settlements

- Time and Skills – this refers to abilities in data (collection, handling, storage, standards and maintenance), software, personnel, systems development and support,
    - What tools does Ghana use already in reporting?
        - NDPC – reporting is in Excel and Word
        - RMSC: TIF database
        - FC: Wood Tracking System – integrated multi-platform tool, includes biometrics
        - ALU for National Communication by EPA
        - Universities: Crop Research – biometrics
        - Ghana Statistical Service is using FAOStats
        - FC has MSSQL; MYSQL; Web-Based M&E;
        - Energy Commission – NEDPIC
        - Tertiary Institutions – research
        - KNUST – provides software engineering degrees
- Question of where in Ghana the opportunities for applying the data obtained through GHG and MRV efforts could be realised. Which Ministry and where?
    - The national department of planning?
    - It would seem highly desirable for the GoG agencies to interact and work together to optimise the application of the data sets, tools and calculators to national purposes.
    - The structure in place sees EPA as the coordinator for GHG etc under the Ministry of Environment Science, Technology and Industry.
    - Main challenge has to do with implementation and effective action for intended results.

7. SUMMARY DISCUSSION

Calculation tools could have a wide range of reporting outputs and contributions they can make. They could be of value to a wide range of stakeholders. At the national level for land use planning the products, tools themselves and the data they apply could be very valuable.

Any tool needs to be able to report at a national and sub-national level and have use outside of the emissions estimation and potentially outside of Ghana.

The tool(s) are needed to support reporting on various aspects, with REDD+ being an initial focus but others can be considered in the tool selection. There is an important and useful link between land uses and change between agriculture and forestry and reporting on policy outcomes. This may in part be able to set out the change due to drivers of change. Keeping in mind the potential for tools to contribute in these ways will assist in selection of the most suitable tool(s), noting there is potential for tools to be updated, improved and replaced over time [critically meaning that the national account would have to be able to be recalculated from its beginning if the change necessitated that].

7.1 Summary Outcomes

1. There is a need for a calculation tool to meet Ghana's reporting purposes
    a. ACTION TO BE TAKEN
        i. Review of the available tools in use in Ghana that meet the requirements identified
        ii. Identify local expertise for development of tools/calculators
        iii. Develop a ToR and create tool(s)
        iv. Monitor what is taking place internationally and communicate progress and steps to others
        v. Formalising the institutional arrangements for the tool/calculator
2. Reporting requirements are both national and sub-national

3. The data collected will have wider use and value beyond the agencies mandated for collecting it, such as the Forestry Commission, COCOBOD, Agriculture, Soils Research Institute and so on. Hence the relationships of stakeholders need to be effective – this is an ongoing process and may need wider consultation among stakeholders.
4. Relationships between agencies are not active and strong – it is lacking. The EPA play a vital role in coordinating and ensuring the structures are in place. Implementation remains to be effectively done.
    a. The existing relationships that surround the preparation of the National Communications (cycle, MOUs, etc) is a model that could be used to stimulate wider engagement on the broader potential of the data sets, tools/calculators and outputs from the national MRV system.
5. The tool can be developed in Ghana with Ghana resources in-country. There are some strong software development firms in the country. Look outside only if the capacity is found to be limited or unavailable or for review and guidance.
6. Dissemination of the information is a critical issue. Recipients to be identified and the means of addressing them to be established.
    a. There is a piece of work being carried out on REDD+ Communications under the FCPF.
7. Data gaps (Activity Data) need to be addressed.
8. Scalability – the program should be set up in a way that it can include more activities and also be adaptable (to additional/new data, tools, methods, etc).
9. Transparency relates to the need to be able to be 'transparent' about how the account was prepared. The exposure of the data, methods and process publicly is a matter for government, noting that the report submitted to the UNFCCC will be posted on a website and be generally available.
10. The report on benefit sharing has been delivered and proposes a body for the oversight of the verification of the emissions reduction and therefore qualifying for 'benefits' from that. It is important that the resolution of information required to substantiate the emissions reduction is accommodated by the Forest MRV approach and design requirements.
    a. **ACTION**: follow up to obtain an understanding of the framework that is proposed and the requirements that might be necessary.
11. These steps could be considered under the FIP where all sectors in the landscape are working together on the program.

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Appendix 1

Workshop Agenda

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

17th June 2014

MRV System Development Ghana - Roundtable discussion on Tier 2 calculation tools/databases

Background

The project team of Indufor Oy, Geo-Information Systems Developers and Forest Consult have been working to design and document the MRV systems to enable REDD+ reporting for Ghana.

This workshop on Tier 2 calculation tools/software is designed to be an interactive discussion on meeting the needs of Ghana's reporting system to the UNFCCC and also consider how this may assist other reporting requirements.

Objectives

- To give an update of the MRV design team progress
- To explain how Ghana is meeting IPCC Approach 3, Tier 2 reporting requirements
- To discuss design requirements for Tier 2 integration/calculation tools
- To assess the capacity within Ghana to develop such a tool

Agenda

10.00am Welcome and Opening Introductions (Edward Obiaw)

10.15am Workshop aims and Objectives (Carly Green)

10.30am Update on designing and documenting Ghana's MRV system (Carly Green)

11.00am Selection of GHG Calculators for the Forest MRV (Akyeampong Boakye)

11.15am Short Break

11.30am Facilitated discussion on calculation tool requirements and in-country development capacity (Facilitator: Carly Green)

1.00pm Close and LUNCH

Appendix 2

Workshop Attendees

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

The Ghana Forest MRV Tier 2 Calculation Tools Workshop was attended by:

1. Abena Amponsa Banfi – UNEP SDC
2. Arindam Basu- Consultant G&H
3. Augustine Arthur – FC HQ
4. Ben Torgbor – FC FSD
5. Carly Green – Indfufor EAS
6. Charles Aniagyei – FC RMSC
7. Daniel Benefor – EPA
8. Donkor Emmanuel – FC RMSC
9. Edward Obiaw – FC RMSC
10. Emmanuel Opoku – FC RMSC
11. Ernest Foli – FORIG
12. John Atinga Donkor – FC WD
13. Kofi Affum-Baffoe – FC RMSC
14. Kwabena Akyeampong Boakye – Forest Consult
15. Kwame Agyei – FC CCU
16. Kwame Oduro - FORIG
17. Mohammed Yakubu – FC RMSC
18. Peter Moore – Indufor MWH
19. Raphael Yesoale – FC FSD
20. Samuel Ayensu – FC RMSC
21. William Domenu – FORIG
22. Winston Asante – KNUST
23. Yaw Atuahene – FC FSD
24. Yaw Kwakye – FC CCU

Appendix 3

Workshop Presentations

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Ghana Forest MRV

Tier 2 Calculation Tools

Aims and Objectives

- To give a brief update of the MRV design team progress
- To explain how Ghana is meeting IPCC Approach 3, Tier 2 reporting requirements
- To discuss options for Tier 2 integration/calculation tools
- To assess the capacity within Ghana to develop such a tool

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

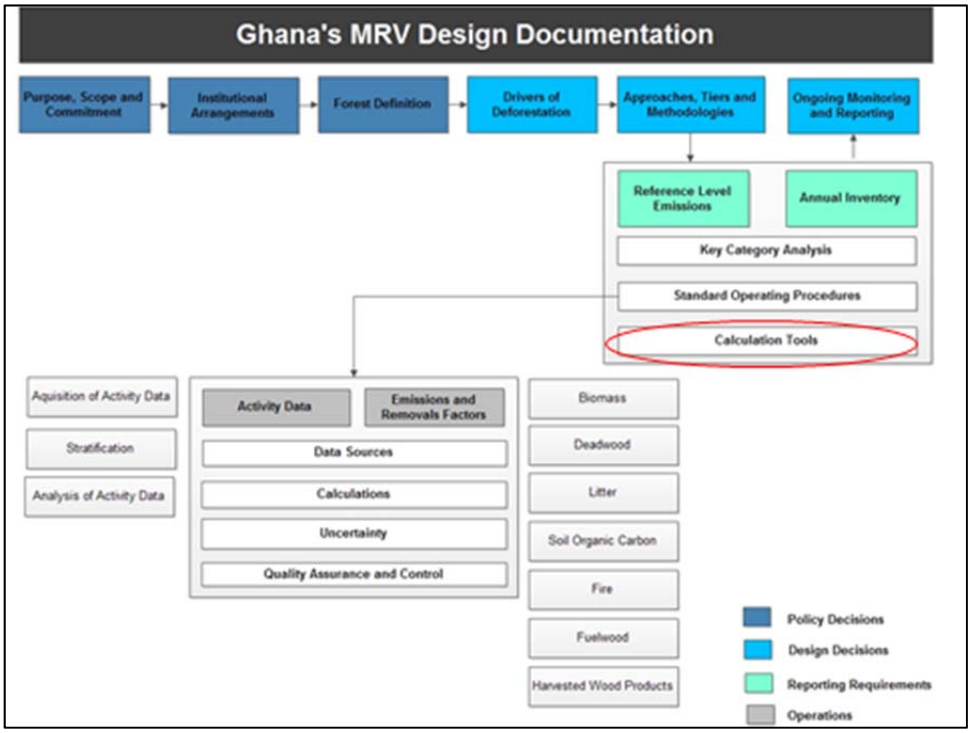
Outline

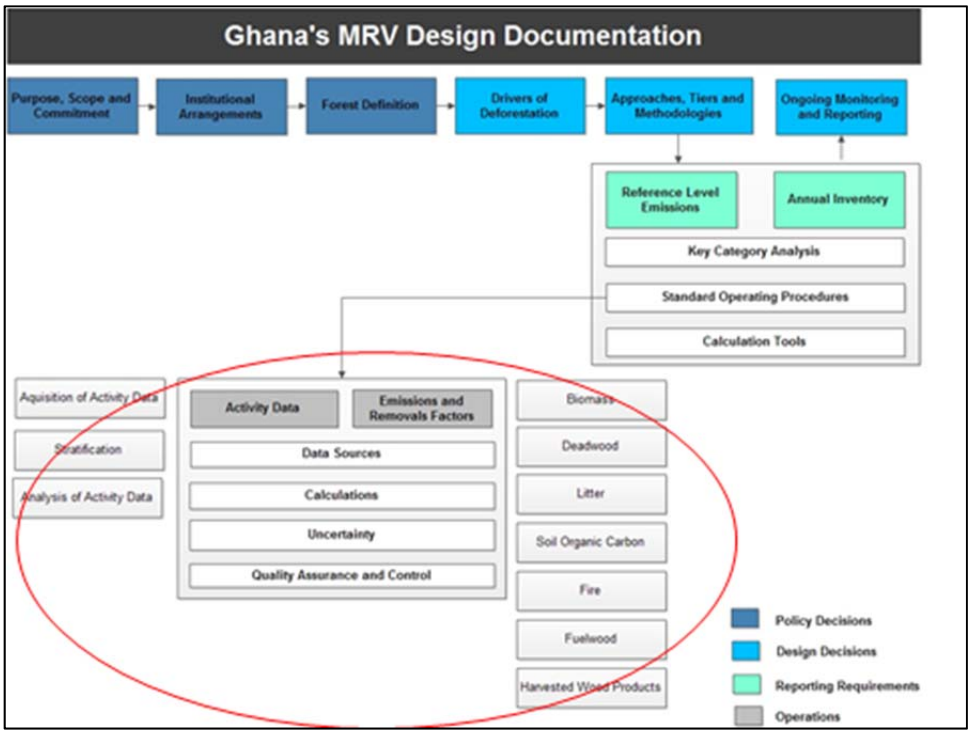
1. **Summary outline of Forest MRV system**
2. Available Tier 2 / Integration tools
3. Roundtable discussion on tool development/requirements

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult





Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Standard Operating Procedures

- Documents the calculation approach and any justifications
- Explains the use of available national data and the identifies priority areas for new data collection
- Designed to meet IPCC Approaches and Tiers to meet REDD+ reporting requirements

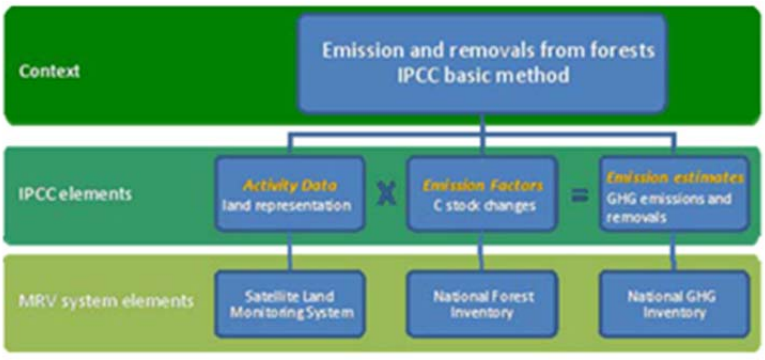
Table of Contents of SOPS

- Sources
- Summary Description
- Definitions
- Applicability Conditions
- UNFCC Specific Requirements
- Procedures
- Data and Parameters
- Quality Assurance / Quality Control
- References
- Glossary

List of Standard Operating Procedures

No	Name
001	Ghana MRV Design Document
002	Key Category Analysis
003	Acquisition of Remote Sensing Data and Generation of Activity Data
004	Stratification of Lands
005	Field Inventory Protocol
006	Estimation of Above- and belowground Biomass, Deadwood and Litter
007	Soil Organic Carbon
008	Estimation of Emissions from Forest Degradation Caused by Harvested Wood Products
009	Emissions from forest degradation caused by extraction of wood for fuel
010	Estimating National and Sub-National Reference Emission Level
011	Combining and Estimating Uncertainty
012	Calculating Ghana's Annual Forest Emissions and Removals

Simplified IPCC Methodology



REDD+ Reporting Requirements

- Activity Data
  - Requires tracking of forest lands using Approach 3 (i.e. wall–to-wall mapping)
- Emissions Factors
  - Required National specific activity data and emissions factors (Tier 2 or Tier 3)

IPCC - TIERS

IPCC classifies GHG accounting using three approaches called Tiers 1, Tiers 2 and Tiers 3

- Tiers 1 global default factors provided for large eco-regions of the world
- **Tiers 2 country or regional specific data**
  - **Most developed countries report using Tier 2 approaches**
- Tiers 3 detailed approach usually including biophysical modeling of GHG processes
  - Only Australia and Canada report using Tier 3 approaches

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

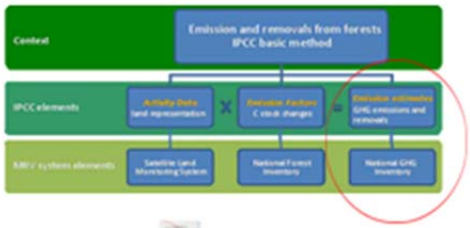
ForestConsult

Ghana's MRV Strengths

- Strengths
  - Significant body of country specific emissions factors
  - Use appropriate Approaches/Tiers for REDD+ reporting (Approach 3, Tier 2)
  - Uncertainty assessment
  - In-country experiences of wall-to-wall mapping and capacities gained from FPP process
  - Well documented methodology including justification for data and documented areas for priority improvement

Ghana's MRV Opportunities

- Opportunities
  - Improve gaps and inconsistencies in national activity data
  - Develop an integration (Tier 2 calculation tool) to meet forestry reporting requirements



Summary

- Ghana is designing and documenting its MRV system
- The system will meet REDD+ reporting requirements (Approach 3, Tier 2)
- There are some data gaps that have been identified and recommendations made
- A calculation tool/software is required and the this tool could/should also meet broader Forestry reporting requirements for Ghana.

Outline

1. Summary outline of Forest MRV system
2. **Available Tier 2 / Integration tools**
3. Roundtable discussion on tool development/requirements

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

SELECTION OF GHG CALCULATOR FOR THE FOREST MRV

BY

KWABENA AKYEAMPONG BOAKYE

11/ 06/14

GREENHOUSE GASES (GHG) CALCULATORS

- Presently many GHG tools have been developed to assess agriculture and forestry practices
- Denef et al. (2012) classify these tools as: calculators (i.e., automated web-, excel-, or other software-based calculation tools), protocols, guidelines and models.
- These calculators have a limited complexity and must be considered as decision supporting tools for policy makers and project managers

NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

GHG CALCULATORS

- Calculators work at landscape/project scale, including several productions: crop, livestock and forest.
- Review by Colomb et al (2012) identified eighteen (18) major calculators amongst them EX-ACT, ClimAgri®, Cool Farm Tool, Holos, USAID FCC and ALU.
- These identified calculators have been tested and analysed according to several criteria.

GHG CALCULATORS

- Calculators are developed following different approaches(objective, target, geographical coverage) and these factors help user to choose the most suitable for its needs
- These calculators are able to identify hotspots (except emissions from land use change that are often ignored) and provide results in tonne of CO_2 equivalent (tCO_2-eq)
- It is impossible to do a straight comparison between studies done using different calculators.

NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

GHG CALCULATORS

For our case major hotspots which deserve special focus in GHG assessments and calculators are:

- **Forest: soil carbon, plantation vs natural forest, land use change**

GHG CALCULATORS

OBJECTIVE OF THE USER	DESCRIPTION	OBJECTIVE OF TOOL	CALCULATORS AND GEOGRAPHICAL ZONE OF APPLICATION
Raising awareness	simple calculators, no training required, limited scope, reveal main hotspots, not solution oriented		Carbon Calculator for New Zealand Agriculture and Horticulture (NZ), Cplan v0 (UK); Farming Enterprise GHG Calculator (AUS); US cropland GHG calculator (USA).
Reporting	The aim is to describe and analyse in detail the current situation. These calculators were created to provide values for reporting, to allow comparisons between countries or farms based on a common basis and to help decision makers to elaborate adapted policies. These calculators take into account the full diversity of management practices in each area or farm	Landscape tools	ALU (World); Climagri (FR), FullCam (AUS)
		Project tools	Diaterre(FR); CALM (UK); CFF Carbon Calculator (UK);IFSC (USA)

GHG CALCULATORS

OBJECTIVE OF THE USER	DESCRIPTION	OBJECTIVE OF TOOL	CALCULATORS AND GEOGRAPHICAL ZONE OF APPLICATION
Project evaluation	Calculators for project evaluation compare a baseline to a "with project" situation. They can be split in between two sub categories, depending if they are carbon market oriented	Focus on carbon credit schemes	Farmgas (AUS), Carbon Farming tool (NZ);Forest tools : TARAM (world), CO2 fix (world)
		Not focus on carbon credit schemes:	EX-ACT (World);US AID FCC (Developing countries), CBP (World), Holos(CAN), CAR livestock tools(USA)
Market and product oriented tools	These calculators provide GHG results per product. The aim is to compare different products rather than assessing a territory. This allows to compare emissions for a similar level of production (avoid leakage). The results are expressed as quantity of GHG per kg of product.		Cool farm tool (World); Diaterre (FR), LCA tools and associated database (SimaPro, ecoinvent, LCA food etc: mainly

Suggested steps with feedback for choosing GHG calculator

1. AIM: Raising Awareness, Reporting, Project evaluation, Product /market oriented

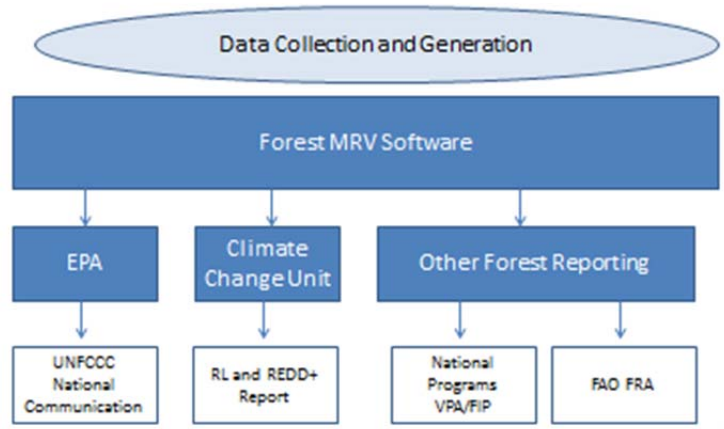
2. Geographical Perimeters: Temperate/ Tropical/ Sub-tropical/ Semi-arid/ Boreal

GHG calculator

3. Activity Scope: Crops/ Livestock, Greenhouses/ Forest/ Fuel etc

4. Time and Skills: Availability

Design Framework for Consistent Reporting



CONCLUSION

- From the literature ***"Review of GHG Calculators in Agriculture and Forestry Sectors"*** only the USAID FCC is recommended for use in the developing countries.
- Need to develop software to be run by Forestry Commission
- Require linkages with the National GHGI reporting led by EPA, and also reporting to FAO/FIP/VPA

Outline

1. Summary outline of Forest MRV system
2. Available Tier 2 / Integration tools
3. **Roundtable discussion on tool development/requirements**

Discussion

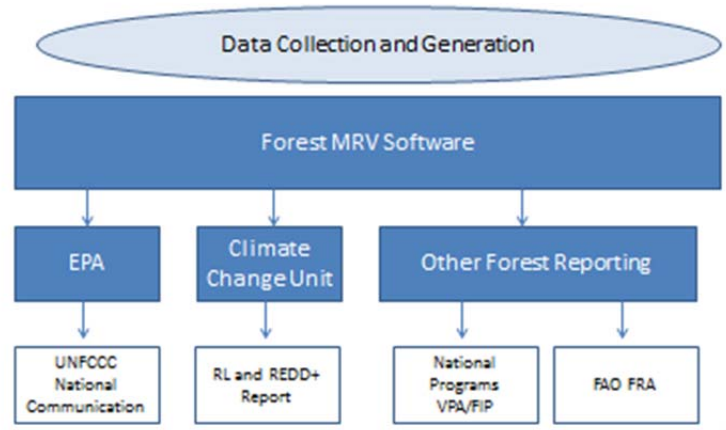
- Over to you now?

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Design Framework for Consistent Reporting



Considerations

- Inventory databases/software currently being used
- Compatible with existing IT infrastructure
- Flexibility to adapt and change
- Format of output data required to those with reporting responsibilities
- Public disclosure of information
- Others

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.

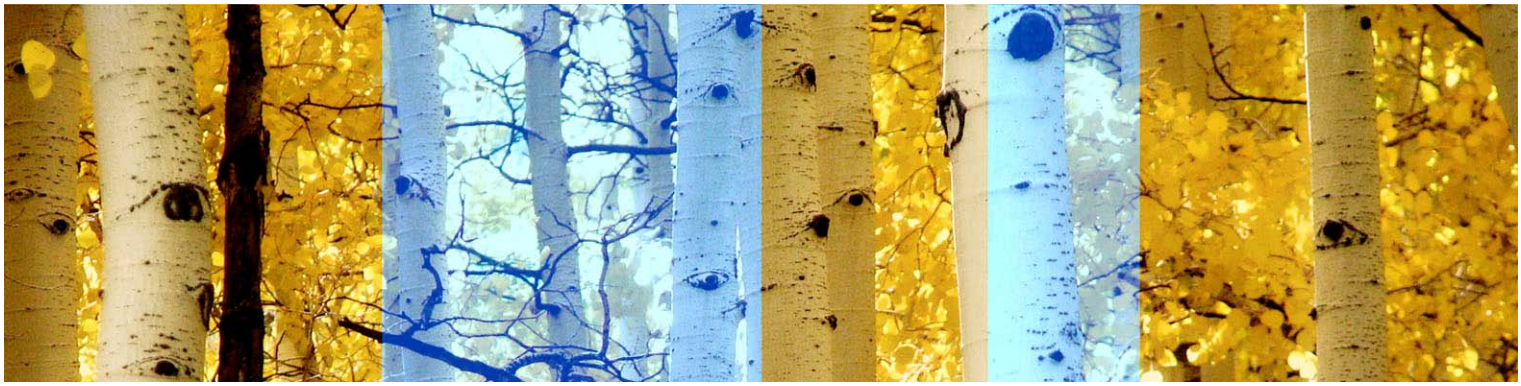
human, business, environment management with geo-ict

NO.05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Indufor Oy
Töölönkatu 11 A
FI-00100 Helsinki
Finland
Tel. +358 9 684 0110
Fax +358 9 135 2552
www.indufor.fi
indufor@indufor.fi

Indufor Asia Pacific Ltd
7th Floor, 55 Shortland St
PO Box 105 039
Auckland City 1143
New Zealand
Tel. +64 9 281 4750
Fax +64 9 281 4789
www.indufor-ap.com



Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Appendix 4

Land Cover Change 2000-2010 by Ecozone

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Wet Evergreen

Total Area (ha) 736,358

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	555,883	109,392	30,738	1,565	405	4,957	**702,941**
Cropland	3,168	1,972	926	425	3	202	
Grassland	7,799	7,472	2,043	490	12	2,564	
Settlements	-	-	-	3,760	-	-	
Wetland	254	5	114	2	1,698	13	
Other land	32	2	21	43	0	399	

Moist Evergreen

Total Area (ha) 1,832,852

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	1,282,280	391,584	33,434	4,666	755	1,513	**1,714,232**
Cropland	47,722	27,010	7,260	1,823	22	178	
Grassland	13,043	5,795	1,998	814	82	533	
Settlements	-	-	-	9,332	-	-	
Wetland	268	157	340	32	1,447	211	
Other land	73	96	51	287	9	38	

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Upland Evergreen

Total Area (ha) 62,599

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	52,096	5,118	2,091	101	-	35	**59,441**
Cropland	137	43	31	15	-	NA	
Grassland	1,190	475	356	81	-	1	
Settlements	-	-	-	571	-	-	
Wetland	16	9	-	-	3	-	
Other land	199	25	7	-	-	-	

Moist Deciduous NW

Total Area (ha) 1,558,903

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	1,128,651	152,547	34,770	1,386	227	1,374	**1,318,956**
Cropland	19,858	12,662	5,373	9,405	31	42	
Grassland	104,360	34,245	19,040	6,532	100	635	
Settlements	2	-	0	25,790	-	-	
Wetland	20	6	8	25	431	-	
Other land	866	263	83	154	4	12	

Moist Deciduous

Total Area (ha) 1,727,191

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	1,237,600	169,716	68,235	5,970	156	398	**1,482,074**
Cropland	71,389	18,956	13,950	10,077	11	14	
Grassland	41,878	17,394	15,010	9,477	72	578	
Settlements				31,451			
Wetland	114	32	129	119	5,114		
Other land	5,936	1,542	1,632	223	3	14	

Savannah

Total Area (ha) 15,429,501

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	2,110,576	112,622	339,083	578	4,773	3,191	**2,570,823**
Cropland	211,995	1,582,992	972,089	11,387	25,496	13,579	
Grassland	917,295	1,838,221	6,218,478	23,220	71,828	48,069	
Settlements	-	-	-	101,433	-	-	
Wetland	864	2,099	1,986	575	716,928	329	
Other land	3,058	4,921	86,818	44	3,066	1,908	

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Dry Semi Deciduous (fire)

Total Area (ha) 1,356,841

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	451,663	84,982	98,267	431	1,529	1,642	**638,513**
Cropland	142,650	149,572	17,293	3,842	253	243	
Grassland	80,112	94,578	172,354	4,773	977	2,617	
Settlements	-	-	-	9,056	-	-	
Wetland	0	0	3	-	34,167	9	
Other land	132	3,156	2,393	-	7	139	

Dry Semi Deciduous (inner)

Total Area (ha) 918,697

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	423,285	72,410	41,335	1,433	128	125	**538,717**
Cropland	85,814	24,225	11,173	1,978	44	18	
Grassland	70,232	66,857	61,196	10,790	512	1,126	
Settlements	-	-	-	20,809	-	-	
Wetland	355	79	1,234	97	6,839	-	
Other land	3,502	3,849	8,757	10	117	368	

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Southern Marginal

Total Area (ha) 260,084

Period 2000 / 2010	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Forest Area in 2000
Forest land	43,751	33,995	13,328	860	67	215	**92,215**
Cropland	11,784	11,298	1,793	744	2	-	
Grassland	28,656	29,126	49,422	11,615	297	2,703	
Settlements	-	-	-	13,576	-	-	
Wetland	46	25	678	1,346	2,075	4	
Other land	398	839	1,354	17	57	12	

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Land Cover Change 2000 -2010 by Ecozone

			AG*		BG		Deadwood		Soil	
Zone	**Land Use**	**Plots**	**x**	**CI**	**x**	**CI**	**x**	**CI**	**x**	**CI**
Wet	Closed Forest	35	504	1.4	86	26	276	61	328	13
	Open Forest	6	142	1.8	11	36	63	63	171	26
	Cropland	13	119	2.9	10	23	15	64	212	27
	Grassland	1	0	NA	0	NA	11	NA	NA	NA
Moist	Closed Forest	54	173	1.2	69	10	49	48	224	11
	Open Forest	31	69	1.1	35	23	52	128	201	15
	Cropland	37	68	2.1	33	19	12	85	244	8
	Grassland	1	5	NA	8	NA	0	NA	180	NA
	Settlement	1	4	NA	5	NA	0	NA	140	NA
Dry	Closed Forest	1	69	9.4	54	NA	2	NA	391	NA
	Open Forest	20	65	1	31	43	4	128	230	11
	Cropland	15	47	1.2	9	40	5	267	219	11
	Grassland	4	38	NA	1	118	2	100	264	44
	Settlement	1	0	NA	817	NA	82	NA	NA	NA

x = Mean value = t(CO_2)/ha; CI = 95-% Confidence Interval for the mean, ± %; Wet = Wet evergreen and Moist evergreen; Moist = Moist Semi-deciduous(SE) and Moist Semi-deciduous(NW); Dry = Dry Semi-deciduous (Inner Zone), Dry Semi-deciduous (Fire Zone); S = Savannah. * = Mean and confidence interval derived with LiDAR-based models (5 % sample); NA = Not sufficient field plot data available.

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Appendix 5

Costs of Data Gaps

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.
human, business, environment management with geo-ict
NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Ghana Forest MRV – Costs of Data Gaps

Increase temporal resolution (time series) to include the years 2013 OR 2014 and 2003, 2005 or 2004 for the development of the RL

The analysis of canopy cover change is currently not possible due to a lack of data in years prior to 2010. Assessment of canopy cover condition (i.e. open and closed) for all forest classes to support forest degradation reporting is a priority improvement area. At a minimum the temporal resolution of the wall-to-wall analysis should be increased to include the years 2013 OR 2014 and 2003, 2005 OR 2004 for the development of the RL.

These figures are for acquiring, preparing and validating one year of imagery. For each year the digital and desk work doubles, the field work does not. The daily rate is reflective of Ghana Consulting rates.

Steps:

1. Acquisition of satellite data for one year
   a. Data is free
   b. Mailing costs and medium of transport (hard drive etc.) [cannot be sent by e-mail]
   c. 1 day to register, justify access, identify images; place the order;
   d. Order placed with USGS directly; takes some time to fill - more than one month
   e. Costs 1 person *5 days at GHS 475 = GHS 2,375
2. Pre-processing of satellite data
   a. USGS undertake pre-processing and edge-matching, ,
   b. No time spent in Ghana
   c. 2 days to check the images at GHS 475 = GHS 950
3. Generation of the Forest/Non Forest Map
   a. 1 week for mosaicking; team of 3 = 15 days at GHS 475 = GHS 7,125
4. Collect Training Data Set – Field Work
   a. For the whole country 3 months; 3 teams of 3 people = 60 days * 3 * 3 at GHS 475 = GHS 256,500
   b. Field costs, transport GHS 10,000 fuel, allowances GHS 120, equipment;
      i. Total of GHS 2,000 per day per team IF Forestry Commission = 60 days * 3 *3 * GHS 2000 = GHS 1,080,000.
5. Develop the Forest Stratification and All Land Use Categories Maps.
   a. 2 weeks 4 people = 10 days * 4 *GHS 475 = GHS 19,000
6. Develop the Change within Forest Lands Map
   a. 2 weeks 4 people = 10 days * 4 *GHS 475 = GHS 19,000
7. Generate the Land Use Change between Forests and Other Forest Lands Map
   a. 2 weeks 4 people = 10 days * 4 *GHS 475 = GHS 19,000
8. Accuracy assessment for the inventory year
   a. 3 months (from FPP experience); 6 people
   b. For the whole country 3 months; 2 teams of 3 people = 60 days * 2 * 3 at GHS 475 = GHS 171,000
   c. Field costs, transport GHS 10,000 fuel, allowances GHS 120, equipment;
      i. Total of GHS 2,000 per day per team IF Forestry Commission – 60 days * 2 *3 * GHS 2000 = GHS 720,000.
9. Calculating Uncertainty
   a. 2 weeks 2 people – 10 days * 4 *GHS 475 = GHS 19,000

TOTAL COST ESTIMATED = GHS 2,313,950

Estimating Area of Plantations

Collection of additional data sources to allow compliant land stratification for plantations as a priority improvement area.

Steps:

1. Identify existing mapping and documentation of plantations:
   a. Obtain 2010 and 2012 plantation mapping from RMSC
   b. Source from Plantations Department of the Forest Service Division
   c. Review the materials
   d. Identify gaps and needs – gap analysis
   e. Prepare a plan to fill gaps and meet needs - plan
   f. 3 months – desktop exercise using available data from monthly and quarterly reports with RMSC and 2 at HQ (fulltime) = GHS 475 X 180 days + 10% for miscellaneous costs = GHS 85,500 + 8,550 = GHS 86,355
2. Compile the plantation data set
   a. 2 people, 2 weeks = 20 days at GHS 475 = GHS 9,500
3. Digitise the plantation data
   a. 2 people, 2 weeks = 20 days at GHS 475 = GHS 9,500
4. Generation of the Plantation Forest Map. Map plantation areas for which there is not sufficient data; will include some in gazetted areas and private areas. There will be older plantations for which records are not strong. There are also small plantations of 2-3 hectares. Commercial plantations will be well documented. Larger plantations can be isolated on the image through textural differences. Small, local plantations less clearer and more difficult.
   a. 2 weeks 4 people = 10 days * 4 *GHS 475 = GHS 19,000
5. Conduct accuracy assessment for the Forest Plantation Map. Ground-truthing to confirm the area as plantation and not tree crops of various kinds (cashew, mango, etc.)
   a. For the whole country 2 months; 2 teams of 3 people = 40 days * 2 * 2 at GHS 475 = GHS 76,000
   b. Field costs, transport GHS 10,000 fuel, allowances GHS 120, equipment;
   c. Total of GHS 2,000 per day per team IF Forestry Commission – 40 days * 2 * 2 * GHS 2000 = GHS 320,000.
6. Design and propose processes, standards and reporting of plantations for the future that consistently provides the data required for the Forest MRV.
   a. Encourage registration and reporting of basic information about all plantations
   b. Transition spatial information to GIS form
   c. 3 months – desktop exercise using available data from monthly and quarterly reports with RMSC and 2 at HQ (fulltime) = GHS 475 X 180 days + 10% for miscellaneous costs = GHS 85,500 + 8,550 = GHS 86,355

TOTAL COSTS ESTIMATED = GHS 587,729

Note that supporting forest degradation and reforestation reporting is a priority improvement area as indications from existing activity data suggest forest degradation is a significant source of emissions and reforestation a significant source of removals in Ghana.

Steps:

1. For reforestation in Ghana this is mainly plantations
   a. Enrichment planting is uncommon and done randomly and will get picked up by general forest mapping
2. Degradation can best be stratified by ground verification (for fire, fuelwood, logging, etc.)
   a. FC has logging plans and information that is spatial
   b. Illegal logging not routinely mapped
   c. Fire is not routinely mapped, within forests this may be difficult in any case
      i. MODIS burnt area product is a possible option to be explored and added as a SOP if it is operationally feasible
   d. Fuel wood data is not collected spatially as such with monitoring by volumes transported past points or from areas or regions.
3. From the biomass fuelwood harvesting will be captured from forest assessment. The energy part will be captured by the energy sector.
   a. Closed forest to open forest; closed forest to grassland; may all be degradation.
   b. So which driver is responsible? Fuelwood, farming, logging, fire etc.
   c. So need ground verification
      i. During FPP divided Ghana into pockets by grids
      ii. Teams sent in to survey the reasons for change
      iii. This was to establish accuracy of land use mapping
      iv. Same approach can be used for confirming degradation.
   d. For the country 4 months; 3 teams of 3 people = 80 days * 3 * 3 at GHS 475 = GHS 342,000
   e. Field costs, transport GHS 10,000 fuel, allowances GHS 120, equipment;
      i. Total of GHS 2,000 per day per team IF Forestry Commission = 80 days * 3 *3 * GHS 2000 = GHS 1,440,000.
   f. During this phase train district staff in the survey
4. For sustainability needs to formulate District teams, stock survey teams to be used or range supervisors if not to collect information as part of monthly reports on
   a. Cover type – description,
   b. Socio-economic data – farming, fuelwood, fire as a factor, mining,
   c. This becomes part of routine work
   d. There will be a process of check measuring and QA/QC
   e. Other possible groups include CREMA, CFC, CBOs

These costs are preliminary. The total is GHS 1,782,000

Indufor ...forest intelligence

Geo-Info Systems Developers [GISD] Ltd.

human, business, environment management with geo-ict

NO. 05, NII KPAKPA-BADU ROAD, ZERO/C-CONNIE JUNCTION, NORTH GBAWE, GA SOUTH MUNICIPAL
PO BOX ML19, MALLAM, ACCRA-WEST [+233 (0)302 330488; mobile +233 (0)244 238845]

ForestConsult

Indufor Oy
Töölönkatu 11 A
FI-00100 Helsinki FINLAND
Tel. +358 9 684 0110 Fax +358 9 135 2552
indufor@indufor.fi

Indufor Asia Pacific Ltd
7th Floor, 55 Shortland St, PO Box 105 039
Auckland City 1143 NEW ZEALAND
Tel. +64 9 281 4750 Fax +64 9 281 4789
www.indufor-ap.com

Indufor Asia Pacific (Australia) Pty Ltd
PO Box 425
Flinders Lane, Melbourne VIC 8009 AUSTRALIA
www.indufor-ap.com