MINUTES FOR REDD+ TECHNICAL WORKING GROUP HELD AT MASADA HOTEL IN NAIVASHA ON 29TH AND 30TH NOVEMBER 2017.

REPUBLIC OF KENYA

Ministry of Environment and Natural Resources

Kenya Forest Service

Programme for REDD+ Technical Working Group Meeting

Date: 29th and 30th November2017

Venue:Masada Hotel, Naivasha

Purpose: Discussion on Kenya's FRL report and Confirmation on establishment of NFMS in Kenya

Day 1	Topic	Contents	Presentation
9:00-9:10	Opening remarks		Mr. Alfred Gichu
9:10-9:30	Review of last TWG meeting	・Confirming of minutes of last TWG meeting(July)	Mr. Alfred Gichu
9:30-10:30	Scope of REDD+ Activities	・Deforestation, Forest Degradation, Sustainable Management of Forests and Enhancement of Carbon Stocks	Mr. Alfred Gichu
10:30-11:00	Tea Break		
11:00-12:00	The Mapping Process	・Summary of the mapping process ・Past TWG Decisions to support AD development ・Change reference period	Ms. Faith
12:00-12:20	Plenary		
12:20-12:50	AD Statistics generated for the Reference Year	・Land Cover / Land Use ・Land Cover Change / Land Use Change	Ms. Faith
12:50-13:00	Plenary		
13:00-14:00	Lunch Break		
14:00-14:30	Change Detection	・Major observations	Ms. Faith
14:30-14:40	Plenary		
14:40-15:10	Historical Emission estimates	・The method of Calculation on historical Emission estimates	Mr. Kazuhiro YAMASHITA
15:10-15:25	Plenary		
15:30-16:00	Tea Break and End of Day One		
Day 2	**Topic**	**Contents**	**Presentation**
8:30-9:00	Kenya's National circumstance	・Result on National circumstance study in Kenya	Mr.Fredrick
9:00-9:30	Plenary		
9:30-10:00	FRL setting	・The method of FRL setting ・Confirmation of the FRL figure	Mr.Kazuhiro YAMASHITA

10:00-10:30	Plenary		
10:30-11:00	Tea Break		
11:00-11:30	FRL Report	General Format and Table of Contents	Mr.KazuhiroYAMASHITA
11:30-11:50	Plenary		
10:30-11:00	Tea Break		
11:50-12:20	Development of NFMS	・Achievement and next process on NFMS	Mr.Kazuhisa Kato
12:20-13:00	Plenary		
13:00-14:00	Lunch Break		
14:00-14:30	Development of FIP	・Progress of FIP development	Mr. Ishizuka
14:30-14:50	Plenary		
15:00-15:30	Tea Break and End of Day Two		

PARTICIPANTS LIST OF THE TECHNICAL WORKING GROUP MEETING ON FRL SETTING FOR 29TH AND 2017

	NAME	ORGANIZATION		
1	Peter Nduati	KFS		
2	J.K Ndambiri	KFS		
3	S.K Kahuri	KFS		
4	Faith Mutwiri	KFS		
5	Maurice N. Otieno	NEMA		
6	Julius Muchemi	ERMIS AFRICA		
7	George Tarus	KFS		
8	Kioko Nzioka	KFS		
9	Charles Mundia	DeKut		
10	James M Kimondo	KEFRI		
11	Margaret M.Ouma	DRSRS		
12	David B. Adegu	MENR/CCA		
13	Felix Mutua	JKUAT		
14	Phobe Oduor	RCMRD		
15	Mwangi Githiru	Wildlife Works		
16	Peter Ndunda	WRI		
17	Mwangi Kinyanjui	Karatina University		
18	Dr. Eng. Benson Kenduiywo	JKUAT		
19	Alfred Gichu	KFS		
20	Richard Mwangi	KFS		
21	Kenichi TAKANO	CADEP-SFM		
22	Kei SATO	JICA consultant		
23	Shintaro ISHIZUKA	JICA consultant		
24	Kazuhiro YAMASHITA	JICA expert		
25	Kazuhisa KATO	JICA expert		
26	Sahori FUJIMURA	JICA Expert		
27	Florence Tuukuo	JOFCA- CADEP _SFM		
28	Merceline Ojwala	DRSRS		

PARTICIPANTS LIST OF THE TECHNICAL WORKING GROUP MEETING ON FRL SETTING FOR 30TH NOV. 2017				
	NAME	**ORGANIZATION**	**TEL.**	**EMAIL ADDRESS**
1	Peter Nduati	KFS		
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26	Sahori FUJIMURA	JICA Expert		
27	Florence Tuukuo	JOFCA- CADEP _SFM		
28	Merceline Ojwala	DRSRS		
29	Fredrick Mokua	GEO- ENVI Solutions		

DAY 1: 29TH NOV 2017

MIN 1/29/11/2017 OPENING REMARKS

The meeting started at 9:10 am with Mr. Gichu (National REDD+ Coordinator) requesting Serah Kahuri to begin with a word of Prayer. This was followed by self-introductory session.

Mr. Gichu said that the two-day meeting was organised to delve into issues that required attention of TWG members after which concrete decisions can be made to aid in carrying out more activities. He supposed that two items would be discussed during the two days i.e. Forest Reference Level (FRL) and National Forest Monitoring Systems (NFMS). The Ministry of Environment and Natural Resources (MENR) has already given early notification to UNFCCC for Submission of FRL for Assessment in March 2018 thus the document should be submitted by January 8th 2018 and this document will be the basis for REDD+ operations.

MIN 2/29/11/2017. Confirming of minutes of last TWG

The Minutes were proposed by Felix Mutua and seconded by Dr. Mwangi.

MIN 2.1/29/11/2017 Matters arising

1. Corrections: - Mr. Jamleck Ndambiri noted that his name was missing
   - Agenda items was also missing
2. A suggestion was raised to leave out names but capture the issues that come out of the discussions which was agreed upon by the TWG members.
3. Another proposal was made for consideration of Standard Operating System for KFS.

MIN 3/29/11/2017 Scope of REDD+ Activities

Presented by Alfred Gichu

He gave an outline of the objectives for REDD+ activities in Kenya by identifying four major areas of focus that are driven by what we see as drivers of Forest Cover change.

I. Conversions to other covers which is deforestation.
II. Forest degradation
III. Sustainable Management of Forests
IV. Enhancement of Forest Carbon stocks.

The program is not able to report on what is happening in other processes and thus knowledge on what other processes are doing is important e.g. GHG in SLEEK. The work done under SLEEK is being used to inform the REDD+ process.

MIN 4/29/11/2017 The Mapping Process

Ms. Faith took the TWG members through the mapping process, she stated that Mapping work was done earlier to support SLEEK where it would be used to establish a robust Measurement, Reporting and Verification (MRV) system so as to track land based emissions. The mapping team which constituted members from the various institutions followed guidance of technical and process manuals to produce Land cover and Land Change information for national greenhouse gas estimation. After going through trainings that were supported by Commonwealth Scientific and Industrial Research (CSIRO) and Food and Agriculture Organization of the United Nations (FAO) the team kicked off with the mapping process. Steps followed included:

MIN 4.1/29/11/2017 Testing of classification techniques

Various classification techniques that had been used by different organizations were tested and the mapping team settled on Classification using Random forest, it was chosen because it is:

i. Open source
ii. Store probability's
iii. Accurate
iv. Easy to implement

MIN 4.2/29/11/2017 Data selection criterion

i. Cloud cover_ desired 0% cloud cover but low cloud cover 20 % is acceptable.
ii. Season _ dry season which is January to February and July to August.
iii. Sensor_ Landsat 5, Landsat 7 SLC-on and Landsat 8 were preferred over Landsat 7 SLC-off.
iv. Date_ Dates of neighbouring scenes were considered

MIN 4.3/29/11/2017 Data Preparation

This included cloud and shadow masking, Terrain illumination correction, projection to the Kenyan Coordinate system and Land Use Land cover classification by making classes for Land Cover Change mapping, these classes are; Forest, Cropland, Grassland, Wetland, Settlement and Otherland this was then followed by stratification in spectral stratification zones based on Kenya Agro-ecological zones.

MIN 4.4/29/11/2017 Classification using Random Forests.

Carried out by running R-Scripts.

MIN 4.5/29/11/2017 QA/QC of the Classification

Checking for consistency of classification results across scenes and zone boundaries. Also, carried out accuracy assessment to check for correctness of the map. Conditional Probability Network (CPN) was used to fill data gaps identified, this mathematical model uses time series maps and probability bands developed during classification. For accuracy assessment, verification survey was done by SLEEK and JICA consultant team and the accuracy was 75.1%.

MIN 4.6/ 29/11/2017 AD Statistics generated for the Reference Year

In order to determine reference year and interval, data screening was carried out which involved checking satellite imagery for stripping effect especially from May 2003, after that; certain years were recommended for based on results these were; 1990, 2000,2010 and 2014, with 10-year interval and 2014 being the latest reference year.

Images selected, had to fit into forest definition for Kenya which is described as mapping unit area of 0.5ha as the minimum, canopy cover ≥15% and based on this definition, elimination of pixels that do not fit into Forest definition was done by selecting more than 6 pixels.

Other discussions and engagement with experts of UNDP, FAO and CfRN on Activity Data were incorporated. Also, Green Climate Fund decisions at the 18th Board meeting on 30th September to 2nd October 2017 were considered. These include:

i. Less than 5yrs or More than 20yrs of reference period is FAIL
ii. 5 – 9yrs or 16 – 20yrs LOW SCORE
iii. 10 – 15yrs HIGH SCORE

From the above decisions the options available for Kenya are:

Options

1. 1990, 2000, 2010, 2014 – Previous decision

2. 2000, 2010, 2014

3. 1995, 2000, 2010, 2014

4. 2000, 2005, 2010, 2014

5. 2000, 2014

Ms. Faith explained that years 2000 and 2014 had good maps due to the data quality hence suggesting that Kenya could use the two as reference years. Option 2 was also considered however she said that 2010 had 'moderately good maps'.

Reactions

- All datasets could be plotted then compare the curve obtained with the previous one, this could be used to examine how data for the last epoch behaves in comparison to previous years.
- If two points are used, average method is appropriate to apply but for more than two points regression method is appropriate. Average method prevents complications.
- Should there be interval equality and is an average of 5 years adequate? Mr. Kinyanjui responded that its not necessary to have equal intervals but uniformity is key.
- A concern was raised whether year 2003 or 2002 could be used since they also have good maps suggesting that using more than two points would increase accuracy, the response given was that it is not possible to pick changes within a very short period hence 2000-2003 will not be suitable to use.
- Do average values for 2, 3 or 4 points would be different telling the TWG members to consider country trend also adding that change detection, analysis and accuracy assessment take a lot of time and therefore replacing the data would be quite involving.
- An explanation was that Reference level informs how REDD+ will be implemented and sets a basis for the strategy where after 4 years, assessment will be done to determine emission reduction value. This led to two scenarios; selection of option 2: 2000,2010 and 2014 or Option 5: 2000 and 2014.
- TWG members after closely looking into the two options decided to take up Option 5.
- On AD statistics: Stratification with forest classes in Kenyan context was adhered to after which sum area change is established.
- If possible breakdown exactly where the changes occurred and thus be able to explain about the situation on the ground. Data could be obtained from KWS to identify what happened to animal population in the period of interest.
- A suggestion to get to the ground which could help in differentiating between grassland and woodlands from forest.
- FAO opined that the changes do not seem realistic hence errors of commission and omission could be addressed after which values will be calculated based on technology issues like Reflectance problem.
- The source of problems could be definition of classes and technology issues thus open grassland should be separated from wooded grassland then introduce Emission Factor on wooded grassland. However, this is possible if the available data can be utilised.
- Supposition that no country has perfect Activity Data but if a country is able to explain the causes of incorrect data e.g. the 25% for Kenya then Assessment will be successful.

CONCLUSION

A decision was made that challenges encountered in selecting reference points should be well described in the report hence satisfy international bodies that could raise issues and concerns on the data. This will also allow Kenya to get support for generation of more data.

MIN 5/29/11/2017 Historical Emission Estimates

Mr. Yamashita explained how Emission Estimates were for three- year points and two-year point by comparing FRL values for different reference years from 2000 to 2014 by average method.

- By three points

Period	2000-2010	2010-2014	2000-2014
FRL (tCO_2/year)	-7,374,735	-7,374,735	-7,374,735

- By two points

Period	2000-2014
FRL (tCO_2/year)	-7,369,087

He then explained that that emissions are estimated by multiplying Activity data by Emission Factor

Emission estimates were then broken down for monitoring Land Cover Land Use changes by use of REDD+ Activities considered in the case of Kenya i.e. Deforestation, Forest Degradation, Sustainable Management of Forests and Enhancement. The values that make up the activities were clearly exemplified which was also aided by use of different colours for each activity in a matrix format.

Reactions

From the presentation, some figures were not very realistic and this led to questions as to whether the results were correctly calculated.

Conclusion

The experts team from Japan guaranteed to look into the data again after which they would give clear results the following day of the meeting.

The meeting was adjourned at 4.00 pm.

Day 2: 30th November 2017

MIN 8/30/11/2017 Recap of Day 1

The meeting kicked off at 8:55 am. Mr. Gichu (Chairman of the day) invited Mr. Nduati to do a recap of the discussions from the previous day.

Mr. Nduati summarized by saying that the discussions were majorly on the changes that have to be taken up due to GCF decisions during its 18th Board meeting where the TWG meeting had decided to settle on 2000 and 2014. As for reporting on Forest Reference Level for Kenya he stated that it would be later well understood after presentation on National Circumstances. However, he pointed out time constraints explaining that the document has to be ready for Quality Assessment and Quality check (QA/QC) by external experts before submission to the UNFCCC on 8th January 2018.

Mr. Gichu added that work still needs to be done on AD which means technical discussions shall continue to support the efforts to develop a reference level that is appropriate for Kenya.

MIN 9/ 30/11/2017 FRL SETTING

Mr. Yamashita took TWG members through the procedure to be followed for setting Forest Reference Level for Kenya. Activity Data and Emission Factor shall be used to calculate emission estimates by either Use of Average method or National Circumstance method.

AD: To be made by Land Cover Land Use change map data calculated by the Land Cover /Land Use maps in the different points of time for each period expressed in ha/yr.

EF: To be acquired by the default data from IPCC 2006 guidelines or country data which is from Forest Inventory expressed as tCO_2/ha

Using a matrix to illustrate changes from one forest type to another, REDD+ activities were well captured to depict the transitions that have occurred within the reference period. The exact figures within the forest area were clearly explained by breaking the matrix into AD and EF figures, then multiplication of these figures resulted into emissions estimate delineating emission/removal in the amount of CO_2 as weight per year in ton/year.

Explanation of how Forest Reference Level will be set;

i. **Average Method**

FRL will be set by each year which shall be provided by reference period. The average value for emission estimates in different years will be the basis of projection for National Circumstances. However, if National Circumstance is not projected, the average value will be FRL. By this method, emission estimation figures for each REDD+ activity are as shown below:

Period	
Deforestation	20, 254,838
Forest Degradation	2,883,723
Sustainable Management of Forests	-787, 332
Enhancement	-29,720,316
Total (Emission Estimates/ Net)	-7,369,087
FRL	**-7,369,087**

ii. FRL Setting by National Circumstance

National Circumstance can be projected by calculation taking historical trend as average method. Forest Reference Level will be set with the result of analysis for National Circumstance. This was also illustrated by use of graphs.

Reactions

According to historical average, Kenya is currently at Removal of -7million tCO_2/year, in order to receive finance based payments, removal must go below this current average value hence as it is linear projection is the maximum that can be depicted for removals.

Solution to dryland problem could be using a scientific method to support separation of grassland into open and wooded grassland then establish an Emission Factor.

Introduction of a scientific approach will lead to a lower reference level hence the most important COP decisions should be taken into account these are: Decision 4/CP15, Decision 1/CP 16, Decision 12 /CP 17 and decision 13/ CP. 19.

Decision

With these discussions it was decided that a sub-group was necessary to form so that they could look keenly into the data and clean it up, the members of the sub- group were:

1. Dr. Kinyanjui
2. George Tarus
3. Faith Mutwiri
4. Mr. Yamashita
5. Dr. Kimondo
6. Peter Ndunda
7. Serah Kahuri
8. Mwangi Githiru

MIN 10/ 30/11/2017 FRL REPORT

This was presented in two sections:

1) Documentation Process

An outline of the schedule for development and submission of Forest Reference Level to United Nations Convention on Climate Change. This also included overview table of Technical Assessment time frames for 2018/2019.

2) Table of contents of FRL Report

An overview of what the FRL document entails.

MIN 11/30/11/2017 Kenya's National Circumstance

Presentation by Mr. Mokua

This highlighted focus areas for National Circumstance consideration. Forests have a variety of benefits to Kenya's population and this is as a result of the people being within the forest area where the benefits are direct or by indirectly using resources acquired from forests. The current status of Kenya's Forests 6.99% of total land area by 2010 where they are categorized as Montane, Western rainforest, Bamboo, Afro-montane undifferentiated forest, Coastal and Dryland forests. However major changes occurring within the forest area can be captured by considering National Circumstance which include:

a) Forest Sector Governance

b) Economic Profile

c) Energy Management

d) Infrastructural, and industrial developments

e) Agricultural Development

f) Forest Management

g) Development Priorities

Under each circumstance detailed discussion was given of what they entail.

Forests in Kenya are managed by various institutions. These was explained in the following sections:

i. Forest types,
ii. Forest policy, legislation and strategies;
iii. Forest management practices
iv. Forest management challenges and future scenarios

Also included was the forest types in Kenya, the region in which they are found and drivers of change for the forest types.

Reactions

- Mr. Mokua was advised to look at Forest Act 2016 and National Land policy which his presentation seemed to have left out.
- This projection with National Circumstance should enable the government to make decisions on the opportunities that can be used to improve specific functions devolved to county governments.
- Government commitment is lacking and also community role in conservation.
- Interrogate areas that have been left out like Forest Finance to identify opportunities available to drive National Circumstance, also public private partnerships to see how it plays out nationally especially on research and technology.
- Compliance and governance – National Circumstance should show how it has played out and how its relevance should come out clearly. Kenya Forest Service has strong enforcement unit and other organizations too have units that deal with forest governance but are not directly related to other sectors hence policies should form the basis for projection.
- Should the work that has been done through geo sciences be included in National Circumstance and projection for instance use the data available and also other global instruments apart from Sustainable Development Goals like United Nations Forum on Forests.
- Is possible to use new data and re-do the projection work as a result of the decision to use 2000 and 2014 as the reference years.
- The current projection is using regression model but according to GCF scorecard, Historical Annual Average should be used, it is possible to make projections if two intervals data is available for example 2000-2010 and 2010 -2014.
- The relation between focus areas and how they affect forest sector changes is not very clear. Emission Factor has been captured in other areas and projection has borrowed from it.
- How will policy conflict be addressed? The 10% outlined in the Constitution of Kenya 2010 shall comprise of contribution from the various sectors but implementation in all sectors is

dependent. National Scale depends on involvement of all sectors but for now the focus is on the forestry sector.

- Is it possible to quantify what percentages of land should be allocated for enhancement in all sectors i.e. National Spatial Plan? According to Nationally Determined Contributions, Forest Abetment total potential is 40.2% M tons, 20.1 M tons which is 50 % of total abetment is NDC target and low-level scenario 11 M tons which is 51% of 20.1 M tons and this is the current target for forest sector. NDC borrows from Climate Change Action Plan which outlines eligible areas for forest enhancement and it also borrows from other documents.

Conclusion

Projection on National Circumstance should work with data for 2000 and 2014 since including 2010 will cause complications after which TWG can be convened to deliberate on results obtained. It should be clear that NDC shall not report independently for the activities being carried out within the various sectors hence Climate Change Directorate shall combine REDD+ with other sector reports like energy and give an inclusive report.

MIN 12/30/11/2017 Development of NFMS

Mr. Kato gave a presentation on Definition of National Forest Monitoring Systems (NFMS) under UNFCCC which are guided by;

i. Decision 4/CP.15 "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"
ii. Decision 11/ Cp.19 "Modalities for national forest monitoring systems"

The two decisions are made up by various conditions which were clearly outlined by use of pictorial representation. UN-REDD NFMS strategy describes two key functions of NFMS which are; Monitoring and Measurement, Reporting and Verification (MRV) functions.

Monitoring function of the NFMS is primarily a domestic tool to allow countries to assess a broad range of forest Information, including in the context of REDD+ activities and comprises of;

- Remote Sensing
- Web Interface
- Community Monitoring
- Other monitoring systems related to Forest.

The MRV function for REDD+, on the other hand, refers to the estimation and international reporting of national-scale forest emissions and removals and it includes;

- Satellite Land Monitoring System
- National Forest Inventory
- GHG Inventory

NFMS for Kenya will be established from two aspects; Monitoring function and Data Management Function.

The monitoring function;

This will include estimation of anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stock and forest area changes and forest reference level, information of policy and measure biodiversity and registration of forest related project.

Data management Function

It is a database to input the information and data gathered by monitoring function and provide them for implementing forest management including REDD+. After determining the activities to be carried out for each function, the questions of how, who, what, where and when shall be considered such that it will be clear until completion of the functions.

The contents of the proposed NFMS document were outlined

Chapter 1	Background and Purpose	
Chapter 2	UNFCCC Requirements	
Chapter 3	Basic conditions for NFMS	3.1 Scale
		3.2 REDD+ Activity
		3.3 Forest Definition
		3.4 Carbon Pool
		3.5 Scope of GHG
Chapter 4	Conceptual design of the NFMS in Kenya	4.1 Composition of NFMS
		4.1.1 Monitoring Function
		4.1.2 Data Management Function
		4.2 Phased Approach
		4.3 Relation with Other Activities
Chapter 5	NFMS Components	5.1 Activity Data
		5.2 Emission Factor
		5.3 Forest Cover Change Monitoring
		5.4 Providing information to SIS
		5.5 Data Management System in the Forest Information System
Chapter 6	Institutional Arrangement for NFMS	6.1 Institutional Arrangement for Monitoring Function
		6.2 Institutional Arrangement for Data Management Function
Chapter 7	Calendar of NFMS	

For Kenya, the objective of NFMS is gathering accurate and transparent data and information related with Kenya forest management and providing it to inform interested stakeholders on the forest status, to report to international conventions and to make use of sustainable forest management in Kenya.

In addition, the methodologies for how the NFMS functions shall be carried out were described and in accordance with each particular activity. Also, methodology for monitoring was explained by dividing it into monitoring of AD and Monitoring of EF, AD monitoring is guided by Forest Definition, and stratification by use of class zoning while EF monitoring is done by following guidance of SLEEK procedure.

NFMS contributes to Safeguards Information Systems by providing relevant information in the following manner;

Safeguards Information System (SIS)	**National Forest Monitoring System (NFMS)**
1. Consistency with the national forest policy	Satellite analysis (AD)
2. Transparent and effective forest governance	Forest carbon stock (EF)
3. Respect for the knowledge and rights of indigenous peoples	GHG inventory
4. Full and effective participation of relevant stakeholders	Forest area change Monitoring
5. Consistency with the conservation of natural forests and biological diversity	FRL
6. Actions to address the risks of reversals	Policy and Measures
7. Actions to reduce displacement of emissions	Biodiversity
8	Project registration

Institutional arrangement will be taken into account to ensure that all items that contribute to success of REDD+ are well taken care of. Also itemised were the tasks to be carried out for NFMS development.

Reactions

- The team should read and understand the manuals to clearly differentiate M of Monitoring and Measurement of MRV,
- Has the data management function been properly defined considering it also involves reporting?
- Outline of the NFMS is good but it should be able visualize how it will work for the country since it forms the basis for other systems.
- As of now, the prototype should be out because it has been taking time thus a team to design the platform, should be composed to define what should be in the system first then develop the prototype.

Conclusion

NFMS should consider other functions of KFS and what other stakeholders do then check what other countries have done for user needs this will help to fill gaps identified. Also, consider landscape restoration and ecological dimension.

Development of FIP

By. Mr. ISHIZUKA

The Forest Information Platform will be developed to serve the following objectives:

1）To grasp the quantities of the carbon accumulation, emissions and absorption of the forest with GIS through past, present, future. （NFMS）

2）To provide the information and data which contribute to REDD＋Safeguard information system （NFMS)

3）To grasp the deforestation monitoring with the factor about the practical "Real time " timing （NFMS）

4）To Provide REDD+ strategy which can be historically grasped

5）To provide the data which contribute to draw up a forest management plan

6）To confirm the report and the verification of MRV

The following functions will help the FIP to achieve the above objectives:

i. Replacement of KFIS's functionality with the Web Portal Service with ArcGIS Enterprise
ii. Using the Portal for ArcGIS Server with limited access to the contents.
iii. Utilization of ArcGIS Online as the gateway to the accessible contents
iv. Supporting PDA devices for the data collection activities at the field
v. Supporting the other external system data with the static link

FIP comprises basic components that shall support its operation;

After accessing data from Forest Management Information System, the shape files generated are imported into database after which it is enhanced by Arc GIS online services then used for web, mobile and desktop applications.

After this a diagrammatic illustration of The FIP was shown and it incorporates data collection tools and techniques and how it will be utilised within the various organizations until it is disseminated to the public.

FIP entails 8 main components namely:

- FRL
- MRV
- Safeguards
- Forest Removal /emissions monitoring
- National REDD+ strategy and Rerated information
- Forest administrative information
- Other relevant data
- Project Registry

The FIP has four contents which can be accessed by various persons depending on access rights set. A detailed description of who has access was given in this presentation. Inventory data which shall be of most important for FIP shall be collected using Survey 123 and PDA client after which the data shall be analysed and made available to users. Within the FIP, plantation data shall be linked with shapefile data and stored in the Portal for ArcGIS.

The schedule for FIP development was given where it is to be done throughout the project life cycle and as of now program design is ongoing.

Reactions

- The platform seems to be developed in a commercial direction.; to avoid limitation to users, data can be collected using various methods where it combines Open source and commercial platforms.
- Were user needs considered, before the development of FIP, an internal team was formed to look into the needs of potential users.
- Will the FIP reside in KFS? Yes, but all other users shall also be incorporated and be able to access information.
- The system will work for KFS because it is based on GIS knowledge e.g. PDA is expensive then how shall it work for layman? Technical group should assess the operability of FIP.
- Could high cost of GIS software lead to failure in future, other data collection tools can also be used, also Survey 123 for mobile data collection.
- On sustainability of the system, is KFS able to sustain FIP after the development and can the economic side of the platform be explored to identify if it can sustain itself.
- ESRI_Arc GIS server has the capability to support interoperability in which other tools can be utilized.

Conclusion

The ideas for FIP should be shared with stakeholders who can support the system as well as the NFMS and FRL in terms of data and finances, the various decisions from the TWG were to be shared the following day with these stakeholders including work that has been accomplished for AD and EF. The National REDD+ coordinator, requested some members of the TWG to take on the task of presenting these decisions to the stakeholders.

AOB

The meeting was adjourned at 4.40 pm.

REPUBLIC OF KENYA
Ministry of Environment and Natural Resources
Kenya Forest Service

TWG MEETING – MAPPING PROCESS

ACTIVITY DATA

Date: 29th to 30th June 2017

By Faith MUTWIRI and Kei SATO

Introduction

- Mapping done in support of the SLEEK to establish robust MRV (Measurement, Reporting and Verification) system to track land-based emissions.
- SLEEK designed to track all emissions and removals in the land-sector;
- The mapping team provides land cover and change information required for national land based greenhouse gas estimation
- A multi-institutional Technical Working Group established to do the mapping,
- Work strongly guided by a Technical and process manual.

Time Series Land Cover / Land Use Map preparation

Activity Data

Capacity building

- Several trainings have been undertaken by FAO and CSIRO

1. CSIRO (Commonwealth Scientific and Industrial Research)

- ➢ Random Forest classification and scripts used in the classification
- ➢ Terrain illumination correction
- ➢ Change detection and time series

2. FAO (Food Agricultural Organization

- ➢ Accuracy Assessment
- ➢ Change detection using Google Earth Engine
- ➢ Land Cover Classification System (LCCS)
- ➢ Data collection using collect earth

Methodology

1. Testing of methods

A. Methods as used by various institutions were tested.

- **Maximum likelihood,**
- **Progressive extraction and disaggregation of land covers,**
- **Random forest classification and**
- **Decision tree classifier.**

B. Classification using Random Forest – pixel based method was selected

- **✓Open source**
- **✓Store probability's**
- **✓Accurate**
- **✓Ease of implementation**

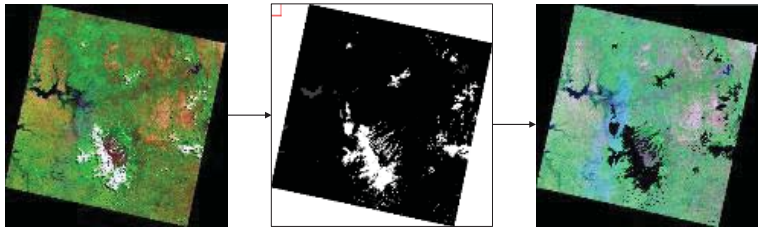
2. Data acquisition - *Data selection*

- **Cloud cover** – desired 0% cloud cover, low cloud cover (20%) is acceptable
- **Season** – dry season - January to February and July to August.
- **Sensor** - Landsat 5, Landsat 7 SLC-on, Landsat 8 are preferred over Landsat 7 SLC-Off
- **Date** - If more than one cloud-free choice is available, then dates of neighbouring scenes are considered (same-date with neighbours in the path or close date to neighbouring row will be preferred)

3. Data preparation

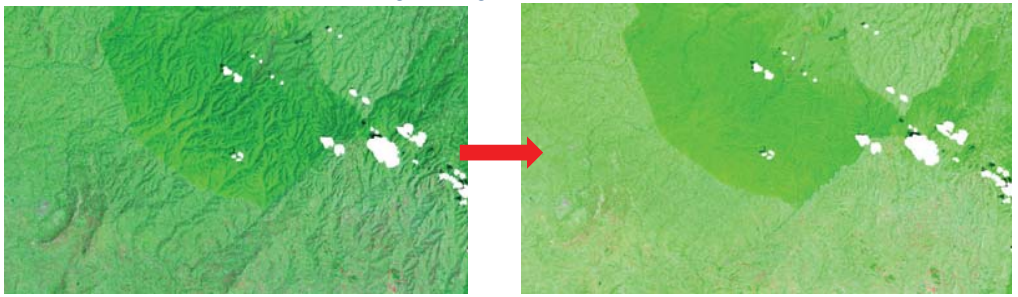
1.Cloud and shadow masking

- **masking all cloud and shadow**
- **Used "cfmask" band from USGS**



2. Terrain illumination Correction

- **variations in slope and aspect**
- **to correct terrain illumination effects so that the same land cover will have a consistent digital signal**



3. Projection to the Kenyan Coordinate System

- **Projection from UTM WGS 84 to UTM Arc1960 37 South**

4. Land Use Land Cover Classification

1. Land cover classes for LCC Mapping

I. Forest
   1. Dense Forest > 65% canopy cover
   2. Moderate Forest 40 – 65% canopy cover
   3. Open Forest 15 – 40% canopy cover

II. Cropland
   1. Annual Cropland
   2. Perennial cropland

III. Grassland
   1. Open Grassland
   2. Wooded grassland

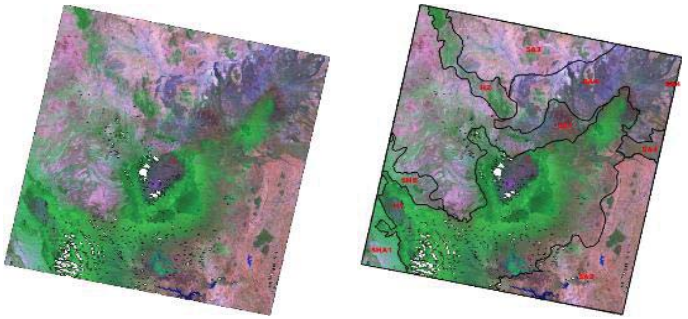
IV. Wetland
   1. Open Water
   2. Vegetated wetland

V. Settlement

VI. Otherland

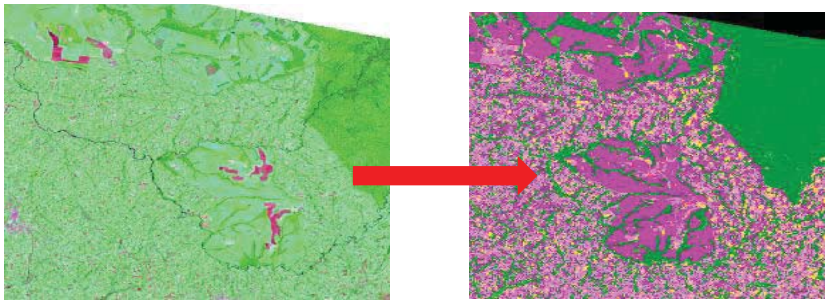
2. Stratification – spectral stratification zones

- Land use land cover variations in Kenya
- spectral stratification zones were initially based on Kenya's Agro-Ecological Zones later modified



4. Classification using Random Forests

- Running R-Scripts

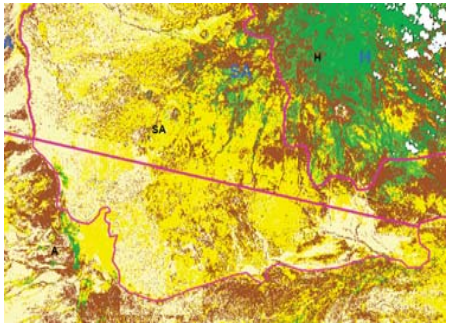


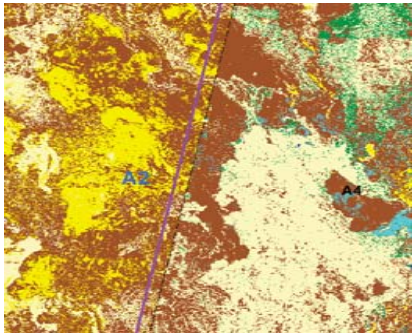
Landsat Image

Output: Classified Image

5. QA/QC of the classification

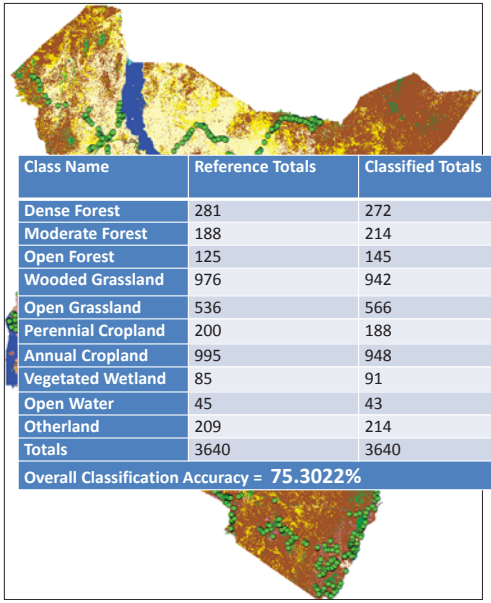
- Checking for consistent classification results across scene and zone boundaries (pink lines)
- Classification inconsistencies between neighbouring scenes





5. Accuracy Assessment

- Checking the correctness of the map
- Sampling Procedure - *Proportionate stratified random*
  - ➢ To consider accessibility
  - ➢ To consider number of points per day
  - ➢ To consider balance of class type
  - ➢ To consider interested class type
  - ➢ To consider accommodation possibility

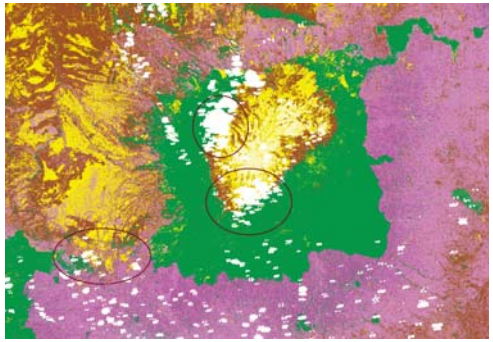


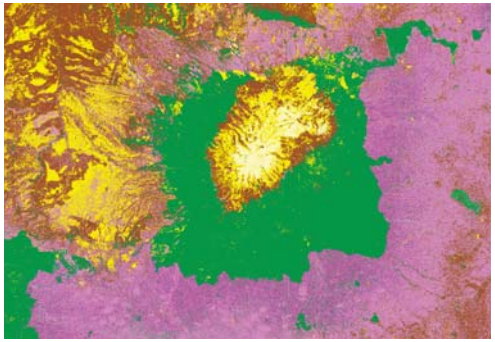
Results - SLEEK Team

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Dense Forest	281	272	216	76.87%	79.41%
Moderate Forest	188	214	148	78.72%	69.16%
Open Forest	125	145	94	75.2%	64.83%
Wooded Grassland	976	942	737	75.51%	78.24%
Open Grassland	536	566	395	73.69%	69.79%
Perennial Cropland	200	188	150	75%	79.79%
Annual Cropland	995	948	726	72.96%	76.58%
Vegetated Wetland	85	91	66	77.65%	72.53%
Open Water	45	43	36	80%	83.72%
Otherland	209	214	173	82.78%	80.84%
Totals	3640	3640	3640		
Overall Classification Accuracy = 75.3022%					

5. CPN (Conditional Probability Network)

- Due to data gaps a mathematical model known as a conditional probability network (CPN) is used to fill.
- It uses the time series maps and the probability bands developed during classification

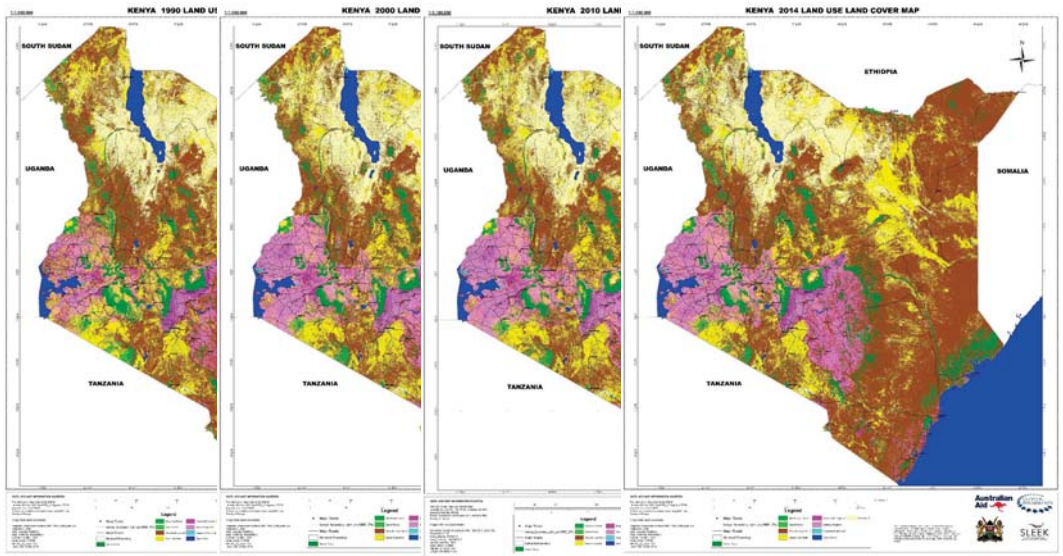




5. Time series maps

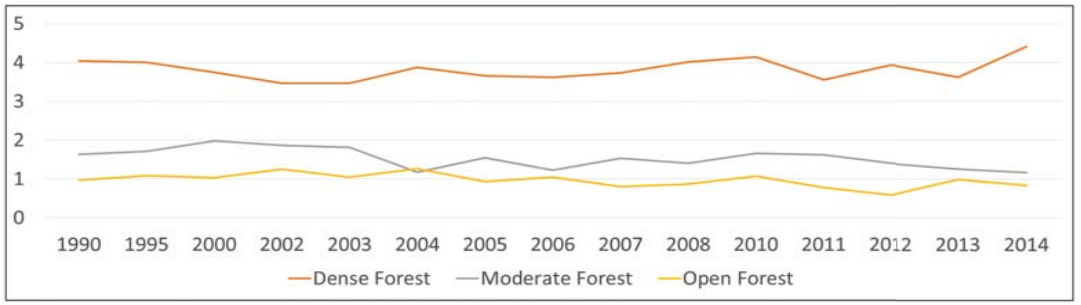
- Maps developed
  - 1990
  - 1995
  - 2000
  - 2002
  - 2003
  - 2004
  - 2005
  - 2006
  - 2007
  - 2008
  - 2009
  - 2010
  - 2011
  - 2012
  - 2013
  - 2014

Time Series Maps

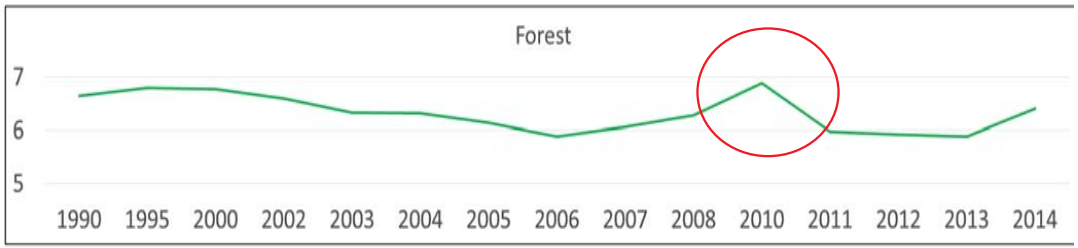


Statistics

	1990	1995	2000	2002	2004	2006	2008	2010	2012	2014
Dense Forest	4.06	4.21	3.77	3.60	4.14	3.89	4.30	4.29	4.09	4.53
Moderate Forest	1.32	1.56	2.02	1.74	0.94	0.94	1.07	1.49	1.18	1.00
Open Forest	1.28	1.10	1.02	1.24	1.21	1.00	0.81	1.06	0.53	0.82
Wooded Grassland	57.65	57.65	55.19	55.60	54.64	54.02	52.66	53.07	54.41	54.13
Open Grassland	16.76	16.84	17.42	16.09	16.49	16.39	17.79	16.60	16.62	15.72
Perennial Cropland	0.55	0.48	0.42	0.54	0.62	0.61	0.48	0.53	0.52	0.59
Annual Cropland	5.37	5.79	6.83	8.03	8.06	9.32	9.02	9.22	8.72	9.38
Vegetated Wetland	0.05	0.06	0.04	0.07	0.04	0.08	0.07	0.10	0.08	0.07
Open Water	2.04	2.04	2.05	2.05	2.02	1.99	2.01	2.06	2.11	2.07
Otherland	10.91	10.27	11.23	11.05	11.83	11.76	11.80	11.58	11.73	11.69

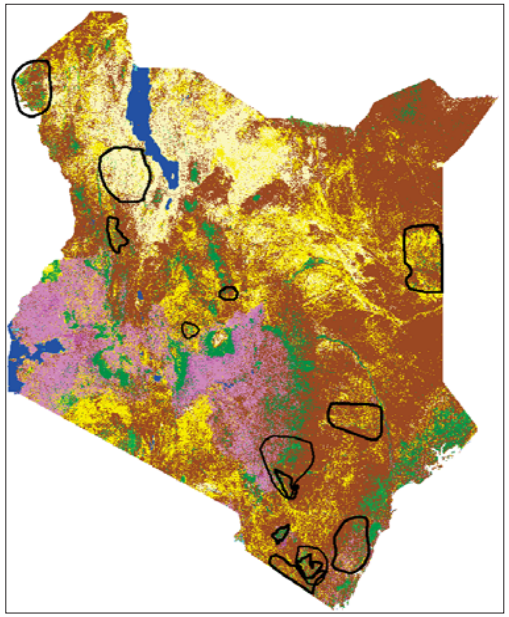


Statistics Cont...

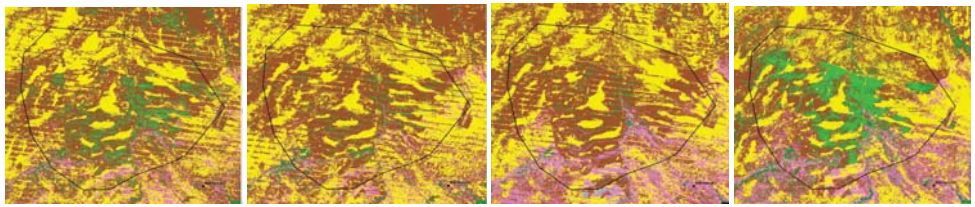


Post Classification

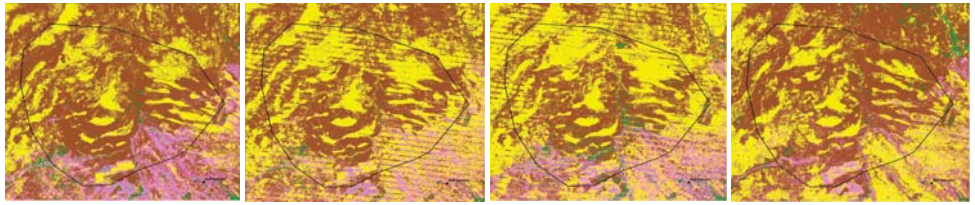
- In 2010 inconsistency in forest cover
- Post analysis of the land use land cover map
- Identifying areas with issues in Forest coverage year 2010



Post Classification - *Laikipia*

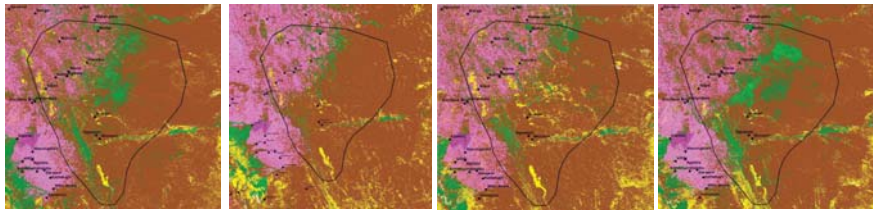


2006 2007 2008 2010

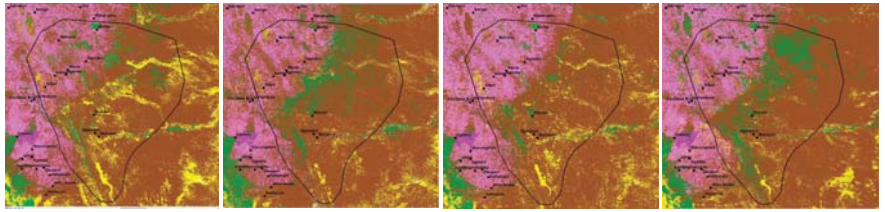


2011 2012 2013 2014

Post Classification - *Kitui*



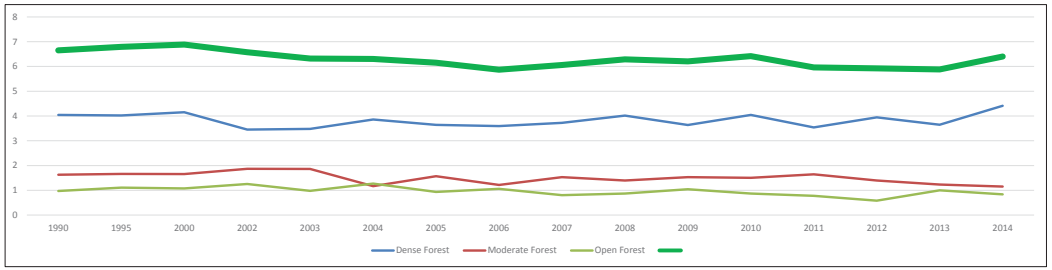
2006 2007 2008 2010



2011 2012 2013 2014

Statistics after post classification

	1990	1995	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Dense Forest	4.05	4.02	4.15	3.45	3.48	3.86	3.64	3.60	3.72	4.02	3.64	4.04	3.54	3.95	3.65	4.41
Moderate Forest	1.63	1.66	1.66	1.87	1.86	1.17	1.57	1.22	1.53	1.40	1.53	1.50	1.64	1.40	1.23	1.15
Open Forest	0.97	1.11	1.07	1.25	0.98	1.27	0.94	1.06	0.80	0.87	1.04	0.87	0.78	0.58	1.00	0.84
Wooded Grassland	57.90	58.03	52.97	55.66	56.95	54.70	56.37	53.96	51.35	52.30	55.14	53.21	49.91	54.00	51.21	54.01
Open Grassland	16.65	16.64	16.59	16.07	16.04	16.50	15.78	16.34	18.33	17.83	15.91	16.83	20.50	16.67	17.62	15.73
Perennial Cropland	0.54	0.48	0.53	0.54	0.44	0.61	0.53	0.60	0.48	0.47	0.58	0.53	0.56	0.53	0.52	0.60
Annual Cropland	5.30	5.72	9.28	8.00	6.90	8.04	7.59	9.38	10.14	9.17	9.05	9.25	10.15	8.88	10.15	9.42
Vegetated Wetland	0.05	0.06	0.10	0.07	0.05	0.04	0.07	0.08	0.10	0.08	0.08	0.10	0.07	0.09	0.09	0.07
Open Water	2.04	2.04	2.05	2.05	2.03	2.02	2.03	1.99	2.06	2.00	2.04	2.05	2.02	2.11	2.06	2.07
Otherland	10.87	10.23	11.60	11.05	11.28	11.79	11.47	11.78	11.47	11.85	11.00	11.61	10.83	11.79	12.48	11.70



Thank you very much!

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REPUBLIC OF KENYA
Ministry of Environment and Natural Resources
Kenya Forest Service

Past TWG decisions to support AD Development

Date: 29th to 30th June 2017

By Faith MUTWIRI and Kei SATO

REDD + Decision on Activity Data

1. Accuracy Assessment

- **Checking the correctness of the map**
- **Sampling Procedure -** *Proportionate stratified random*

Result

Correctness Table by Verification Survey (SLEEK and JICA Consultant team)

Class Name	Land Cover / Land Use	Number of correct	Accuracy Ratio
Dense Forest	312	239	76.6%
Moderate Forest	221	152	68.8%
Open Forest	150	97	64.7%
Wooded Grassland	984	761	77.3%
Open Grassland	581	406	69.9%
Perennial Cropland	205	165	80.5%
Annual Cropland	989	748	75.6%
Vegetated Wetland	95	70	73.7%
Open Water	47	40	85.1%
Other Land	215	174	80.9%
TOTAL	**3799**	**2852**	**75.1%**

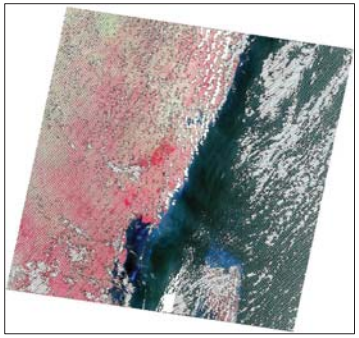
Class Name	Land Cover / Land Use	Number of correct	Accuracy Ratio
Forest	683	488	71.4%
Wooded Grassland	984	761	77.3%
Open Grassland	581	406	69.9%
Perennial Cropland	205	165	80.5%
Annual Cropland	989	748	75.6%
Vegetated Wetland	95	70	73.7%
Open Water	47	40	85.1%
Other Land	215	174	80.9%
TOTAL	**3799**	**2852**	**75.1%**

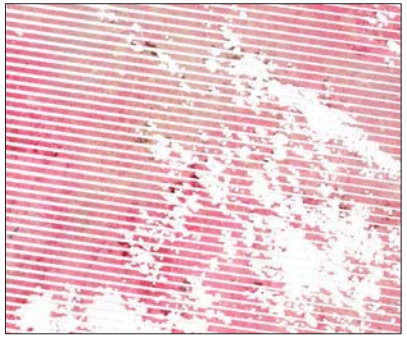
REDD + Decision on Activity Data

2. Reference year and interval

Data screening

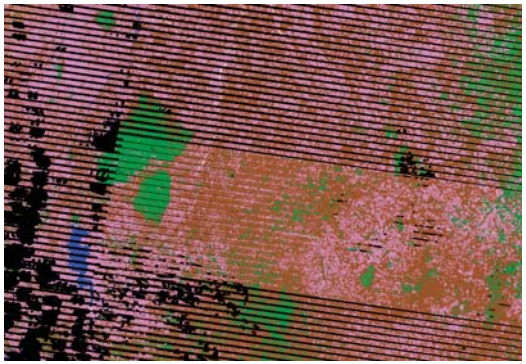
- The quality of Land Cover/ Land Use Map by image classification is affected by the quality of source data which is satellite imagery.
- So the good quality satellite imagery shall be utilized
- Stripping is from end of May 2003



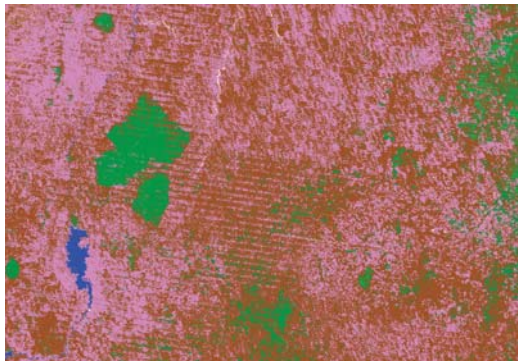


Stripping effect on classification

2006 Land cover Land use map



Before CPN



After CPN

Result of data screening and Recommendable Year

	1990	1995	2000	2002	2003	2004	2005	2006
No DATA (%)	10.59%	14.35%	6.50%	6.53%	8.56%	23.77%	20.86%	23.13%
LANDSAT4 (scene)	26	0	0	0	0	0	0	0
LANDSAT5 (scene)	8	34	0	0	0	0	0	0
LANDSAT7 (scene)	0	0	34	34	34	34	34	34
Missing scenes	0	0	0	0	0	0	0	0
LANDSAT8 (scene)	0	0	0	0	0	0	0	0
Stripping Effect (scene)	0	0	0	0	0	34	34	34
Ratio of Stripping Effect (%)	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**100.00%**	**100.00%**	**100.00%**

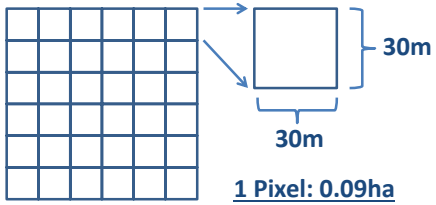
	2007	2008	2009	2010	2011	2012	2013	2014
No DATA (%)	26.14%	28.00%	15.85%	6.81%	12.51%	20.85%	16.98%	3.75%
LANDSAT4 (scene)	0	0	0	0	0	0	0	0
LANDSAT5 (scene)	0	0	11	24	15	0	0	0
LANDSAT7 (scene)	34	34	23	9	19	34	13	0
Missing scenes	0	0	0	1	0	0	0	0
LANDSAT8 (scene)	0	0	0	0	0	0	21	34
Stripping Effect (scene)	34	34	23	9	19	34	13	0
Ratio of Stripping Effect (%)	**100.00%**	**100.00%**	**64.60%**	**26.50%**	**55.90%**	**100.00%**	**38.20%**	**0.00%**

10 Year's epoch shall be utilized and 2014 as recent Activity Data

2. Image Filtering to meet Forest Definition

Image vs. Forest Definition

0.5ha as minimum mapping unit was considered as concept of SLEEK Map

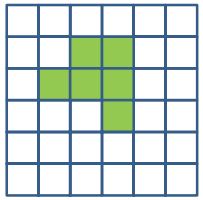


1 Pixel: 0.09ha

LANDSAT Imagery

Forest Definition

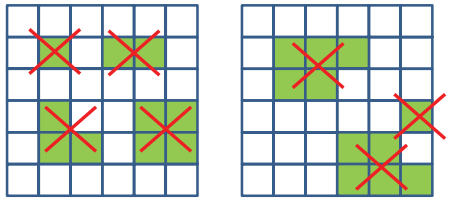
- Canopy Cover Ratio: ≥ 15%
- Area size: 0.5ha



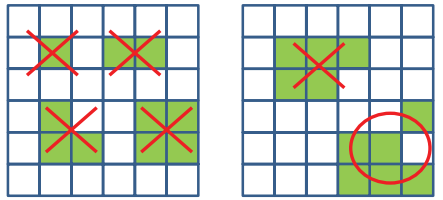
Forest area size: 0.54ha

Elimination of Cluster

Eliminate the pixels which are less than 6 pixels



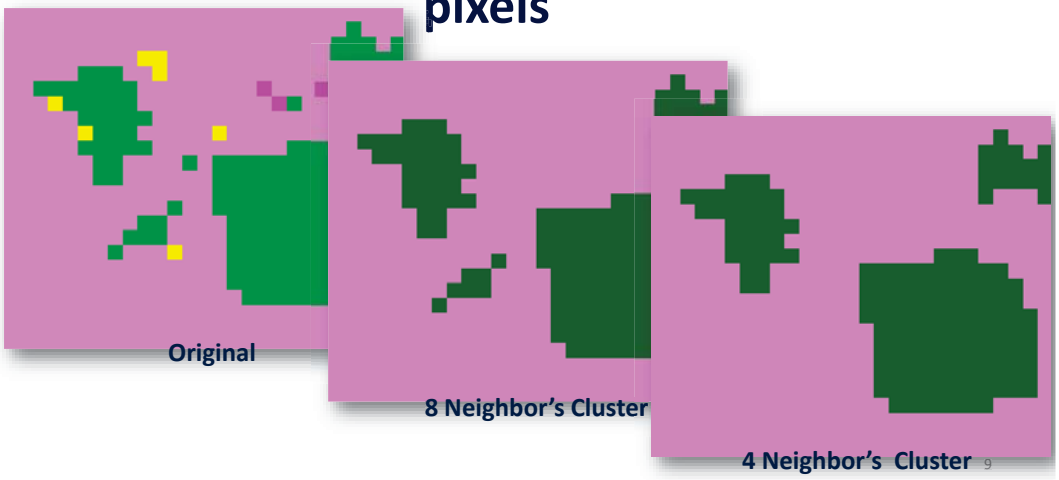
4 neighbor searching method



8 neighbor searching method

Eliminated less than 6 pixels will be replace neighbor bigger cluster of class Type

Example of Elimination which is less than 6 pixels



Other decisions

- Further discussions and engagement with experts from FAO, UNDP and CfRN on AD
- Based on Decisions of the Board - 18th meeting of the Board 30th Sep - 2nd Oct 2017;
  - Less than 5yrs or More than 20yrs of reference period is **FAIL**
  - 5 – 9yrs or 16 – 20yrs **LOW SCORE**
  - 10 – 15yrs **HIGH SCORE**

Options

1. 1990, 2000, 2010, 2014 – *Previous decision*
2. 2000, 2010, 2014
3. 1995, 2000, 2010, 2014
4. 2000, 2005, 2010, 2014
5. 2000, 2014

Thank you very much!

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Reference

Comparing FRL values (Avergage method)
by different reference year from 2000 to 2014

Emission estimates and FRL (Average method)

Table 1 Emission estimates by three points of time (tCO_2/year)

Period	2000–2010	2010–2014	Av 2000–2014
Net Emisssion	−6,918,626	−8,515,006	−7,374,735
Gross Emission	34,501,902	77,292,798	46,727,872
Gross Removal	−41,420,528	−85,807,804	−54,102,607
FRL	−7,374,735	−7,374,735	−7,374,735

Table 2 Emission estimates by two points time (tCO_2/year)

Period	2000–2014
Net Emisssion	−7,369,087
Gross Emission	23,790,276
Gross Removal	−31,159,363
FRL	−7,369,087

➢ The values of Emission estimates

Table Emission estimates (tCO_2/year)

Period	2000–2014
Net Emisssion	−7,369,087
Gross Emission	23,790,276
Gross Removal	−31,159,363
FRL	−7,369,087

Table Total emissions/removals for each REDD+activity (tCO_2/year)

Period	2000–2014
Deforestation	20,254,838
Degradation	2,883,723
Sustainable management of forest	−787,332
Enhancement	−29,720,316
Total (Emission estimates (Net))	−7,369,087
FRL	−7,369,087

Confirmation of Emission estimates

Kazuhiro YAMASHITA
Japan Overseas Forestry Consultants Association

The 29th November 2017

➢ FRL setting procedure

Three steps for FRL setting

Step 1) Decision making on various requirements of FRL

Step 2) Analysis of historical data (AD and EF)

Step 3) Combining AD and EF

➢ FRL setting procedure

Three steps for FRL setting

Step 1) Decision making on various requirements of FRL

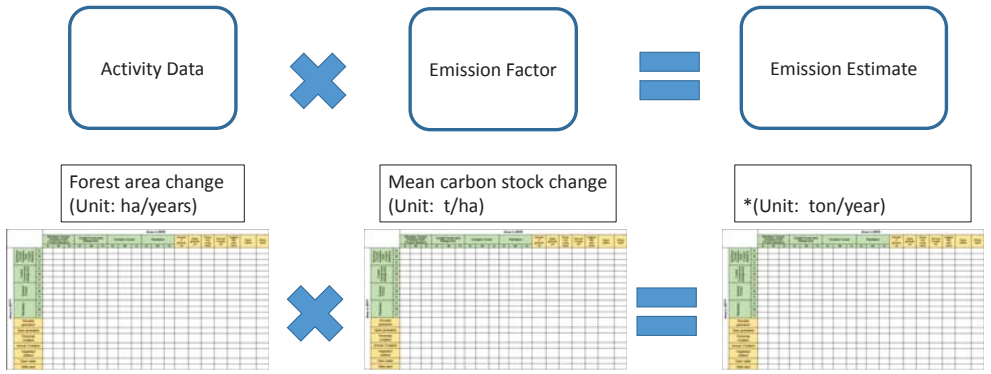
Step 2) Analysis of historical data (AD and EF)

Step 3) Combining AD and EF

✓ Combining AD and EF

Forest Reference Level （FRL)

* The Units of the calculation multiplied by AD and EF are tCO_2/years.
The values of emission estimates should be divided by the period of years.



➢ Calculation of Emission estimates

- Calculation: multiplication between AD and EF

- Emission estimates: indicated by the emission/removal in the amount of CO_2 as weight per year (ton/year)
- The unit of Emission estimates: tCO_2/year.

Monitoring Land Cover/Land Use Changes (IPCC Approach 3)

Area in 20XX			Area in 20XX+(X)														
			Forest												Non Forest		
			Montane Forest/ Western Rain Forest/ Bamboo			Costal Forest and Mangroves			Dryland Forest			Plantation Forest			Glass land	Other Non-forest
			D	M	O	D	M	O	D	M	O	D	M	O		
Forest	Montane Forest/ Western Rain Forest/ Bamboo	D	n	dg	dg										df	df
		M	e	n	dg										df	df
		O	e	e	n										df	df
	Costal Forest and Mangroves	D				n	dg	dg							df	df
		M				e	n	dg							df	df
		O				e	e	n							df	df
	Dryland Forest	D							n	dg	dg				df	df
		M							e	n	dg				df	df
		O							e	e	n				df	df
	Plantation Forest	D										n	s	s	s	s
		M										s	n	s	s	s
		O										s	s	n	s	s
Non Forest	Glass land		e	e	e	e	e	e	e	e	e	s	s	s		
	Other non Forest		e	e	e	e	e	e	e	e	e	s	s	s		

df Deforestation (F→NF)
n No Change (F→F)
dg Forest Degradation (F→F(Degraded))
s Sustainable Management of Forest (F→F, F→NF, NF→F)
e Enhancement (F→F(Improved) ,NF→F)

➢ Multiplication of AD and EF

Table . The value of Multiplication of AD and EF in each reference periods*

		2014															
		Montane Forest / Western Rain Forest / Bamboo			Costal Forest and Mangroves			Dryland Forest			Plantation			Cropland	Glassland	Wetland	Settlement and Other land
		Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open				
2000	Montane Forest / Western Rain Forest / Bamboo	Dense	0	20,814,837	8,290,505	–	–	–	–	–	–	–	–	–	59,094,415	57,322,517	239,729	487,648
		Moderate	-52,998,784	0	1,021,936	–	–	–	–	–	–	–	–	–	2,379,940	6,653,849	70,213	11,652
		Open	-20,852,779	-978,240	0	–	–	–	–	–	–	–	–	–	813,554	1,741,978	1,546	9,056
	Costal Forest and Mangroves	Dense	–	–	–	0	1,201,342	89,880	–	–	–	–	–	–	244,635	5,724,061	54,420	113,381
		Moderate	–	–	–	-12,115,641	0	144,255	–	–	–	–	–	–	1,000,922	16,074,963	48,709	108,289
		Open	–	–	–	-296,556	-111,348	0	–	–	–	–	–	–	104,991	991,120	1,099	6,594
	Dryland Forest	Dense	–	–	–	–	–	–	0	3,999,716	3,513,742	–	–	–	13,353,566	90,709,069	364,890	295,454
		Moderate	–	–	–	–	–	–	-13,174,203	0	1,295,833	–	–	–	2,323,184	19,188,308	132,057	223,186
		Open	–	–	–	–	–	–	-5,510,194	-1,587,829	0	–	–	–	353,418	3,150,146	45,327	147,773
	Plantation	Dense	–	–	–	–	–	–	–	–	–	0	383,536	208,492	4,458,151	3,836,910	5,754	2,441
		Moderate	–	–	–	–	–	–	–	–	–	-889,645	0	-774	48,306	117,587	746	227
		Open	–	–	–	–	–	–	–	–	–	-430,153	567	0	26,603	34,663	28	0
	Cropland		-37,307,679	-548,142	-83,276	-654,314	-35,146	-1,366	-3,161,462	-143,378	-13,311	-4,776,977	-18,656	-15,702				
	Glassland		-127,668,914	-6,769,051	-1,868,216	-26,173,780	-4,161,750	-153,514	-82,307,020	-8,782,429	-3,048,198	-13,685,952	-76,863	-47,691				
	Wetland		-200,497	-1,724	-313	-254,036	-61,457	-3,122	-693,904	-110,936	-26,680	0	0	0				
	Settlement and Other land		-345,725	-30,997	-14,775	-162,806	-25,287	-288	-891,651	-234,824	-274,530	-104,099	-159	0				

* Units are tCO_2/14 year between 2000 and 2014. The values of emission estimates should be divided by the period of years.

- The results were classified by colors which indicated each REDD+ activity.

➢ The values of Emission estimates

Table Emission estimates (tCO_2/year)

Period	2000–2014
Net Emisssion	−7,369,087
Gross Emission	23,790,276
Gross Removal	−31,159,363
FRL	−7,369,087

Table Total emissions/removals for each REDD+activity (tCO_2/year)

Period	2000–2014
Deforestation	20,254,838
Degradation	2,883,723
Sustainable management of forest	−787,332
Enhancement	−29,720,316
Total (Emission estimates (Net))	−7,369,087
FRL	−7,369,087

Thank you for your attention.

Procedure of FRL setting

Kazuhiro YAMASHITA
Japan Overseas Forestry Consultants Association
The 30th November 2017

Table of contents

➢ Activity data (AD) and EF (Emission Factor)

- Requisite items: AD and EF for FRL setting
- AD: to be made by the Land cover/Land use change map data calculated by the Land cover/Land use maps in the different two point of times for each period
- EF: to be acquired by the default data from 2006 IPCC Guidelines or the country data which was from the forest inventory data
- The unit of AD: ha/years, as area data
- The unit of EF: tCO_2/ha

Monitoring Land Cover/Land Use Changes (IPCC Approach 3)

Area in 20XX			Area in 20XX+(X)														
			Forest												Non Forest		
			Montane Forest/ Western Rain Forest/ Bamboo			Costal Forest and Mangroves			Dryland Forest			Plantation Forest			Glass land	Other Non-forest
			D	M	O	D	M	O	D	M	O	D	M	O		
Forest	Montane Forest/ Western Rain Forest/ Bamboo	D	n	dg	dg										df	df
		M	e	n	dg										df	df
		O	e	e	n										df	df
	Costal Forest and Mangroves	D				n	dg	dg							df	df
		M				e	n	dg							df	df
		O				e	e	n							df	df
	Dryland Forest	D							n	dg	dg				df	df
		M							e	n	dg				df	df
		O							e	e	n				df	df
	Plantation Forest	D										n	s	s	s	s
		M										s	n	s	s	s
		O										s	s	n	s	s
Non Forest	Glass land		e	e	e	e	e	e	e	e	e	s	s	s		
	Other non Forest		e	e	e	e	e	e	e	e	e	s	s	s		

df Deforestation (F→NF)
n No Change (F→F)
dg Forest Degradation (F→F(Degraded))
s Sustainable Management of Forest (F→F, F→NF, NF→F)
e Enhancement (F→F(Improved) ,NF→F)

AD

Table . Area of Land Cover/Land Use change in each reference periods (ha)

			2014															
			Montane Forest / Western			Costal Forest and Mangroves			Dryland Forest			Plantation			Cropland	Grassland	Wetland	Other land
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open				
2000	Montane Forest / Western	Dense	779,153	32,764	11,616										77,272	76,551	313	638
		Moderate	82,637	76,106	13,035										18,383	58,617	542	90
		Open	28,938	12,476	24,814										15,932	49,609	30	177
	Costal Forest and	Dense				130,627	14,833	662							1,164	29,472	259	539
		Moderate				149,591	70,442	2,636							7,748	141,966	377	838
		Open				2,185	2,034	255							1,410	16,942	14	116
	yland Fore	Dense							332,633	35,600	21,645				68,841	509,522	1,881	1,523
		Moderate							117,258	64,698	25,926				28,462	291,866	1,618	2,734
		Open							33,943	31,767	50,164				11,169	200,729	1,432	4,669
	Plantation	Dense										31,612	535	315	4,602	4,027	6	3
		Moderate										1,381	127	14	192	498	3	0.90
		Open										650	10	2	87	119	0.09	0
	Cropsland		48,784	4,234	1,827	2,304	303	18	16,298	1,757	421	4,931	74	51				
	Glassland		170,496	77,251	53,204	134,762	36,754	2,624	462,326	148,951	194,297	14,365	326	164				
	Wetland		262	13	6	1,209	476	42	3,577	1,359	843	0	0	0				
	Other land		452	236	289	775	196	4	4,597	2,877	11,836	107	0.63	0				

EF

Table Matrix of EF setting for Country data (Forest) with Default data (Non forest) CO_2(ton/ha) Emission

			The end year of the period															
			Montane Forest/Western Rain			Coastal Forest and Mangroves			Dryland Forest			Plantation			Cropland	Grassland	Wetland	Other land
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open				
The beginning year of the period	Mountane Forest /Western Rain Forest/Bamboo	Dense	0	635.30	713.70	–	–	–	–	–	–	–	–	–	764.76	748.81	764.76	764.76
		Moderate	−635.30	0	78.40	–	–	–	–	–	–	–	–	–	129.46	113.51	129.46	129.46
		Open	−713.70	−78.40	0	–	–	–	–	–	–	–	–	–	51.06	35.11	51.06	51.06
	Coastal Forest and Mangroves	Dense	–	–	–	0	80.99	135.72	–	–	–	–	–	–	210.17	194.22	210.17	210.17
		Moderate	–	–	–	−80.99	0	54.73	–	–	–	–	–	–	129.18	113.23	129.18	129.18
		Open	–	–	–	−135.72	−54.73	0	–	–	–	–	–	–	74.45	58.50	74.45	74.45
	Dryland Forest	Dense	–	–	–	–	–	–	0	112.35	162.33	–	–	–	193.98	178.03	193.98	193.99
		Moderate	–	–	–	–	–	–	−112.35	0	49.98	–	–	–	81.63	65.68	81.63	81.63
		Open	–	–	–	–	–	–	−162.33	−49.98	0	–	–	–	31.64	15.69	31.64	31.64
	Plantation	Dense	–	–	–	–	–	–	–	–	–	0	716.82	662.07	968.69	952.74	968.69	968.69
		Moderate	–	–	–	–	–	–	–	–	–	−716.82	0	−54.75	251.87	235.92	251.87	251.87
		Open	–	–	–	–	–	–	–	–	–	−662.07	54.75	0	306.62	290.67	306.62	306.62
	Cropland		−764.76	−129.46	−51.06	−210.17	−129.18	−74.45	−193.98	−81.63	−31.64	−968.69	−251.87	−306.62				
	Grassland		−748.81	−113.51	−35.11	−194.22	−113.23	−58.50	−178.03	−65.68	−15.69	−952.74	−235.92	−290.67				
	Wetland		−764.76	−129.46	−51.06	−210.17	−129.18	−74.45	−193.98	−81.63	−31.64	−968.69	−251.87	−306.62				
	Other land		−764.76	−129.46	−51.06	−210.17	−129.18	−74.45	−193.98	−81.63	−31.64	−968.69	−251.87	−306.62				

➢ The method of calculation of Emission estimates

- Method of calculation: multiplication between AD and EF
- Emission estimates: indicated by the emission/removal in the amount of CO_2 as weight per year (ton/year)
- The unit of Emission estimates: tCO_2/year.

Multiplication of AD and EF

Table . The value of Multiplication of AD and EF in each reference periods*

			2014															
			Montane Forest / Western Rain Forest / Bamboo			Costal Forest and Mangroves			Dryland Forest			Plantation			Cropland	Glassland	Wetland	Settlement and Other land
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open				
2000	Montane Forest / Western Rain Forest / Bamboo	Dense	0	20,814,837	8,290,505	–	–	–	–	–	–	–	–	–	59,094,415	57,322,517	239,729	487,649
		Moderate	−52,466,162	0	1,021,936	–	–	–	–	–	–	–	–	–	2,379,040	6,653,649	70,213	11,652
		Open	−20,652,776	−978,091	0	–	–	–	–	–	–	–	–	–	813,554	1,741,579	1,349	9,058
	Costal Forest and Mangroves	Dense	–	–	–	0	1,201,342	88,890	–	–	–	–	–	–	244,635	5,724,061	54,420	113,361
		Moderate	–	–	–	−12,115,641	0	144,255	–	–	–	–	–	–	1,000,922	16,074,968	48,703	106,288
		Open	–	–	–	−296,356	−111,349	0	–	–	–	–	–	–	104,991	991,120	1,099	8,604
	Dryland Forest	Dense	–	–	–	–	–	–	0	3,999,774	3,513,743	–	–	–	13,353,566	90,709,089	364,890	295,494
		Moderate	–	–	–	–	–	–	−13,174,282	0	1,295,833	–	–	–	2,323,184	19,168,388	132,057	222,188
		Open	–	–	–	–	–	–	−5,510,184	−1,587,809	0	–	–	–	353,416	3,150,146	45,327	147,733
	Plantation	Dense	–	–	–	–	–	–	–	–	–	0	383,536	208,492	4,458,151	3,836,910	5,754	2,441
		Moderate	–	–	–	–	–	–	–	–	–	−989,645	0	−774	48,306	117,587	748	227
		Open	–	–	–	–	–	–	–	–	–	−430,153	−567	0	26,603	34,663	29	0
	Cropsland		−37,307,679	−548,142	−93,276	−484,314	−38,146	−1,360	−3,161,402	−143,378	−13,311	−4,776,977	−18,656	−15,702				
	Glassland		−127,668,914	−8,769,011	−1,868,216	−26,173,795	−4,161,750	−153,514	−62,307,020	−9,782,429	−3,049,198	−13,685,952	−76,863	−47,691				
	Wetland		−200,497	−1,724	−313	−254,036	−61,457	−3,122	−693,904	−110,936	−26,685	0	0	0				
	Settlement and Other land		−345,725	−30,597	−14,775	−162,806	−25,297	−288	−891,851	−234,824	−374,538	−104,096	−158	0				

* Units are tCO_2/14 year between 2000 and 2014. The values of emission estimates should be divided by the period of years.

➢ FRL setting (Step 1): Using Average method

1. Average method will be set by each year.
2. Emission estimate of each reference period will provide the value of emission estimates of each reference period. According to Reference years which are calculated in different points of time, reference periods can be decided in different points of time.
3. The average of each emission estimate in different years will be the basis of the projection of the National circumstances.

✓ Unless the National circumstances are projected, the average of Emission estimates can be FRL.

✓Figures shown as below describe the current result of Emission estimates and other values.

The result of Emission estimates

by the Average method and other values

Table Emission estimates (tCO_2/year)

Period	2000–2014
Net Emisssion	−7,369,087
Gross Emission	23,790,276
Gross Removal	−31,159,363
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Table Total emissions/removals for each REDD+activity (tCO_2/year)

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Total (Emission estimates (Net))	−7,369,087
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Emission estimates and other values

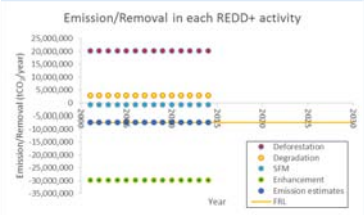


Figure FRL liner projection, and Emission and Removal in each REDD+ Activity

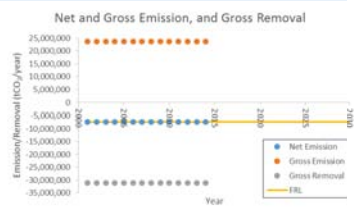


Figure. FRL liner projection, Net and Gross Emission, and Gross Removal

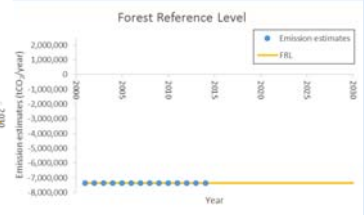


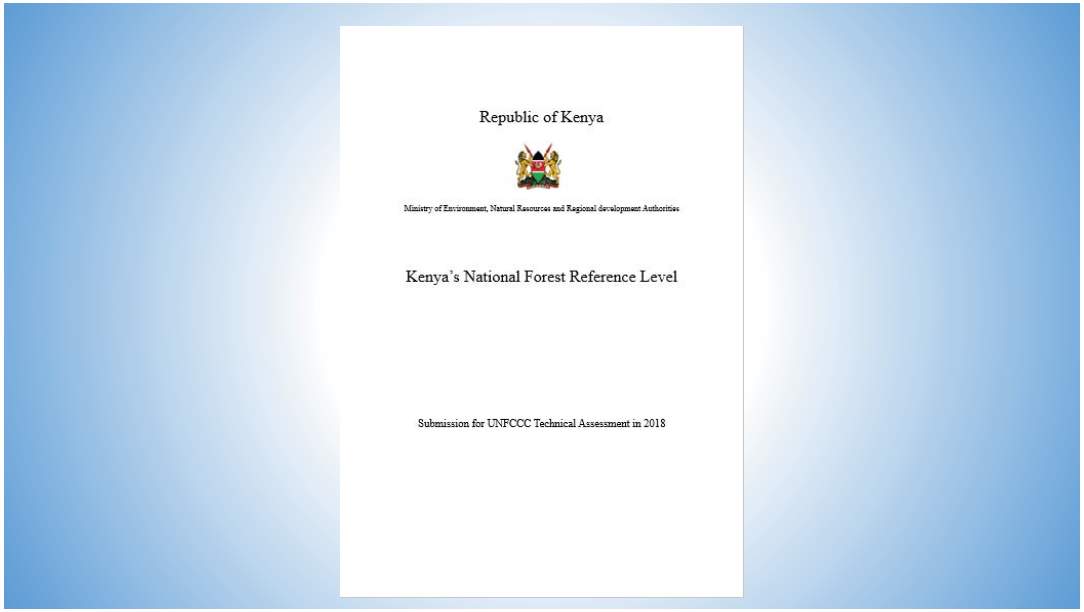
Figure. FRL liner projection and Emission estimates in each year

➢ FRL setting (step 2): National circumstance

◆National circumstances can be projected by the calculation based on the Historical trend as Average method. FRL with National circumstance will be set by the result of analysis for National circumstance.

Progress of Drafting FRL Report

Kazuhiro YAMASHITA
Japan Overseas Forestry Consultants Association
The 30th November 2017


Republic of Kenya

Ministry of Environment, Natural Resources and Regional development Authorities

Kenya's National Forest Reference Level

Submission for UNFCCC Technical Assessment in 2018

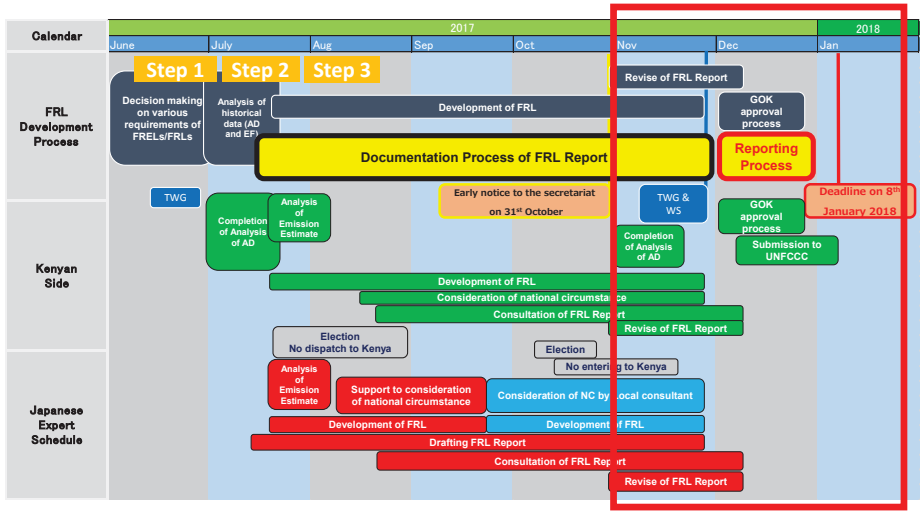
➢ Drafting FRL Report

✓Documentation Process
✓Table of Contents of FRL Report

➢ Drafting FRL Report

✓Documentation Process
✓Table of Contents of FRL Report

Outline of schedule for development and submission of FRL to UNFCCC



Annex

Overview table on the indicative time frames of the technical assessment of reference levels in 2018 and 2019[3]

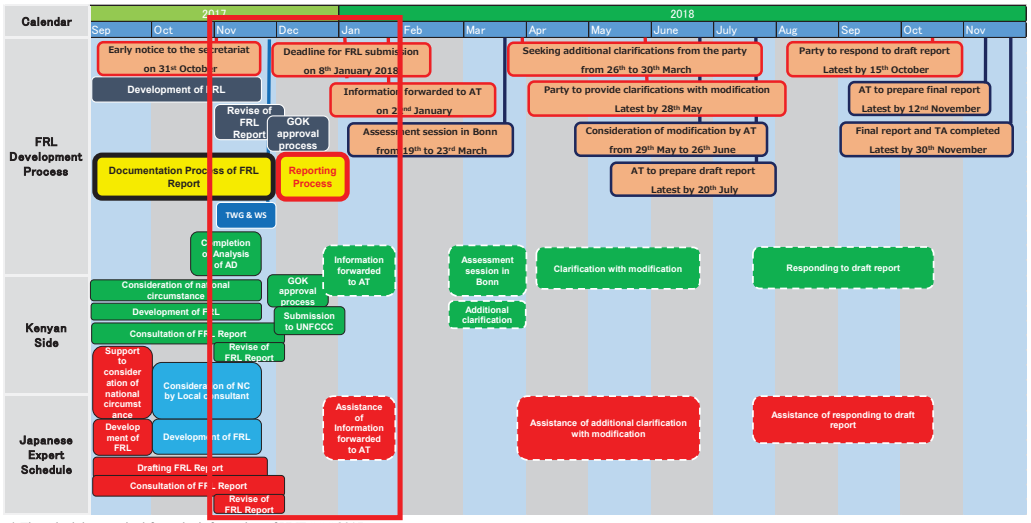
	Technical assessment 2018	Technical assessment 2019
Early notice to the secretariat	Latest by 31 October 2017	Latest by 29 October 2018
Deadline for reference level submission (no later than 10 weeks before the assessment session)	Latest by 8 January 2018	Latest by 7 January 2019
Information forwarded to assessment team (8 weeks before the assessment session)	Latest by 22 January 2018	Latest by 21 January 2019
Assessment session in Bonn (1 week)	**19 – 23 March 2018**	**18 – 22 March 2019**
Seeking additional clarifications from the Party (up to 1 week)	26 – 30 March 2018	25 – 29 March 2019
Party to provide clarifications (8 weeks), including submission of a modified submission, if appropriate.	Latest by 28 May 2018	Latest by 27 May 2019
4 weeks for assessment team to consider modified reference level (applicable in the case that the Party modifies its submitted reference level)	29 May – 26 June 2018	28 May – 25 June 2019
Assessment team to prepare draft report	Latest by 20 July 2018	Latest by 19 July 2019
Party to respond to draft report (12 weeks)	Latest by 15 October 2018	Latest by 14 October 2019
Assessment team to prepare final report within four weeks following the Party's response	Latest by 12 November 2018	Latest by 11 November 2019
Final report published and technical assessment completed	30 November 2018	29 November 2019

* For planning purposes, dates indicate the maximum time frames required in accordance with decision 13/CP.19.

[3] Dates for 2019 are indicative and the exact dates may still change in case of clashes with events which are difficult to envisage at this point of time.

Reference: "UNFCCC 2017. Information on the submission of proposed forest reference emission levels and/or forest reference levels by developing country Parties, on a voluntary basis, when implementing the activities referred to in decision 1/CP.16, paragraph 70, and on the technical assessments of these submitted reference levels in 2018 and 2019"

Outline of the whole schedule* for FRL Report to UNFCCC



* The schedule was cited from the information of UNFCCC 2017.

- Drafting FRL Report

✓Documentation Process

✓Table of Contents of FRL Report

➢Table of Contents of FRL Report

Thank you for your attention.

➢Table of Contents of FRL Report

THE FOREST SECTOR IN KENYA

THE NATIONAL CIRCUMSTANCES

30th NOVEMBER 2017

Outline

I. Introduction
II. Project Objectives
III. National Circumstances
   a) Forest Sector Governance
   b) Economic Profile
   c) Energy Management
   d) Infrastructural, and industrial developments
   e) Agricultural Development
   f) Forest Management
   g) Development Priorities

Introduction

- Historical Background.
  - The importance of the forest sector in Kenya has been emphasized since early 1900s when the first forest department was established in 1902
  - Most of the major forest blocks were reserved as forest area and the first comprehensive forest policy was drawn up by 1957 outlining protection of the forest estate and the sustainable exploitation of forest.
  - The policy also covered afforestation and the conservation of forest and the proper management of privately owned forests for public amenity, recreation and as a habitat for wildlife

Introduction

- Benefits of Kenya's Forests.
  - Forests are the most important natural resource and seen as critical assets with economic, environmental, social and cultural values.
  - The forest sector contributes about kshs. 7 Billion to the economy and employs over 50,000 people directly and other 300,000 indirectly.
  - More than 530,000 households living within a radius of 5 kilometers from the forest reserves depend on forest for cultivating, grazing fishing, fuel food

Introduction

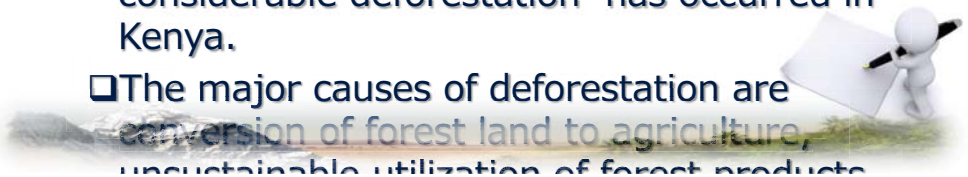
- Benefits of Kenya's Forests.
  - Sustainable supply of raw materials to the wood industry has been found crucial to protection and conservation of natural forest.
  - The forests act as *carbon sinks* as well as offering water catchments and biodiversity conservation functions.

Introduction

- Status of Kenya's Forests.
  - Kenya is classified as a low forest country
  - Forests in Kenya occupy 6.99% of total land area (or 40,726.9 km2 of the country) in 2010 *(National Forest Programme (NFP) 2016-2030,)*
  - These forests are categorized as Montane, Western rainforest, Bamboo, Afro-montane undifferentiated forest, Coastal and Dryland forests.
  - The montane forest and the coastal forest regions are the most forested with 18% and10% forest cover, respectively.

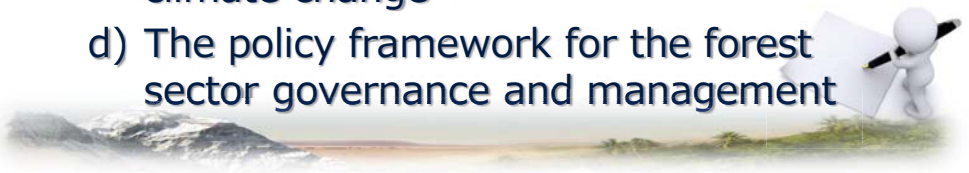
Introduction

- Status of Kenya's Forests.
  - The FAO Global Forest Resources Assessment indicated that forested land (including natural forests, public and private plantations) declined from 4,724,000 hectares (ha) in 1990 to 3,437,000 ha in 2000; but then increased to 4,037,000 ha in 2010. *(Global Forest Resources Assessment 2015)*
  - Over the last twenty to thirty years considerable deforestation has occurred in Kenya.
  - The major causes of deforestation are conversion of forest land to agriculture, unsustainable utilization of forest products



Forest Sector Governance

- Information on governance of the forest sector.
  a) Brief overview of the overall governance of forests in Kenya
  b) Roles and responsibilities for forest management.
  c) Approaches to the cooperation of the government institutions related to climate change
  d) The policy framework for the forest sector governance and management



Forest Sector Governance Challenges

- Quality of Forest Administration

a) KFS is the key manager of the forest resources in Kenya, but also other institutions – especially at the county levels – will increasingly be involved as partners and co-managers.

b) The creation of KFS was one of the major institutional innovations of the Forests Act 2005 to move the sector reform process forward.

Forest Sector Governance

- Roles and responsibilities for forest management.

a) National Environmental Management Authority (NEMA)
   - Policy coordination and harmonization,
   - EIA and compliance under the EMCA and resolution of inter-sectoral/ cross sectoral disputes through the Environmental Tribunal.

b) Kenya Wildlife Services:
   - enforcement of the rules and regulations governing the management of wildlife in parks and nature reserves that also contain forests (ref. CITES).

c) Ministry of Lands: with the mandate over land and land use policy

d) Office of the Attorney General- Registration of Community Forest Association

Forest Sector Governance

- Roles and responsibilities for forest management.

a) Forest Research institutions (KEFRI, Universities)
   - research and piloting on issues that touch on FLEG.

b) The National Museum of Kenya

c) Local Authorities:
   a) With mandate over trust local authority forests under their jurisdiction

d) Commissioner of Police;
   - with the mandate of law enforcement and prosecution

e) Ministry of Water-
   - with mandate for gazettement of water catchment

Forest Sector Governance

- Policy

a) The New Constitution of 2010, Article 69 (1)(b) requiring that Kenya increases its total forest cover to 10%,

b) Vision 2030 which recognizes the need for low carbon development pathway

c) The Agriculture Act of 2009, and with it, the Farm Forestry Rules which requires that 10% of farm land

d) The new National Forestry Bill of 2013, which among other things provides for a chain-of-custody system to verify and report the origins of forest products in compliance with the Initiative; Forest Law Enforcement, Governance and Trade in forest products (FLEGT)

Forest Sector Governance

- Policy
  a) The new Environmental Management and Conservation Act of (EMCA) of 1999
  b) The Energy Act of 2006 – Together with the Energy Policy, Sessional Paper No 4 of 2004, the Act calls for policies to develop renewable forms of energy
  c) The Charcoal Rules of 2009 promulgated by the Kenya Forest Service – enables the growing
  d) of trees for energy, .

Forest Sector Governance

- The policy framework for the forest sector governance and management
  a) Approaches

Forest Sector Governance Challenges

- Economic Efficiency, Equity and Incentives
  - sustainable forest management in kenya require economic efficiency, equity and sufficient incentives,
  - stakeholders who are expected to contribute to the forest governance structure require an increasing role.
  - There is need for joint management of forests with considerable economic potential and the revenues (and other benefits) to provide all participants with sufficient incentive to maintain their interest and commitment.

Forest Sector Governance Challenges

- Poor governance, including weak institutions, corruption, illegal logging, weak law enforcement.
- Weak community participation in forest management
- Inadequate benefit sharing from forest resources (including revenue sharing)
- Local authorities do not value their forests
- Communal land systems - lack of private ownership of the resources/land
- Unclear tenure and access to forest resources
- (e.g. Local Authority forests)

Economic Profile

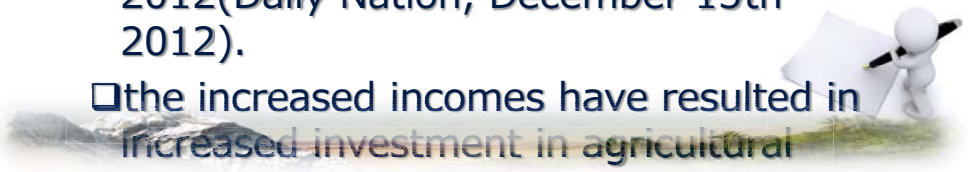
- Information on Economic growth in relation to the forest sector.
  a) Key economic sectors
  b) Future economic developments
  c) impact forestry development;

Economic Profile

- Economic growth
  - The country's Gross Domestic Product (GDP) – is hypothesized to strongly affect forest cover change and is thus worth examining.
  - The 2002 – 2012 period has been characterized by an increase in GDP.
  - While poverty levels stood at 56% prior to 2002, this reduced to 46% by 2012(Daily Nation, December 13th 2012).

Economic Profile

- Economic growth
  - The country's Gross Domestic Product (GDP) – is hypothesized to strongly affect forest cover change and is thus worth examining.
  - The 2002 – 2012 period has been characterized by an increase in GDP.
  - While poverty levels stood at 56% prior to 2002, this reduced to 46% by 2012(Daily Nation, December 13th 2012).
  - the increased incomes have resulted in increased investment in agricultural



Energy Resource Management

- Information on energy resource management in relation to the forest sector.
  a) Total primary energy supply and energy consumption,
  b) Market structure, Prices and Trends,
  c) Taxes, and subsidies
  d) Key national energy plans/strategies and future demands

Infrastructural, and industrial developments

- Information on Infrastructural, and industrial developments in relation to the forest sector.
  a) Key developments in transportation sector, including major recent and planned infrastructure developments
  b) Structure (market, major industry branches/processes and age structure)
  c) Key developments in industrial sector, including planned construction of industrial zones or complexes
  d) Trends in urbanization
  e) Key urban developments including major city developments planned

Infrastructural, and industrial developments

- Trends in urbanization
  a) Establishment of new cities and municipalities has caused deforestation and forest degradation in two ways.
    a) Designated areas for such cities, municipalities and towns have been cleared of vegetation.
    b) created more demand for construction material and hence exploitation of the country's forest resources to meet this demand.

Infrastructural, and industrial developments

- Trends in urbanization
  a) The increasing population creates demand for more housing which translates into more demand for construction wood and timber.
  b) The increased population has also meant more demand for food items and hence more pressure to clear (forest) land to provide for the demanded food.
  c) With over 60% of the urban population dependent on fuel wood (especially charcoal) for cooking, means more pressure on exploitation of surrounding dry land forests

Infrastructural, and industrial developments

- Planned Infrastructural, and industrial developments
  a) Structure (market, major industry branches/processes and age structure)
  b) Key developments in industrial sector, including planned construction of industrial zones or complexes
  c) Trends in urbanization
  d) Key urban developments including major city developments planned

Infrastructural, and industrial developments

- Planned Infrastructural, and industrial developments
  a) From an infra-structure development perspective, the dry woodland areas could be adversely affected if safeguards are not put in place.
  b) The implementation of the developments will result in clearing huge hectares of (forest) land, resulting on massive deforestation and degradation

Infrastructural, and industrial developments

- Planned Infrastructural, and industrial developments
  a) Konza technology city
  b) Isiolo Port
  c) Lamu port, LAPSET Project, comprising of a road, rail and pipeline connecting Kenya to South Sudan and Ethiopia
  d) The Northern Corridor Transport Project
  e) Construction of a standard gauge railway line from Mombasa to Kisumu
  f) Creation of a one-million-ha irrigation scheme in the Tana Delta Region and in Kitui County

Agricultural Development

- Information on Agricultural Development in relation to the forest sector.
  a) Structure by sector (e.g. Major crops, livestock and geographic distribution)
  b) Growth of the agricultural sector and trends
  c) Management practices
  d) Sectoral developments such as agricultural policies, laws and strategies or plans on proposed expansion of irrigated agriculture

Agricultural Development

- Information on Agricultural Development in relation to the forest sector.
  a) the area under sugarcane has increased from 127,560 ha in 1997 to 179,269 ha in 2011
  b) total area under tea has increased from 117,350 ha in 1997 to 187,800 ha in 2000
  c) This increased expenditure on farm inputs (especially improved seed and fertilizer) improved farm productivity thus reducing the pressure to put more land under agricultural production and hence reduced deforestation resulting from agricultural expansion.

Development Priorities

- Information on development Priorities in relation to the forest sector.
  a) Key sectors or areas of development
  b) Development strategies/plans, if any, and national legislation aiming to implement these strategies
  c) Progress towards the UN Sustainable Development Goals
  d) Barriers likely to impact in the implementation of the development priorities

Development Priorities

a) Sustainable Forest Conservation and Management is key to the realization of Kenya's Vision 2030 and the Global Sustainable Development Goals (SDGs).

b) The Forest Sector will directly implement and report on SDG 15 and also contribute to the realization of SDGs; 1, 2, 3, 5, 6, 7, 8, 12, 13 and 14.

The Management of Forest

- Information on the forest sector.
  a) Forest types,
  b) Forest policy, legislation and strategies;
  c) Forest management practices
  d) Forest management challenges and future scenarios

The Management of Forest

	a) FOREST TYPES	a) DIRECT DRIVERS
a) COAST	a) Mangroves b) Coastal Forests Dry woodlands Montane – Taita Hills Plantations	a) Wood extraction a) Poles b) Charcoal production c) Firewood d) Timber e) Agricultural expansion f) Subsistence agriculture g) Commercial agriculture – sugar / bio-fuels Infra-structure - Tourism establishments Grazing and browsing h) Wildlife damage – elephants in (Shimba i) Hills) Kwale j) Mining – still minor but growing at the coast

The Management of Forest

	a) FOREST TYPES	a) DIRECT DRIVERS
a) EWASO NORTH	a) Dry (Acacia-Commiphora) Woodlands b) Dry Evergreen- Montane c) (Mathews Range/ Ndotos, Mt Marsabit and Mt Kulal)	a) Wood extraction b) Charcoal production c) Firewood d) Timber and poles (cedar, podo) e) f) Grazing and browsing g) Livestock h) Wildlife – Elephants i) j) Fires - wildfires

The Management of Forest

	a) FOREST TYPES	a) DIRECT DRIVERS
a) MAU	a) Montane b) Industrial Plantations	a) Agricultural Expansion b) Permanent Subsistence c) Permanent commercial agriculture – Tea, wheat d) e) Wood Extraction f) Domestic fuel wood and charcoal) g) Commercial timber (poles and timber)

The Management of Forest

	a) FOREST TYPES	a) DIRECT DRIVERS
~~WESTERN~~		Agricultural expansion Permanent subsistence Permanent commercial - sugar, tobacco Wood extraction Firewood and charcoal Poles for construction & fencing
a) NOTH RIFT	a) Montane b) Dry woodlands c) Industrial plantations	a) Agricultural Expansion b) Permanent subsistence agriculture Permanent commercial agriculture Wood extraction c) Timber – illegal logging d) Firewood and charcoal

The Management of Forest

	a) FOREST TYPES	a) DIRECT DRIVERS
a) NYANZA		a) Agricultural expansion b) Permanent subsistence c) Permanent commercial- sugar, tobacco d) Wood extraction e) Firewood and charcoal f) Fish smoking g) Poles for construction& fencing

Development of NFMS in Kenya

30TH NOVEMBER 2017

KAZUHISA KATO

Contents of the Presentation

1. Definition of NFMS in UNFCCC

Decision 4/CP.15 : 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

(d) To establish, 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:

(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;

1. Definition of NFMS in UNFCCC

Decision 11/CP.19 Modalities for national forest monitoring systems

1. Affirms that, consistent with decision 1/CP.16, paragraph 71, the activities referred to in this decision are undertaken in the context of the provision of adequate and predictable support, including financial resources and technical and technological support to developing country Parties;

2. Decides that the development of Parties' national forest monitoring systems for the monitoring and reporting of the activities,1 as referred to in decision 1/CP.16, paragraph 70, with, if appropriate, subnational monitoring and reporting as an interim measure, should take into account the guidance provided in decision 4/CP.15 and be guided by the most recent Intergovernmental Panel on Climate Change guidance and guidelines, as adopted or encouraged by the Conference of the Parties, as appropriate, as a basis for estimating anthropogenic forest-related greenhouse gas emissions by sources, and removals by sinks, forest carbon stocks, and forest carbon stock and forest-area changes;

3. Also decides that robust national forest monitoring systems should provide data and information that are transparent, consistent over time, and are suitable for measuring, reporting and verifying anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and forest carbon stock and forest-area changes resulting from the implementation of the activities referred to in decision 1/ CP.16, paragraph 70, taking into account paragraph 71(b) and (c) consistent with guidance on measuring, reporting and verifying nationally appropriate mitigation actions by developing country Parties agreed by the Conference of the Parties, taking into account methodological guidance in accordance with decision 4/CP.15;

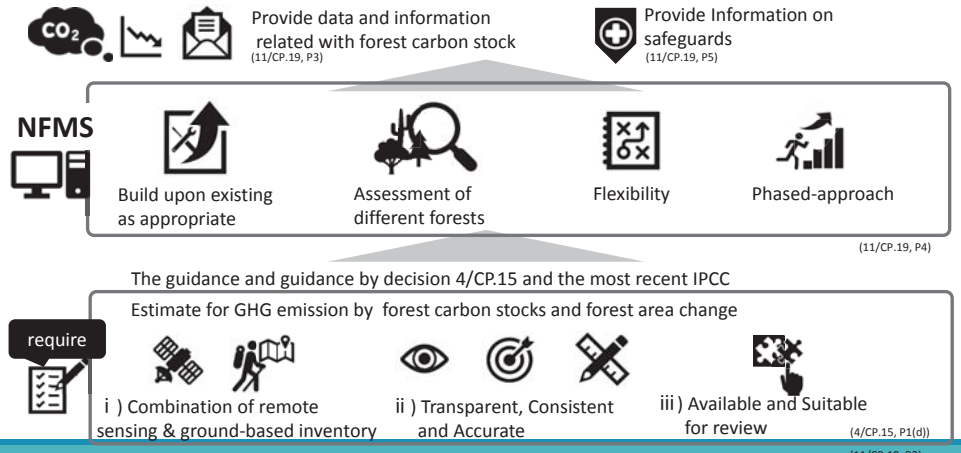
4. Further decides that national forest monitoring systems, with, if appropriate, subnational monitoring and reporting as an interim measure as referred to in decision 1/CP.16, paragraph 71 (c), and decision 4/CP.15, paragraph 1(d), should:

(a) Build upon existing systems, as appropriate;
(b) Enable the assessment of different types of forest in the country, including natural forest, as defined by the Party;
(c) Be flexible and allow for improvement;
(d) Reflect, as appropriate, the phased-approach as referred to in decision 1/CP.16, paragraphs 73 and 74;

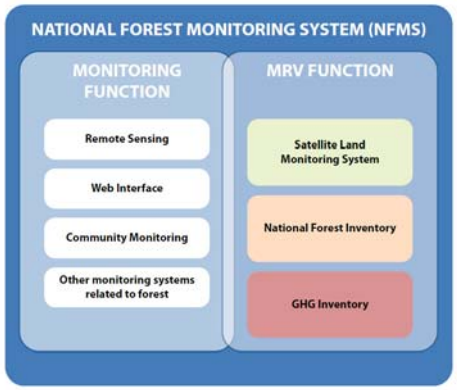
5. Acknowledges that Parties' national forest monitoring systems may provide, as appropriate, relevant information for national systems for the provision of information on how safeguards in decision 1/CP.16,

1. Definition of NFMS in UNFCCC

NFMS in UNFCCC decisions



2. UN-REDD NFMS Strategy



The "monitoring" function of the NFMS is primarily a domestic tool to allow countries to assess a broad range of forest Information, including in the context of REDD+ activities. The monitoring function can be implemented through a variety of methods and serve a number of different purposes, depending on national circumstances, but in the UN-REDD Programme context it focuses on the impacts and outcomes of

1) Demonstration activities carried out during the second phase of REDD+

2) National policies and measures for REDD+ in the third phase of REDD+.

The MRV function for REDD+, on the other hand, refers to the estimation and international reporting of national-scale forest emissions and removals. It is based on three main components, or 'pillars':

1) Satellite land monitoring system(SLMS)

2) National forest inventory (NFI)

3) National GHG inventory. The SLMS and the NFI pillars are used to provide inputs into the third pillar – the forest sector component of the GHG inventory. Countries must progressively

Develop and operationalize these three pillars over the three phases of REDD+, and align them with the monitoring function, so that by the third phase of REDD+ they have a fully functional NFMS.

Source : UNREDD program; National Forest Monitoring Systems: Monitoring and Measurement, Reporting and Verification (M & MRV) in the context of REDD+ Activities (2013)

3. Proposed NFMS in Kenya

NFMS in Kenya will be established from two aspect.

Monitoring function

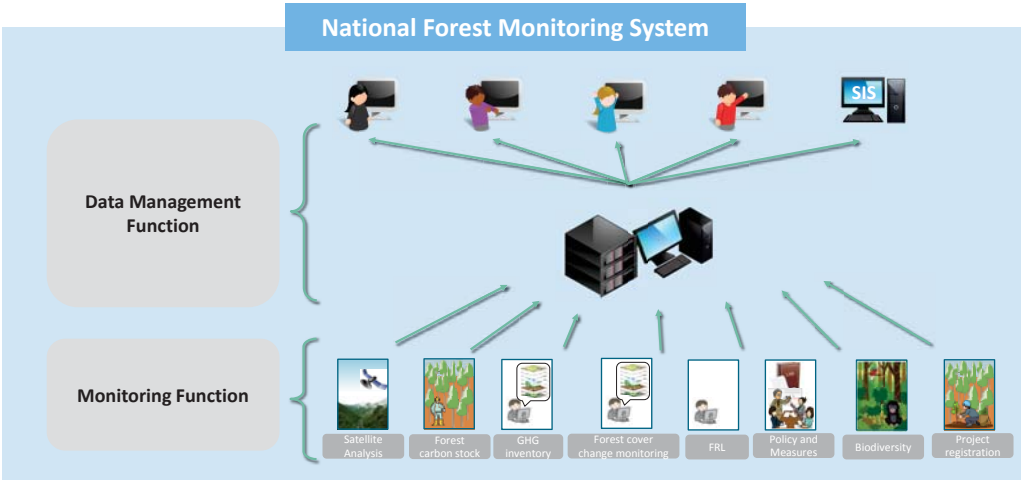
It is included estimation of anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks, forest carbon stock and forest area changes and forest reference level, information of policy and measure and biodiversity and registration of forest related project.

Data management function

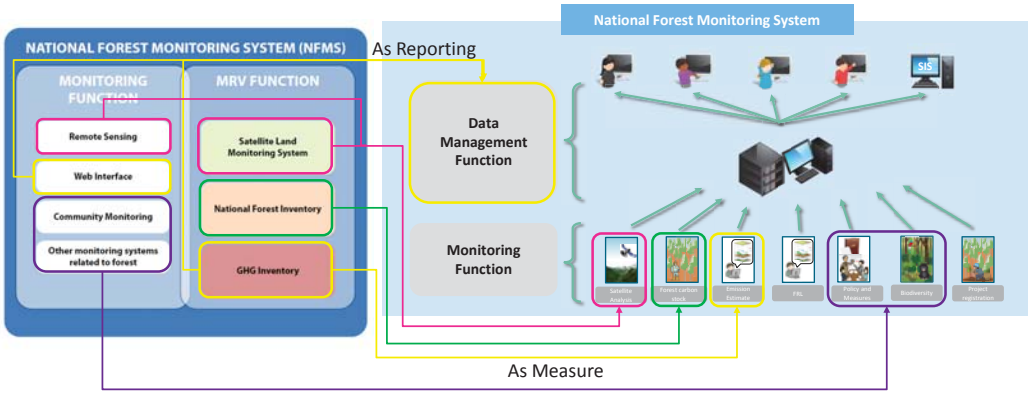
It is a database to input the information and data gathered by monitoring function and provide them for implementing forest management including REDD+.

All of NFMS in Kenya will be described in detail in the "NFMS document in Kenya" to ensure transparency.

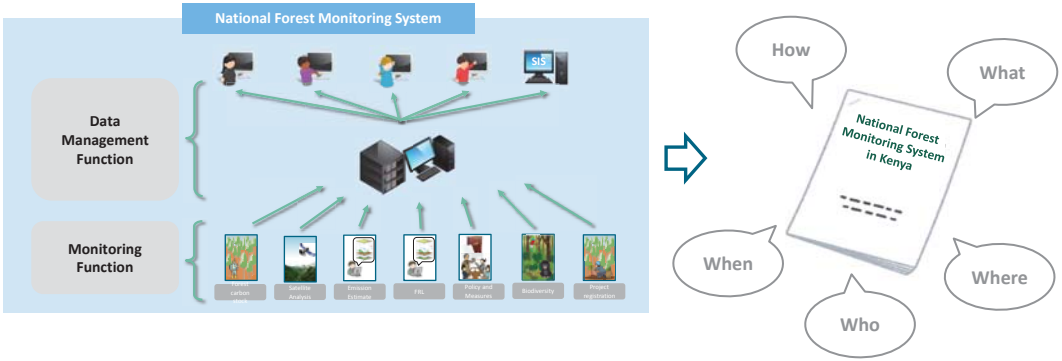
3. Proposed NFMS in Kenya



3. Proposed NFMS in Kenya



3. Proposed NFMS in Kenya



Contents of NFMS document

4. Objective of NFMS in Kenya

UNFCCC mentions objective of NFMS is Monitoring and Reporting of the activities.

Proposal

The objective of NFMS in Kenya is **gathering accurate and transparent data and information related with Kenya forest management and providing it to inform interested stakeholders on the forest status, to report to international conventions, and to make use of sustainable forest management in Kenya**.

5. Detail of Monitoring function of NFMS

Item	Information resource	Methodology
Satellite analysis (AD)	Land use / Land cover map	Methodology is Established based on SLEEK map manual
Forest carbon stock (EF)	National Forest inventory Tree volume equation Allometric equation BCEF、BEF	Methodology of NFI will be developed based on ICFRA proposal Equations have been already selected but it should be developed in Kenya as phased approach
GHG inventory	EF and AD	Forest related GHG emission by sources and removal by sinks is calculated from AD and EF
Forest area change Monitoring	Optical and radar satellite imageries	Detect land cover changed area
FRL	FRL of Kenya (and each conservancy)	FRL document
Policy and Measures	NDC, National REDD+ strategy and National Forest Program, etc.	Monitoring Methodology to be developed in Action Plan of National Forest Program etc..
Biodiversity	Protected area management plan, biodiversity assessment etc.	Methodology should be discussed with KWS and etc.
Project registration	Registration form of REDD+, CDM project	Registration system should be developed.

Methodology for AD monitoring

- **Forest Definition:**

Minimum surface area	0.5ha
Minimum Height	2m
Minimum Cover	15%

-Stratification: SLEEK stratification will be used

Forest Class
Montane Forest, Western Rain Forest and Bamboo Forest
Mangrove Forest and Coastal Forest
Dryland Forest
Plantation

X

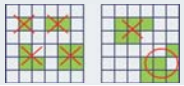
Canopy coverage class
Dense
Moderate
Open

= 12 forest types

*Each forest class is set by zoning

Methodology for AD monitoring

- **MAP :**

Map	SLEEK MAP
Image	Land Sat image or any available and more aculeate image
Methodology	Wall to Wall, Supervised Classification Developing 2014 map as base map
Time	Every two years ??
Filtering	More than 6 connected pixels(>0.54ha) is counted as one forest cluster 8 neighbor searching 

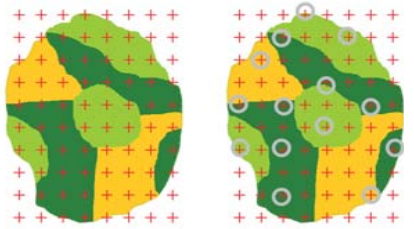
Methodology for EF monitoring

-NFI is utilized for developing EF

Sampling Design of NFI

1 Stratified sampling method: SLEEK stratification (12 forest types)

2 Random sampling method: The necessary number of clusters to be surveyed based on the SLEEK stratification. The number is randomly selected from the grid point of 2km-by- 2km distance: (4km^2 grids) over the whole country



Stratified sampling method Random sampling method

Methodology for EF monitoring

-Sampling Design of NFI

ICFRA proposal: Cluster sampling method

Cluster design is as follows. However, since SLEEK stratification is used that means, it is needed to decide how the cluster design will be adjusted, e.g. left side figure is for forest except for mangrove, right side figure is for mangrove. In addition, cluster method itself should be re-considered whether it is applied or not because of possibility that more than two forest types are mixing in a cluster.

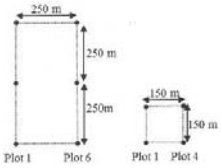


Figure . Cluster designs in Strata 1-3 (left) by ICFRA and in Stratum 4 (right).

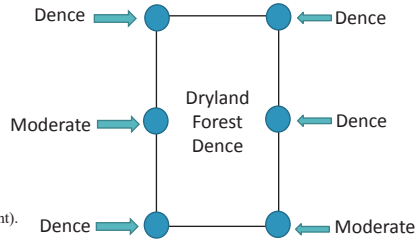


Figure . Example of cluster with more than two forest type mixed

In this case, how can the data be compiled? Moderate data is compiled as Dense forest or moderate forest? Otherwise no cluster method applied?

Methodology for EF monitoring

-Plots shape

ICFRA proposal: Cercle shape is used as mentioned in the following figure. However, since SLEEK stratification is used, it is needed to decide how each shape will be applied to the SLEEK stratification, e.g. left side is for non-forest, right side is for forest.

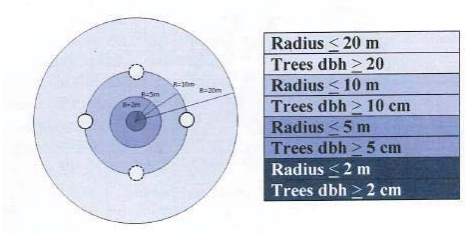


Figure . Sample plot design for Stratum 1 and 3

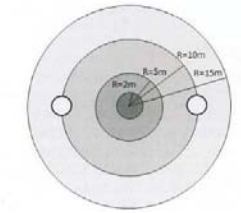


Figure . Sample plot design for Stratum 2 and 4

*ICFRA 2016. Proposal for National Forest Resources Assessment (NFRA) in Kenya.

Methodology for EF monitoring

- **Measurement method in the plots:**
- ICFRA proposal: As mentioned in the table

Table .Measurement on the circular sample plots.

	DBH/ diameter (cm)	Height/ length (m)	Plot radius (m)	Plot area (m^2)
Tree	≥ 2	≥ 1.3	2	12.6
Tree	≥ 5	≥ 1.3	5	78.5
Tree	≥ 10	≥ 1.3	10	314.2
Tree (Strata 2 and 4)	≥ 20	≥ 1.3	15	706.9
Tree (Strata 1 and 3)	≥ 20	≥ 1.3	20	1256.6
Climber	≥ 2	≥ 1.3	2	12.6
Climber	≥ 5	≥ 1.3	15	706.9
Bamboo		≥ 1.3	10 or 2 × 2.0	314.2 or 25.13
Lying dead wood	≥ 10	≥ 1.0	15	706.9
Shrub		≥ 1.3	15 or 2 × 2.0	706.9 or 25.13
Stump			15	706.9
Regeneration	< 2	≥ 0.10	2 × 1.5	14.13

*ICFRA 2016. Proposal for National Forest Resources Assessment (NFRA) in Kenya.

6. Contribution for Safeguard Information System

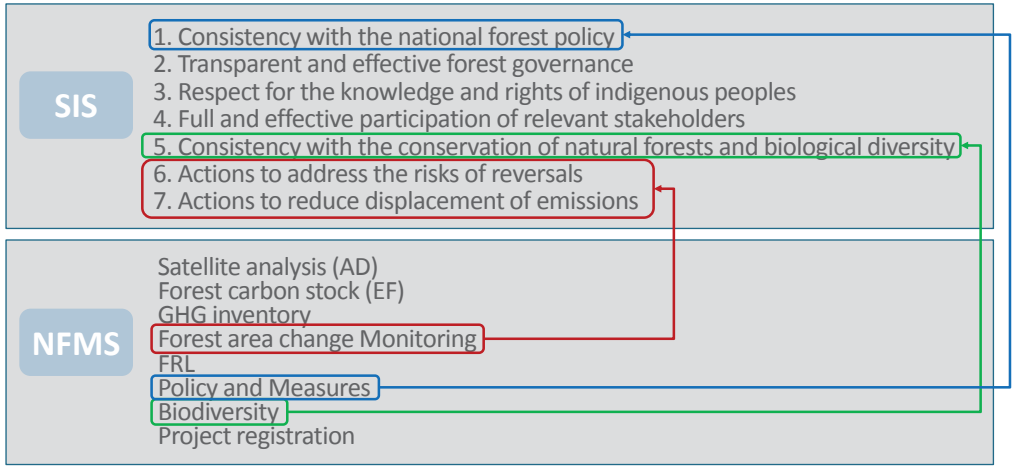
7 safeguards which should be promoted on implementation of REDD+ activities

1. Consistency with the national forest policy
2. Transparent and effective forest governance
3. Respect for the knowledge and rights of indigenous peoples
4. Full and effective participation of relevant stakeholders
5. Consistency with the conservation of natural forests and biological diversity
6. Actions to address the risks of reversals
7. Actions to reduce displacement of emissions

Safeguard Information System

Provide relevant information

NFMS



Information which is gathered by NFMS will be provided to SIS as relevant information

7. Consideration of Institutional arrangement

Item	Responsible body	Related institution
NFMS	KFS	KEFRI, KWS
Forest carbon stock (EF)	KFS(Inventory section??)	KEFRI? College
Satellite analysis (AD)	DRSRC or KFS ??	SLEEK member
GHG inventory	MEMR?	KFS
Forest cover change Monitoring	KFS (GIS, remote sensing section?)	SLEEK member
FRL	KFS	TWG member of FRL
Policy and Measures	KFS, MEMR ??	KEFRI
Biodiversity	KWS	KFS, KEFRI
Project registration	KFS(Forest Information Systems section??)	
FIP	KFS(Forest Information Systems section??)	

8. Provisional task for development of NFMS

Item	Task
Forest carbon stock (EF)	・Complete NFI's methodology ・Decide NFI Schedule ・Development of Tree volume equation and biomass equation in Kenya
Satellite analysis (AD)	・Revise Sleek map manual
GHG inventory	・developing reporting system of forest related GHG emission by sources and removal by sinks
Forest cover change Monitoring	・Develop land cover change monitoring methodology
FRL	・Finalization and submission of FRL Report
Policy and Measures	・Development of feasible monitoring methodology of implementation of the relevant policy and measures
Biodiversity	・Sort out information which should be provided to FIP
Project registration	・Develop registration system ・Register REDD+ (CDM) projects in Kenya

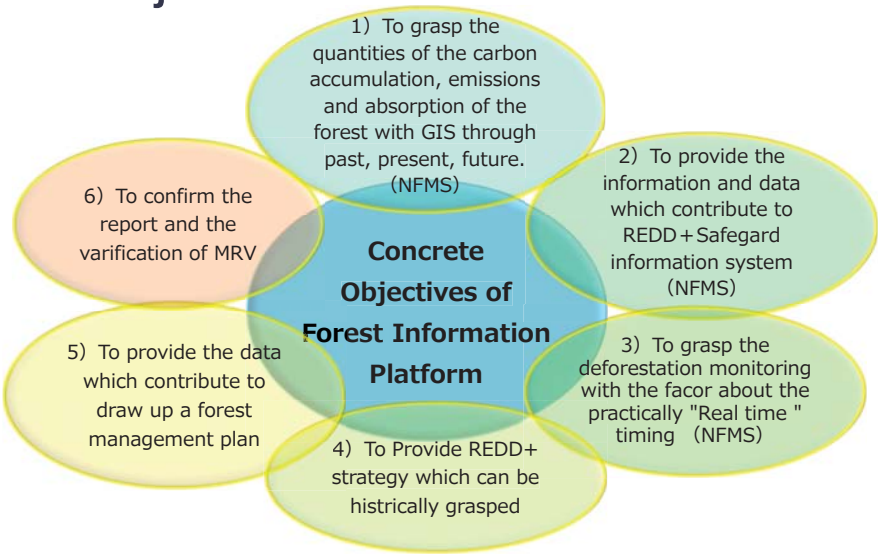
Forest Information Platform for NFMS , REDD+ and SFM

30th Novemver 2017

Shintaro ISHIZUKA
JICA Consultant Team
Database

Table of Presentation

FIP Objectives



FIP Functional description

To **replace KFIS's** functionality with the Web Portal Service with ArcGIS Enterprise

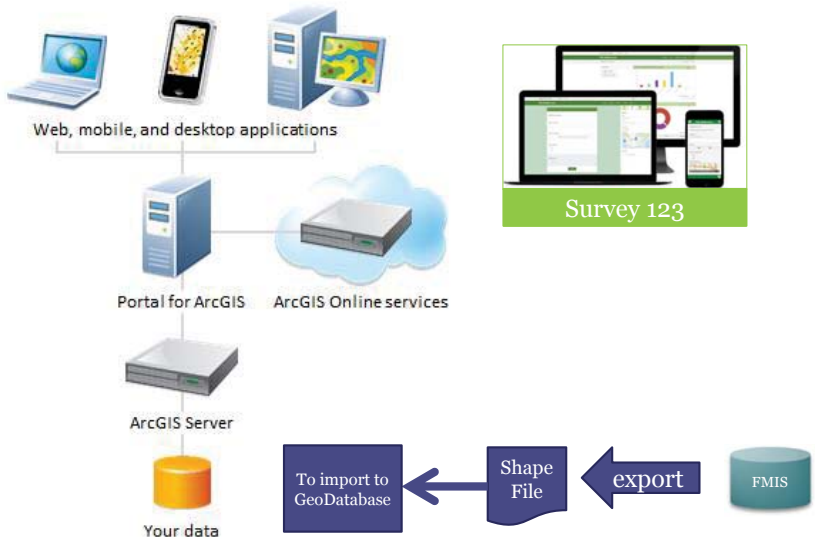
To use the Portal for ArcGIS Server with the limited access to the contents.

To utilize ArcGIS Online as the gateway to the accessible contents .

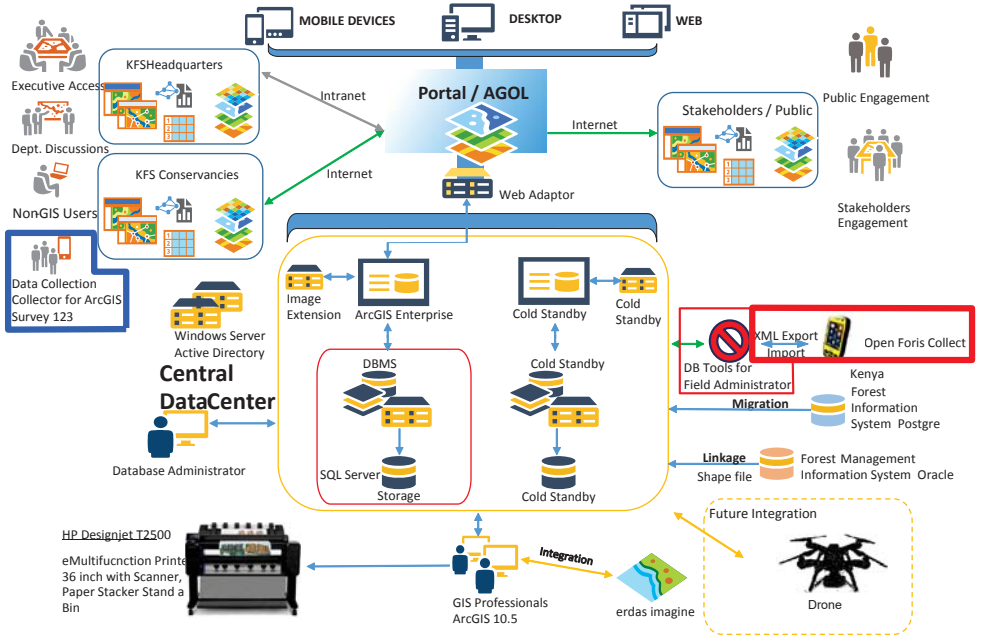
To support PDA devices for the data collection activities at the field

To support the other external system data with the static link.

FIP Basic Components



Forest Information Platform (overview design)

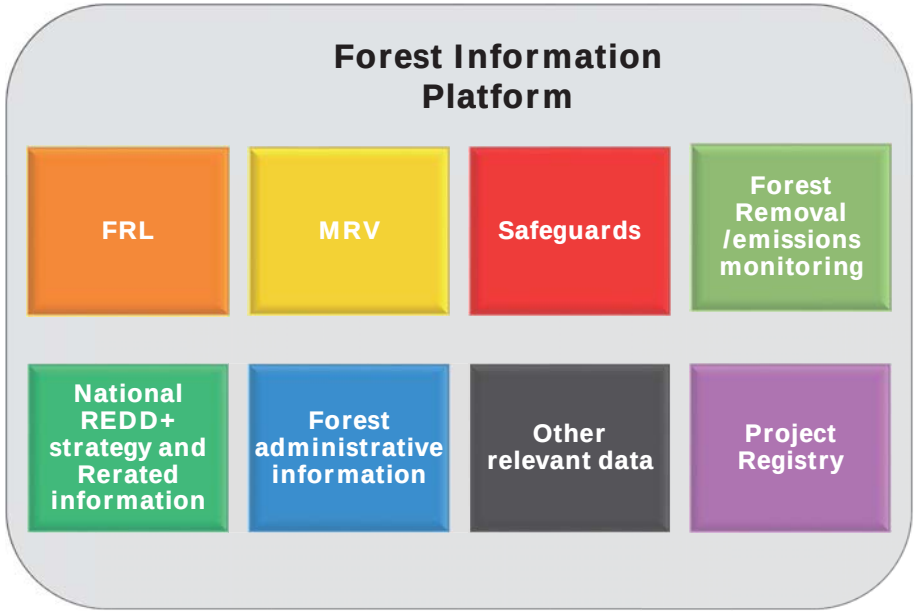


FIP Main Functions

1. FIP Site Map
2. Management of Inventory Data
3. FMIS Linkage

1. **FIP Site Map**

FIP Main 8 Components(Draft)



Contents type and persons to access FIP

- 4 type Contents
  - ①Description：Explanation of Contents
  - ②GIS data
  - ③Table：The result of calculation or Inventory
  - ④Document
- 4 type persons with access right on FIP
  - FIP Administrator
  - KFS
  - Related Stakeholder
  - General Citizen

Access Right of each contents type(Draft)

○:Edit and Update
△:View

Contents type	Access Right			
	FIP Administrator	KFS	Related Stakeholder	General Citizens
①Description	○	△	△	△
②GIS data	○	○※	△	△
③Table	○	○	△	△
④Document	○	○	○	△

※Specified persons can edit and update related forest GIS data

FIP Contents1(Draft)

Component	Contents	Contents type	Access Right (○Edit and update, △View)			
			KFS FIP Administrator	KFS	Related Stakesholders	General citizens
Top	Platform Objectives, Information Handled by the Platform, Outline of the Platform Functions	Description	○	△	△	△
FRLs	FRLs					
	What is FRELs/FRLs?	Description	○	△	△	△
	Evidence of formulation of FRELs/FRLs					
	Activity data					
	Land cover/land use change area	Table	○	○	△	△
	Land cover/land use map of the historical reference years	GIS data	○	○	△	△
	Emission factor					
	Forest inventory survey	Table	○	○	△	△
	Biomass conversion information	Table	○	○	△	△
	Emission estimate	Table	○	○	△	△
	National-circumstances	Document	○	○	○	△
	Useful Information for FREL/FRL	Document	○	○	○	△
MRV	MRV concept	Description	○	△	△	△
	What is MRV?	Description	○	△	△	△
	Measurement system		Same editing right to Forest Removal/Emissions Monitoring			
	Reporting system	Table	○	○	△	△
	Verification system	Table	○	○	○	△

FIP Contents2(Draft)

Component	Contents	Contents type	Access Right (○Edit and update, △View)			
			KFS FIP Administrator	KFS	Related Stakeholders	General citizens
Safeguards	Safeguard information system	URL linkage	○	○	△	△
Forest Removal/Emissions Monitoring	Forest removal and emissions monitoring					
	Activity data					
	Land cover/land use change area	Table	○	○	△	△
	Land cover/land use map	GIS data	○	○	△	△
	Forest cover change monitoring	Table	○	○	△	△
	Emission factor					
	Forest inventory survey	Table	○	○	△	△
	Biomass conversion information	Table	○	○	△	△
	JJ-FAST	URL linkage	○	○	△	△
	Forest carbon stock removal and emissions	Table	○	○	△	△
National REDD+ Strategy and related information	National REDD+ strategy	Document	○	○	○	△
	Policies and laws related REDD+	Document	○	○	○	△
	Conventions related climate change already ratified	Document	○	○	○	△
	Driving forces of deforestation and forest degradation	Document	○	○	○	△

FIP Contents3(Draft)

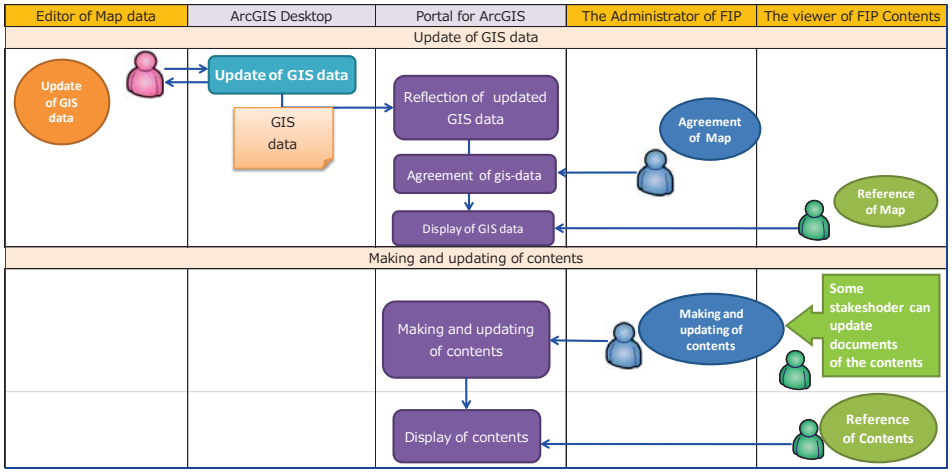
Component	Contents	Contents type	Access Right (○Edit and update, △View)			
			KFS FIP Administrator	KFS	Related Stakeholders	General citizens
Forest Administrative Information	Forest administration and REDD+	Document	○	○	○	△
	Forest related organization chart					
	Institutional Arrangement for REDD+ with role of each institution					
	Legal jurisdiction of Forest Management					
	Information on forest governance					
Other Relevant Data	Relevant information	Document	○	○	○	△
	Rule & regulation and other detailed information (area, data on endangerd and of prcious species etc.) of potected area including national parks					
	Demographic information including tribe information					
	Other related maps	GIS data	○	△	△	△
	Siol maps					
	Precipitation map					
	temprature map					
	Carbon map					
	Glossary	Document	○	○	○	△
Project Registry	Project Registry	Document GIS data	○	○	△	△

Next page

FIP Contents4(Draft)

Component	Map layers	Contents type	Access right (○Edit and update, △View)			
			KFS FIP Administrator	KFS	Related Stakeholders	General citizens
Other Relevant Data	Cities and Towns					
	Capital of District	GIS data	○	△	△	△
	Cities and Towns	GIS data	○	△	△	△
	Clusters	GIS data	○	△	△	△
	River					
	Watershed	GIS data	○	△	△	△
	River	GIS data	○	△	△	△
	Water body	GIS data	○	△	△	△
	Meteorological station	GIS data	○	△	△	△
	Road	GIS data	○	△	△	△
	Mining Concession	GIS data	○	△	△	△
	Land Units, Land Systems, Land Regions		○	△	△	△
	Agriculture					
	Flora Zambesiaca	GIS data	○	△	△	△
	Agra-ecological zone	GIS data	○	△	△	△
	Ecological zoning	GIS data	○	△	△	△
	Soil	GIS data	○	△	△	△
	Elevation	GIS data	○	△	△	△
	Other project(preparing)	GIS data	○	△	△	△
	Forest fire (by Queimadas) (preparing)	GIS data	○	△	△	△

Flowchart of FIP operation process



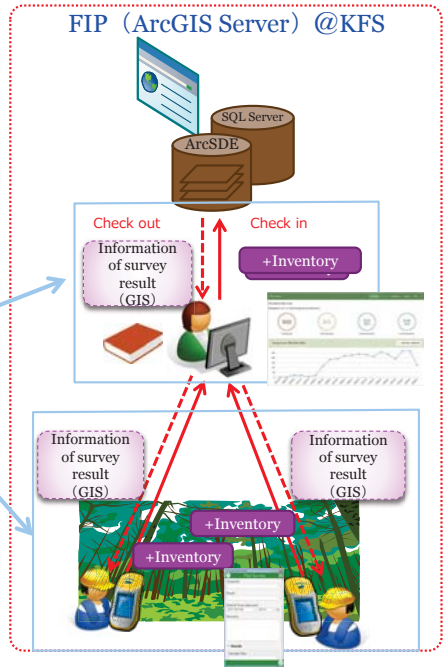
2． Management of Inventory Data

Survey 123

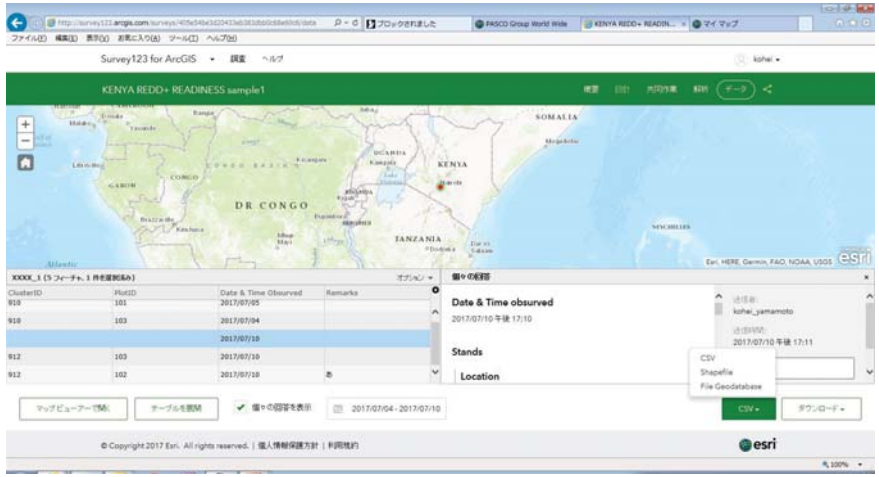
Survey 123 is the software based on ArcGIS Online Solution. Because FIP takes ArcGIS Online as a web service core software for open data survey 123 will be adapted for the data collection at field survey.

[Developed Items]
- To develop the functionality of submission of the inventory data to the FIP with security control.
- To develop interface for inventory data registration as same as Open Foris Collect, further more with Map and Satellite imagery.

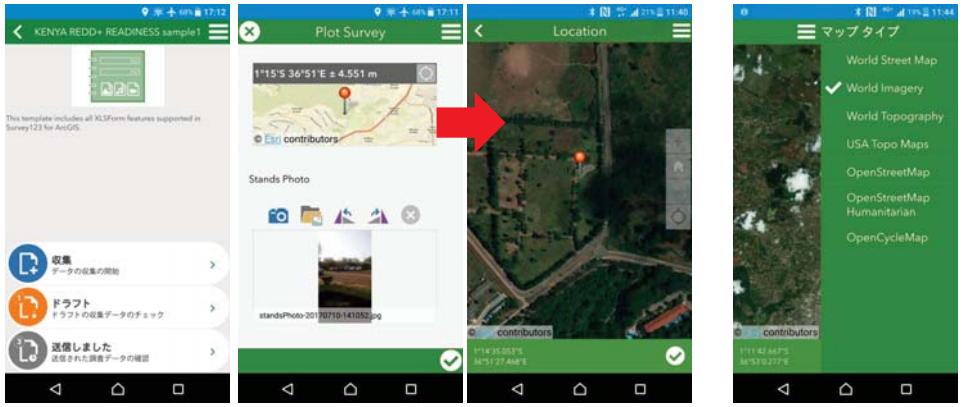
*Interface and function will be developed based on the function of ArcGIS Server



Sample application of survey 123 Administrator's tools



PDA Client



Survey 123 for FIP data collection

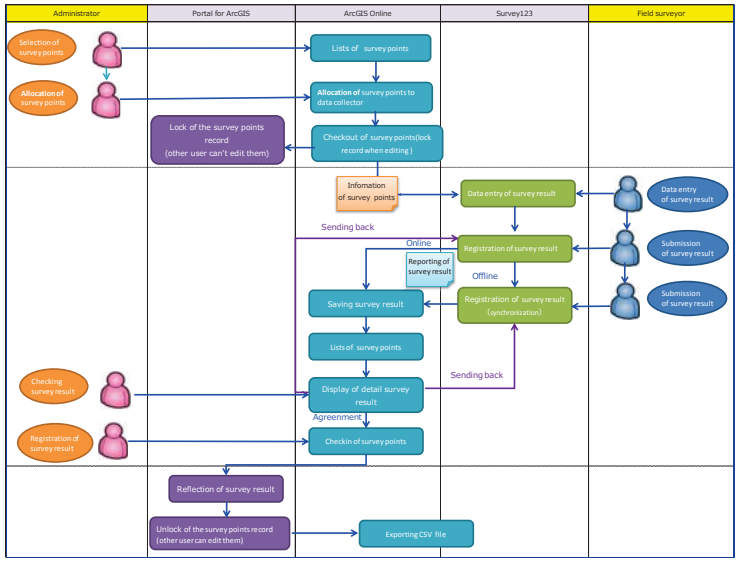
PDA Client

- Installed with Survey 123 on PDA
  - Receive work order message
  - Collect data following the work order record which are assigned
  - Register the data and upload to the survey 123 data cloud

Administrator's tools

- Design tools to create work order
  - Unique ID will be checked out from ArcSDE server database.
  - Unique ID will be written to the row of XLS files to be accessed by each surveyor
- Consistency tools of Database
  - The results of data collection will be checked in to ArcSDE Server database after the consistency tools verification.

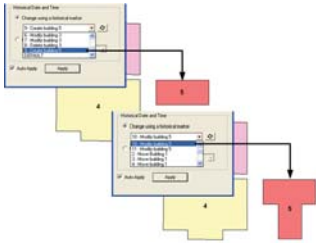
Flowchart of Forest Inventory collection operation process



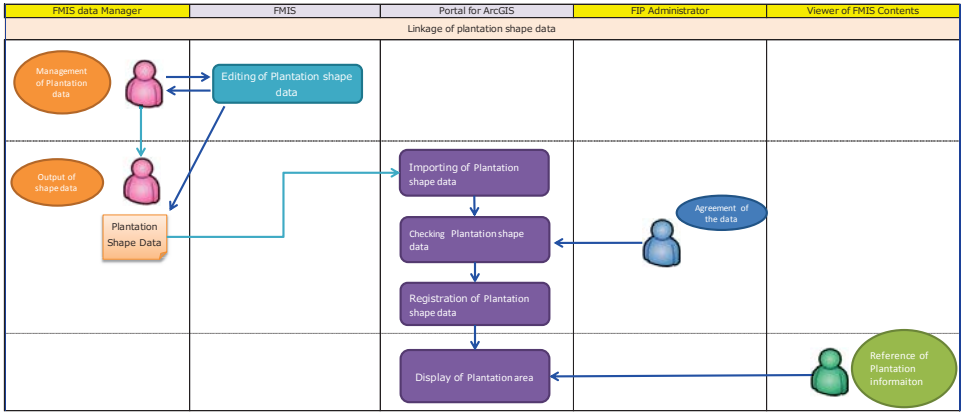
3. FMIS Linkage

FMIS System Linkage Functionality

- Periodically the shape file for planation from FMIS will be exported at the certain location.
- The linkage functionality will import shapefile data to the geodatabase which are enabled archiving .

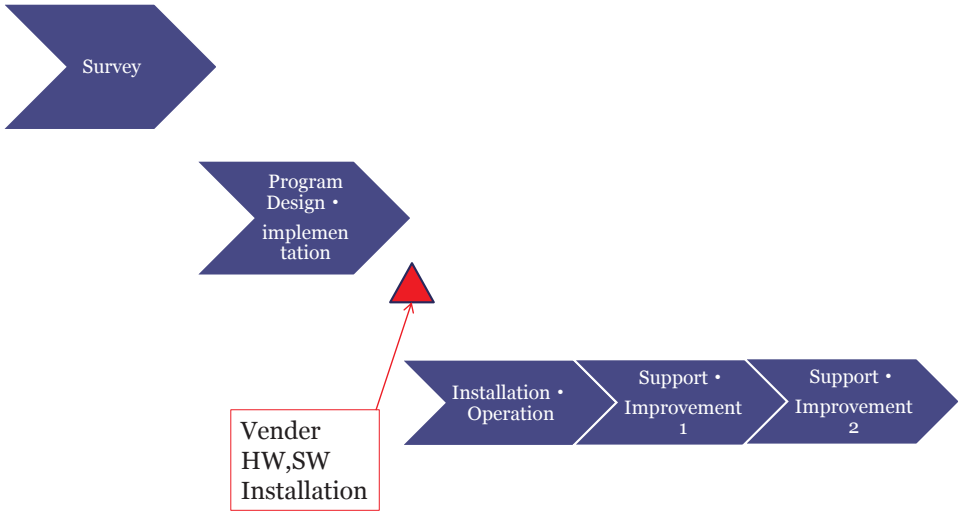


Flowchart of FMIS Linkage operation process



FIP Development Schedule

2016 2017 2018 2019 2020



REPUBLIC OF KENYA

Ministry of Environment and Forestry

Kenya Forest Service

Programme for REDD+ Technical Working Group Meeting

Date: 20th and 21st September 2018.

Venue: Lake Naivasha Resort, Naivasha

Purpose: Discussion on Kenya's Progress in Forest Reference Level (FRL) development and establishment of National Forest Monitoring System (NFMS).

Day 1	Topic	Facilitator
8:30 -9:00	Arrival and Registration of participants	Ms. Florence
9:00-9:10	Introduction and climate setting	Mr. Nduati
9:10- 9:20	Confirmation of previous minutes	Mr. Nduati
9:20-9:30	Workshop Objectives / Opening remarks	Mr. Gichu
9:30-10:30	Discussion for Further Improvement of FRL ✓ Uncertainty of AD, EF and FRL ✓ Emission Value of Forest degradation ✓ Including Data Points in Reference Period ✓ Assessment of Deadwood and Litter as Carbon Pool ✓ Assessment of MODIS Fire Data ✓ EF from Non-Forest to Forest especially Dense Forest	Mr. Gichu/ Mr. Nduati/ Mr. Kato
10:30-11:00	Tea Break	
11:00-1:00	Continuation of discussion on further improvement of FRL	Mr. Gichu/ Mr. Nduati/ Mr. Kato
13:00-14:00	Lunch Break	
14:00-15:00	Continuation of discussion on further improvement of FRL	Mr. Gichu/ Mr. Nduati/ Mr. Kato

Day 1	Topic	Facilitator
15:00-16:00	Work Plan for further improvement of FRL development.	Mr. Gichu/ Mr. Nduati/ Mr. Kato
16:00	Tea Break	

Day 2	Topic	Facilitator
9:00-10:30	Current Status of NFMS	Mr. Gichu/ Mr. Nduati/ Mr. Kato
10:30-11:00	Tea Break	
11:00-12:50	Way forward on development of NFMS	Mr. Gichu/ Mr. Nduati/ Mr. Kato
12:50-13:00	Official Closing of workshop	Mr. Gichu
13:00-14:00	Lunch and Departure	

PARTICIPANTS LIST OF THE TECHNICAL WORKING GROUP MEETING

20TH AND 21ST SEPTEMBER 2018

NO.	NAME	ORGANIZATION	TELEPHONE	EMAIL ADDRESS	20TH	21ST
1.	Peter Nduati	KFS			√	√
2.	Alfred Gichu	KFS			√	√
3.	J K Ndambiri	KFS			√	√
4.	Dr. Mwangi Kinyanjui	Karatina University			√	√
5.	Dr. James Kimondo	KEFRI			o	√
6.	Maurice Otieno	NEMA			√	√
7.	Faith Mutwiri	KFS			√	√
8.	Jane Wamboi	KWS			√	o
9.	Anthony Macharia	Survey of Kenya			√	√
10.	Margaret Midika	DRSRS			√	√
11.	Merceline Ojwala	DRSRS			√	√
12.	Dr. Benson Kenduiywo	JKUAT			√	√
13.	Mwangi Githiru	Wildlife Works			√	√
14.	Dr. Winnie Musila	KWTA			√	o

NO.	NAME	ORGANIZATION	TELEPHONE	EMAIL ADDRESS	20TH	21ST
15.	Frank Msafiri	Suswatch Kenya			√	√
16.	Kimani Peris	MoEF (SLEEK)			√	√
17.	John Ngugi	KEFRI			√	√
18.	David Adegu	MoEF (CCD)			√	√
19.	Prof.Balozi Bekuta	University of Eldoret			√	√
20.	Keiichi TAKAHATA	JICA CADEP-SFM			√	√
21.	Kazuhisa KATO	JICA CADEP-SFM (REDD+ component)			√	√
22.	SATO Kei	JICA CADEP-SFM (REDD+ component)			√	√
23.	Kazuhiro YAMASHITA	JICA CADEP-SFM (REDD+ component)			√	√
24.	Yoshihiko SATO	JICA CADEP-SFM (REDD+ component)			√	√
25.	Florence Tuukuo	CADEP- SFM/ JOFCA			√	√
	TOTAL				24	23

NB: √ - Present o - Absent

Day 1: 20th September 2018

MIN1: 20/09/2018 Workshop Objectives / Opening Remarks

The meeting was called to order at 9:30 AM by Mr. Alfred Gichu who requested Ms. Peris to lead in a word of prayer. This was followed by a self-introductory session whereby all participants stated their roles in the organizations they work for. Mr. Gichu, who chaired the meeting then briefed participants the reason for convening the technical working group and stated that the Forest Reference Level had not been submitted to the UNFCCC yet.

He explained that Forest Reference Level should be guided by the REDD+ strategy so that it can capture the guidelines outlined therein, at the time, REDD+ strategy had not been developed. Also, from experts review of the drat FRL, some comments and recommendations needed to be revisited so that FRL would be improved. The objective of the meeting was therefore to understand the current status of FRL development in Kenya and to provide an opportunity to strengthen some technical areas that had not been considered so far.

Why FRL was not submitted in January 2018

- After the document was shared with stakeholders included the member of CfRN who is a UNFCCC reviewer, the feedback was that Kenya needed to carry out data cleaning to avoid missing out on great opportunities as a result of using irrelevant value.
- The Forest Reference Level, REDD+ strategy, National Forest management System and Safeguards Information System ought to be delivered as a package hence submitting FRL alone would not have been very useful.
- The REDD+ strategy formulation process was recently launched hence other REDD+ elements can move together and be able to synergize. FRL will be established as baseline informed by strategic activities which will push towards implementation.

MIN2: 20/09/2018 Confirmation of previous minutes

The project manager took the participants through minutes of the TWG held on 29th November 2017 for refresh the memory of participants on what has been done, the current status and the way forward for the REDD+ process.

REDD+ has to be reported through national communications and FRL should be consistent with Green House Gas Inventory being carried out at the Ministry of Environment and Forestry. The FRL figure (-7,369, 087 tCO_2/ yr.) which would be the baseline for achieving financial based payments needed to be improved by considering a number of issues including; reference years, data points, activity data, maps, emission factor of forest degradation and conservation. These processes need to be reexamined to improve on the FRL figure which can be acceptable and reflect the true situation of the forestry sector.

Conservation (which is not included as a REDD+ activity in Kenya) has been identified as a major category for Kenya by peer review. FRL development may be not be allowed to do away with it hence TWG should decide on how to deal with the activity. The two points considered; 2000 and 2014 may not sufficient to justify the GHG emissions from the forest sector and more points may need to be included.

The National REDD+ coordinator (Mr. Gichu) took the participants through minutes of the TWG for the second day on 30th November 2017.

The minutes were confirmed by Mr. Maurice and seconded by Dr. Benson.

MIN3: 20/09/2018 Discussion for Further Improvement of FRL

Discussion for Uncertainty for AD, EF, and FRL

In consideration of the key recommendations for FRL improvement by the member of CfRN, for FRL submitted after 2019, uncertainty must be calculated according to IPCC guideline. Moreover, information on estimation of uncertainty is required if Kenya will get result-based payment from GCF.

IPCC 2006 guidelines explain how to combine uncertainty of AD and EF in Vol. 3. The uncertainty of FRL should be estimated after that based on consolidation uncertainty of AD and EF. The

uncertainty of AD has not been obtained yet hence FRL uncertainty has not been estimated. In addition, the methodology of AD estimation is still under study and will be shared with TWG after it will be well understood. Even though the IPCC 2006 guidelines outlines the methodology for calculation of uncertainty, the deviations of AD uncertainty are not mentioned, therefore, Kenya has to decide on this issue in order to get the uncertainty of AD.

CfRN recommended for assessment of the accuracy of land use changes and canopy cover % changes, by Collect Earth which is used with high resolution imagery but for Kenya only satellite data can be used from Landsat, Worldview and other aerial imagery. However, 2000 does not have high resolution satellite imagery by collect earth thus it is necessary to conduct estimation of uncertainty after which discussion on appropriate modification of Activity Data can be engaged in. Factors to be considered include for calculation of AD uncertainty; Appropriate methodology, number of points to be assessed for accuracy, number of reference years and the number of data points to be used for accuracy assessment of activity data. Other issues to be considered are sampling design, verification plot size for instance MMU (30m by 30m) or bigger, location of verification plot and verification class type. One factor that can inform the process is inclusion of all types of land use/ land cover by stratification which will enable highlighting the change pattern by class type hence accuracy check can be performed according to the country's purpose.

Work done by SLEEK and GHGI was modified previously based on classes of FRL forest types hence if the current stratification follows their methodology it will constitute 8 classes. There should be appropriate documentation of the proceedings of TWG since it will affect progress of the FRL process. Determination of the number of points to be included in calculation of patterns of change will make it easier to identify changes that occur for instance forest to grassland.

A proposal was given to postpone the discussion on estimation of uncertainty of AD since the expert team was still studying the scientific documents that were received from UNFCCC expert.

The references being quoted include Global Forest Observation Initiative, Methods and Guidance Document (MDG), Olofsson et al. 2013 and Olofsson et al. 2014 together with IPCC guidelines are being applied in accuracy assessment and estimating uncertainty of AD.

Estimation of Uncertainty of Emission Factor (Presented by Mr.Yamashita)

The estimation was done by bootstrap method which is mentioned in 2006 IPCC guidelines, Vol 1 Chapter 3. Kenya' s pilot inventory was carried out in only 127 plots which is not enough for symmetric distribution hence bootstrap simulation was performed and the results were described to the TWG. This method helps to estimate uncertainty to obtain the confidence interval of the mean in case the uncertainty of the mean is not a symmetrically (2006 IPCC Guideline). Since a national forest inventory has not been carried out in Kenya, the trial estimation was tested using only data from pilot forest inventory (127 plots).

Estimation of Uncertainty of Forest Reference Level

Estimation of FRL by combining uncertainty of AD and EF is guided by IPCC guidelines (Volume 3), and it will be carried out after calculating both the uncertainty of AD and EF.

Discussion for Emission Value of Forest degradation

There are concerns on emission from forest degradation because it is easy to identify dense, moderate and open forests. But for the changes within the forest types e.g. from 90% to 70% in dense forest is not factored in.

The question is therefore how to account for forest degradation apart from the canopy cover change, is it possible to have proxies to check on this? Considering other countries are using proxies like for fire and deadwood matter. Discussion of forest degradation would have much influence on pattern change, also there is need to factor in Kenya's situation i.e. where does the biggest change occur, for instance change of forest to what? Another point of consideration for Kenya will be identifying the area in the forest area where the major benefits should come from.

Emission Estimate of Forest Degradation

Forest degradation value is very low as compared to FAOSTAT data which constitutes default data, this is due to accuracy issue. Forest degradation can be measured by a different approach for example include production of fuelwood, wood removal and occurrence of forest disturbance. FAO provides default data for all these factors and according to these data, emission from fuelwood extraction may be higher compared to the current degradation value by use of the matrix method. The matrix method indicate that forest degradation value is about 2.8 million tCO_2 / yr. while FAOSTAT data indicate emission from forest degradation is 70 million tCO_2 / yr., if this is changed, it may change the FRL value from emission to removal. Emission estimate highlighted in yellow color (in the change matrix) will be deleted from this change matrix and emission estimate for forest degradation will be re calculated based on default values by FAOSTAT data instead of using estimation by the change matrix.

The recalculation should factor in unsustainable sources that contribute to forest degradation. In the light of this, Forest Resources Assessment (FRA 2015) will be considered as it details Kenyan data from KFS and KNBS on the amount of fuelwood utilized in Kenya. Information on forest degradation from wood fuel extraction should be extracted from FRA 2015 data, by studying the amount of it produced mostly from marginal areas after which total emissions from the wood fuel extraction can be approximated**.** Wisdom analysis report indicates that 1/3 of forest degradation is from marginal areas (estimated 9 Mt) and 33% of drylands contribute to total fuelwood demands. FAOSTAT data is global data against which UNFCCC reviewers will check the data generated by Kenya so that the forest degradation calculation should be based on FAOSTAT data and Wisdom data and other scientific papers including Forest Outlook Observation in Africa and Master plan for 1994.

Under forest degradation also; production of fuelwood, wood removals and occurrence of disturbance have been captured. Production of fuelwood is one of the wood removals and disturbance is caused by fires. Data on other wood removals should be researched on for accurate calculation of emission estimation for forest degradation. In conclusion, FAOSTAT data and Wisdom data should be studied carefully to compute baselines which can be later compared and

submitted in another TWG for getting accurate value of forest emission factors after making clear recommendations.

Occurrence of Disturbance

Forest fire data will be used to capture occurrence of disturbance, FAOSTAT data and MODIS fire data can be used for determination of the occurrence of disturbance. A demonstration was given on how to select fire data on FAOSTAT where specific criteria are necessary e.g. year, biomass value and biomass burning.

MODIS fire data includes spatial value but does not capture how much biomass is burnt. MODIS fire data should be counter checked to confirm whether fire occurred in forest or non-forest area. Also, MODIS which captures fire that extends 500m by 500m necessitates knowledge of fire spatial extent in Kenya to be well factored in. The challenge with MODIS data is capturing the actual area of fire occurrence, hence this data should be combined with IPCC default values for fire to capture forest degradation within an area. The MODIS data should be assessed to check consistency and its possibility to capture forest fires for Kenya.

Discussion of Including Data Points in Reference Period

Reference points should be consistent which is critical to support the model used for FRL development. The recommendation was to consider inclusion of more data points in the time-series to understand not only the net change, but also the behavior of emissions and removals in time and its trend. The JICA team took TWG members through data for the various years to give their suggestion on the years whose data can be included. If FRL is submitted after 2019, 2014 may not be very reliable to use as the baseline year, moreover, a land use land cover map for 2018 will be developed by DRSRS, therefore, the years (2000,2002, 2003, 2014) with good maps can be considered in addition to 2018. The 2018 LULC map will be ready by January 2019, thus the 2018 map can be used as the baseline for FRL. Also 2010 map can be smoothened (which is a moderately good map). SLEEK representative stated that Government of Australia communicated on their interest to fund accuracy assessment of the maps which can then generate more data points.

The meeting was adjourned at 5:00 pm as the participants agreed to start the meeting at 8:30 am the following day.

MIN4: 20/09/2018 Recap of day 1

The meeting was called to order by Mr. Alfred Gichu who requested Ms. Margaret to start off with a word of prayer. He then called upon Mr. Nduati to briefly take the participant's through a recap of what was discussed the previous day. Mr. Nduati then stated that quite a number of issues were covered including estimation of uncertainty of AD, EF and FRL, and where AD was keenly discussed in terms of changes and uncertainty. The changes expected from one forest cover to another need to be covered in pattern change calculation. However, the reference materials are being studied after which recommendations on the way forward in estimating uncertainty of AD and EF can be done.

Uncertainty of EF will be calculated using the bootstrap method through the R software. Uncertainty of FRL will be calculated after acquisition of uncertainty of AD and EF. Emission value for forest degradation will be acquired by application of the wisdom tool, FAOSTAT data and FOSA report where the results from the three methods will be compared to capture the real forest degradation. This will determine whether to use the canopy cover densities in the matrix or to use the recommended FAOSTAT data by reviewers. MODIS fire data covers 500m by 500m area but not biomass burnt in the area, a comparison was done with data acquired by KFS and KWS and check if they rhyme after which forest fires can be matched to specific areas of occurrence. The reference period was suggested on to include more data points and introduce some other points for the reference period.

Day 1: 21st September 2018

MIN5: 20/09/2018 Discussion for Further Improvement of FRL

Discussion of Assessment of Deadwood and Litter as Carbon Pool

In calculation of FRL, deadwood had been excluded as well as biomass burning. Kenya should assess possibility of using existing deadwood and litter from field plot data according to the recommendation of the reviewers. ICFRA strata data should be checked to assess if it can be used and decide on the allometric equation to use. For litter, there is no field plot data on litter is available hence it is not possible to include litter as a carbon pool. However, the reviewer may have recommended that because litter may be a key category or big emitter of GHG. It's crucial to understand deadwood and litter contribution in GHG emissions. ICFRA project data can be checked to determine the volume of deadwood and litter. This should be considered in the knowledge that litter is a significant pool especially in natural forest because it is unutilized.

An allometric equation can be developed as soon as parameters are well known by relating the various factors including AGB, BGB and deadwood. ICFRA data can be used to inform the inclusion of deadwood and litter as carbon pools but the issue about matching their stratification methodologies to ensure data is appropriately captured should be factored in, if some ICFRA data does not match with the SLEEK stratification it can be eliminated. The ICFRA data should be looked into to assess the number of plots data that can be applied to determine the significance of deadwood and litter.

Discussion of EF from Non-Forest to Forest especially Dense Forest

Full re-stocking of Carbon Stocks is assumed in the 14-yr period for transitions from non-forest land to Forest land. This may be overestimating removals hence a big difference between the current value and IPCC default value therefore expert judgement can be used to estimate the number of years it takes for full restocking of the forest. Based on expert opinion, a decision was made to use 60 years for natural/montane forest, 50 years for dryland and 30 years for plantation

forest as the period within which they attain full maturity. The plantation forest period was informed by its rotation age, montane forest and dryland forest periods were left to be researched on in scientific papers for reference.

MIN6: 21/09/2018 Current Status of NFMS

The NFMS is defined by existing policies in Kenya including decisions (11/cp.19, p3), (11/cp.19, P5, 11/cp.19, p4), (4/cp.15 p1(d)) and (11/cp.19, p2), these policies guide NFMS definition by UNFCCC which has much interest in natural forest. The monitoring system should be designed to monitor natural forest. The NFMS should; provide data and information related with forest carbon stock, provide Information on safeguards and estimate GHG emission by forest carbon stocks and forest area change.

NFMS will have two functions namely; data management function and Monitoring function; the data management function will include the Safeguards Information System (SIS) while the monitoring function will include information on balance of GHG for forests, providing information to SIS and project registration. An explanation on comparison between UNREDD strategy NFMS and proposed NFMS was given for both reporting and measurement. The items to be monitored within the NFMS are outlined in the table below including where the information will be obtained from and the methodology that will be applied for each item.

Item	Information resource	Methodology
Satellite analysis (AD)	Land use / Land cover map	Methodology is Established based on SLEEK map manual
Forest carbon stock (EF)	National Forest inventory, Allometric equation	Methodology of NFI will be developed based on ICFRA proposal with modification. Equations have been already selected but it should be developed in Kenya as phased approach
Forest area change Monitoring	Optical and radar satellite imageries	Detect land cover changed area
Policy and Measures	NDC, National REDD+ strategy and National Forest Program, etc.	Monitoring Methodology to be developed in Action Plan of National Forest Program etc..
Biodiversity	Protected area, management plan, biodiversity assessment etc.	Methodology should be discussed with KWS and NMK as well.
Project registration	Registration form of REDD+, CDM project	Registration and monitoring system should be developed.

The NFMS shall comprise various contents which were presented to the participants, it shall include;

<table>
<tr><th>Chapter</th><th colspan="2">Contents</th></tr>
<tr><td>Chapter 1</td><td colspan="2">Background and Purpose</td></tr>
<tr><td>Chapter 2</td><td colspan="2">UNFCCC Requirements</td></tr>
<tr><td colspan="2" rowspan="8">Chapter 3
Basic conditions for NFMS</td><td>3.1 Scale</td></tr>
<tr><td>3.2 Forest Definition</td></tr>
<tr><td>3.3 Forest stratification and classification</td></tr>
<tr><td>3.4 Land use categorization</td></tr>
<tr><td>3.5 Carbon Pool</td></tr>
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<tr><td rowspan="5">Chapter 4</td><td rowspan="5">Conceptual design of the NFMS in Kenya</td><td>4.1 Purpose of Kenya’s NFMS</td></tr>
<tr><td>4.2 Composition of NFMS</td></tr>
<tr><td>4.2.1 Monitoring Function</td></tr>
<tr><td>4.2.2 Data Management Function</td></tr>
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<tr><td rowspan="8">Chapter 5</td><td rowspan="8">NFMS Components</td><td>5.1 Forest Cover area and forest cover change AD</td></tr>
<tr><td>5.1.1 Forest cover area by mapping</td></tr>
<tr><td>5.1.2 Forest cover change area by mapping</td></tr>
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<tr><td>5.2 Forest carbon stock for emission factors</td></tr>
<tr><td>5.3 PaMs</td></tr>
<tr><td>5.4 Biodiversity</td></tr>
<tr><td>5.5 REDD+ and AR-CDM project for the register</td></tr>
<tr><td rowspan="4">Chapter 6</td><td rowspan="4">Data Management function by FIP</td><td>6.1 Component and contents of the FIP</td></tr>
<tr><td>6.2 Access rights of each content</td></tr>
<tr><td>6.3 Linkage with NFMS</td></tr>
<tr><td>6.4 Update and Operation</td></tr>
<tr><td>Chapter 7</td><td>Institutional Arrangement for NFMS</td><td>7.1 Institutional Arrangement for Monitoring Function</td></tr>
<tr><td></td><td></td><td>7.2 Institutional Arrangement for Data Management Function</td></tr>
<tr><td>Chapter 8</td><td colspan="2">Calendar of NFMS</td></tr>
</table>

The content items highlighted in red color had not yet been included in the current NFMS draft document since they are still under development. Institutional arrangement should be informed by the NRS thus a linkage between the two should be factored in. A decision needs to be made on the period within which monitoring shall be carried out. The actions outlined in NRS can be monitored through the NFMS.

The monitoring of policies and measures is still under development but the procedure involves selecting programme strategies from among the strategies of thematic clusters in National Forest Program (NFP) where status of implementation of the programs are considered which informs the methodology of monitoring. A registry is required to capture all efforts pertaining to the REDD+ process and it should be able to report on everything relating to the forestry sector, the registry shall also serve as a standard such that reporting about carbon stock should meet a certain threshold. As for the monitoring of EF, modification of ICFRA stratification should be considered so as to harmonize it with SLEEK stratification.

The activities to be carried out were itemized as below:

Item		Task
Monitoring Function	Satellite analysis (AD)	• Revise SLEEK map manual
	Forest carbon stock (EF)	• Complete NFI 's methodology • Decide NFI Schedule • Development of Tree volume equation and biomass equation in Kenya
	Forest cover change monitoring	• Identify the purpose of using • Identify method of forest cover change monitoring
	Policy and Measures	• Discuss for considering method of monitoring of PaMs
	Biodiversity	• Examine how KFS, KWS and NMK are conducting monitoring activities
	Project registration	• Identify what kinds of data/information items should be provided in the FIP
Data Management Function		• Develop the linkage with FMIS and system of update and operation on FIP
Institutional arrangements for NFMS		• Have a close relationship with NRS
Calendar of NFMS		• Decide schedule of future monitoring for AD, EF (NFI), and others

The expert team agreed to share draft 1 of the NFMS with the TWG members so as to get inputs from them as well as engage them in the process of development of NFMS.

MIN7: 21/09/2018 Closing Remarks

Mr. Gichu stated that the discussions were very fruitful and encouraged continuous engagements adding that the progress of the work on FRL, NFMS and NRS is clearer in terms of how to move

forward with development. The TWG members were called upon to support various tasks to ensure successful development of the REDD+ process.

AOB

1. Mr. Kazuhiro YAMASHITA informed that he was leaving the project to pursue further studies. He does not have any other assignment in Kenya.
2. The project manager Mr. Nduati introduced the Chief Technical Advisor (Mr. Keiichi TAKAHATA) for CADEP-SFM project who took over from Mr. TAKANO.
3. Mr. Nduati then thanked participants and informed them about logistical arrangement.

There being no other business the meeting ended at 12:45 pm with a word of prayer lead by Prof. Balozi.

Discussion for Further Improvement of FRL

REDD+ TWG Meeting

2018. Sep. 20

Discussion based on mainly Key findings and options for short-term improvements

1. Uncertainty of AD including accuracy assessment, EF and FRL
2. Emission estimate of forest degradation
3. Including data points in reference period
4. Assessment of including deadwood and litter as carbon pool and assessment of MODIS fire data
5. EF from non-forest to forest especially dense forest

1 Uncertainty of (1) AD including accuracy assessment, (2) EF and (3) FRL

- The estimation of uncertainty must be done if Kenya will get result-based payment from GCF. Based on the GCF scorecard, FRL without uncertainty information is FAIL in case of submission of FRL to UNFCCC after 2019
- For getting uncertainty of FRL, at first, uncertainty of EF and AD have to be estimated respectively.

1 (1) Accuracy assessment and uncertainty of AD

Key findings and options for improvements for uncertainty of AD

Issue type (TACCC) and description	Priority level and Key Category	Options for improvement	Notes for implementing improvements
Accuracy. The accuracy assessment of land use changes is not complete.	Short-term Key Category	Assess the accuracy of land use changes and canopy cover % changes as determined for 2000-2014, using higher-resolution satellite imagery If large errors are found, identify a better option (if practicable) for representing land use changes and forest degradation/enhancements As an alternative, change the canopy cover % threshold in the forest definition and select a value that is less uncertain in terms of the classification. If intermediate-small errors are found, the areas of the maps may be adjusted following the methods described by Olofsson et al. 2014.	*Accuracy assessment*. This assessment may be done through Collect Earth, recognizing that the availability of high-resolution images in the dryland areas is poor (some areas like in the image below, only have satellite images available for one yr). 

1 (1) Accuracy assessment and uncertainty of AD

What we should decide for conducting work to assess accuracy of AD

Items	Point to be confirmed and/or decided
Methodology	Collect Earth will be used for accuracy assessment, but we should study how the uncertainty of AD will be estimated based on some scientific papers such as GFOI MGD, 2016 and Olofsson, 2013 and 2014.
The work of accuracy assessment through checking the satellite imageries by use of Collect Earth.	To identify how long months are needed and how much cost is need for the preparation of work plan, the necessary information is as follows. 1 Necessary Work Period (1) Total how many points for the accuracy assessment should be assesed? 1) How many reference years must be assessed? (2000, 2010, 2014, 2018?) 2) How many points should be assessed per reference year (It is necessary to calculate statistically, but the calculation method is clear?) (2) How many points can be checked per person per day? (the required man-months can be calculated from the information of (1) and (2)) (3) How many people can engage with the work? (the required months can be calculated from the man-months and the information of (3)) 2 Required Budget if needed (1) Cost item (2) unit price (3) Quantity (It can be calculated from required man-months indicated by above mentioned in 1 (2))

1 (1) Accuracy assessment and uncertainty of AD

What we should decide to identify necessary work period

- Sampling Design for accuracy assessment
  - * We should consider balance of the cost and purposes
  - Verification Point Size

    Ex) Mapping Minimum Unit (MMU) basis e.g. 30 m x 30 m by LandSat or Bigger size than MMU

    *Recommendation: Simple
  - Location of Verification Point

    *Recommendation: Simple Random
  - Verification Class Type (change pattern of class type)

    Ideal design is all class type, however change pattern is depended on number of class types i.e. check that the number of change patterns will be class types times class types.

    This is related to number of assessment points

1 (1) Accuracy assessment and uncertainty of AD

What we should decide to identify necessary work period

- Verification Class Type (change pattern of class type)

Ex)

	Ratio of size	Num of Samles
Forest (O)	0.7%	43
Forest (M)	1.0%	63
Forest (D)	4.3%	254
Cropland	10.5%	576
Grassland	69.6%	1,301
Water Body	2.1%	128
Other & Settlements	11.7%	637
TOTAL		3,002

	Ratio of size	Num of Samles
Forest (O)	0.7%	43
Forest (M)	1.0%	63
Forest (D)	4.3%	254
Cropland	10.5%	576
Grassland	39.6%	1,470
Wooded Grassland	20.0%	983
Wetland	10.0%	553
Water Body	2.1%	128
Other & Settlements	11.7%	637
TOTAL		4,708

Ex) Forest → Non Forest ○

Non Forest → Forest ○

Forest → Forest x

etc.

1 (2) Uncertainty of EF

Key findings and options for improvements for uncertainty of EF

Issue type (TACCC) and description	Priority level and Key Category	Options for improvement	Notes for implementing improvements
Accuracy. An estimation of the error (standard deviation) for the Emission Factors is missing at the forest type level (e.g. table 5, p.14).	Short-term Key Category	From the 127 plots, estimate the uncertainty using IPCC guidelines for the Emission Factors.	This is a necessary step for propagating total uncertainty for the FRL.

1 (2) Uncertainty of EF

Progress of uncertainty of EF and way forward

- Methodology of the estimation for uncertainty of EF is based on IPCC 2006 guideline, which is the bootstrap method (one of the Monte Carlo method).
- The trial estimation was done and the results of trial estimation should be explained and discussed in this REDD+ TWG meeting.

1 (3) Uncertainty of FRL

Key findings and options for improvements for uncertainty of FRL

Issue type (TACCC) and description	Priority level and Key Category	Options for improvement	Notes for implementing improvements
Accuracy. Even though the estimation of uncertainty for AD and EF is reported, total FRL uncertainty is missing (Section 4).	Short-term Key Category	Total uncertainty is necessary to provide a global estimate of the accuracy of the FRL. This can be done following IPCC guidelines and existing data.	

1 (3) Uncertainty of FRL

Current status

- Methodology of the estimation for uncertainty of FRL by combining the uncertainty of EF and AD is based on IPCC 2006 guideline.
- Therefore, the estimation based on the method will be made after estimating uncertainty of AD and EF.

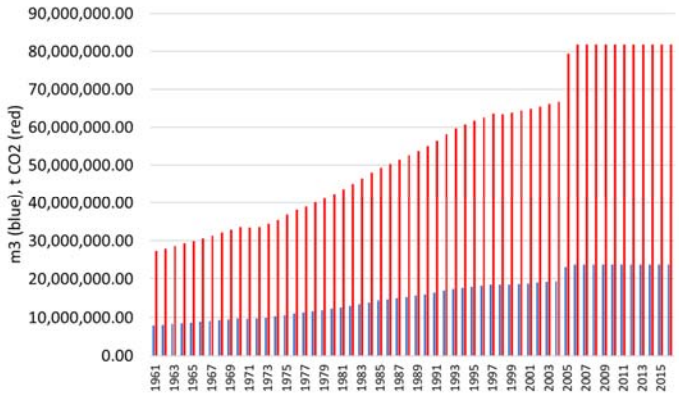
2 Emission Estimate of Forest Degradation

Key findings and options for improvements

Issue type (TACCC) and description	Priority level and Key Category	Options for improvement	Notes for implementing improvements
Accuracy. Forest degradation estimates seem very low compared to FAOSTAT data.	Short-term Key Category	Forest degradation may be measured using a different approach, for example, through considering the production of fuelwood, wood-removals and the occurrence of disturbances. FAOSTAT provides default values for all. According to this data, emissions from fuelwood production may be extremely high (Annex 1).	

2 Emission Estimate of Forest Degradation

Annex 1. Fuelwood production (m3) according to FAOSTAT for Kenya.



2 Emission Estimate of Forest Degradation

How we should replace the emission estimate of forest degradation

			2014														
			Montane Forest / Western Rain Forest / Bamboo			Costal Forest and Mangroves			Dryland Forest			Plantation			Cropland	Grassland	Wetland	Other land
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open				
2000	Montane Forest / Western Rain Forest / Bamboo	Dense	0	1,465,355	581,435	–	–	–	–	–	–	–	–	–	4,118,881	3,994,579	17,046	34,643
		Moderate	−3,661,797	0	72,459	–	–	–	–	–	–	–	–	–	168,465	474,139	5,001	625
		Open	−1,437,890	−69,322	0	–	–	–	–	–	–	–	–	–	58,303	125,976	112	653
	Costal Forest and Mangroves	Dense	–	–	–	0	89,817	6,577	–	–	–	–	–	–	17,789	416,817	3,957	8,242
		Moderate	–	–	–	−905,905	0	10,213	–	–	–	–	–	–	71,494	1,148,195	3,479	7,731
		Open	–	–	–	−21,693	−7,858	0	–	–	–	–	–	–	3,548	71,372	76	618
	Dryland Forest	Dense	–	–	–	–	–	–	0	287,918	254,969	–	–	–	965,714	6,572,913	26,410	21,387
		Moderate	–	–	–	–	–	–	−948,138	0	95,699	–	–	–	169,384	1,404,444	9,629	16,273
		Open	–	–	–	–	–	–	−389,572	−117,257	0	–	–	–	25,243	225,006	3,238	10,552
	Plantation	Dense	–	–	–	–	–	–	–	–	–	0	52,662	24,830	455,172	405,498	523	442
		Moderate	–	–	–	–	–	–	–	–	–	−173,696	0	−182	8,848	12,424	92	46
		Open	–	–	–	–	–	–	–	–	–	−66,336	207	0	4,429	5,557	2	6
	Cropland		−2,579,282	−38,652	−6,648	−35,217	−2,796	−98	−228,425	−10,449	−951	−453,684	−2,414	−1,628				
	Grassland		−8,826,143	−623,158	−135,174	−1,906,000	−297,257	−11,055	−5,961,891	−716,672	−217,800	−1,370,368	−14,369	−6,082				
	Wetland		−13,878	−123	−23	−18,472	−4,390	−224	−50,224	−8,085	−1,906	0	0	0				
	Other land		−24,617	−2,186	−1,066	−11,839	−1,806	−21	−64,536	−17,122	−26,753	−7,554	−16	−6				

- Emission estimate highlighted in yellow color will be deleted from this change matrix, and emission estimate for forest degradation will be made based on default values by FAOSTAT data instead of using estimation by the change matrix.

2 Emission Estimate of Forest Degradation

What should we conduct for using FAOSTAT data?

- Will the following data be used?
  Fuel wood (a kind of wood-removal): FAOSTAT from 2000 to 2014 for getting the average.
  Wood-removals except for fuel wood: data showing Table 4c in Kenya country report for FRA 2015 can be used, but from 2000 to 2011 (not 2014) for getting the average.
  Occurrence of disturbances: Data for forest fire will be used for occurrence of disturbances. The Data is available from FAOSTAT. Meanwhile, there is another option to get the forest fire data, which is the use of MODIS fire data. Therefore, it should be decided which data will be used, FAOSTAT or MODIS fire data. In case of FAOSTAT data, data from 2000 to 2014 for getting the average.

- All of the available data on forest degradation in FAOSTAT and other sources should be consolidated and emission estimate for forest degradation will be calculated.

3 Including Data Points in Reference Period

Key findings and options for improvements

Issue type (TACCC) and description	Priority level and Key Category	Options for improvement	Notes for implementing improvements
Consistency. Due to satellite imagery data availability/quality, two points in time 2000-2014 were compared to derive land use and land use changes. This is critical to support the model used to define the FRL values.	Short-term Key Category	Consider including more data points in the time-series to understand not only the net change, but also the behavior of emissions and removals in time and its trend.	This is important to validate if the historical average approach to define the FRL values is accurate for Kenya.

3 Including Data Points in Reference Period

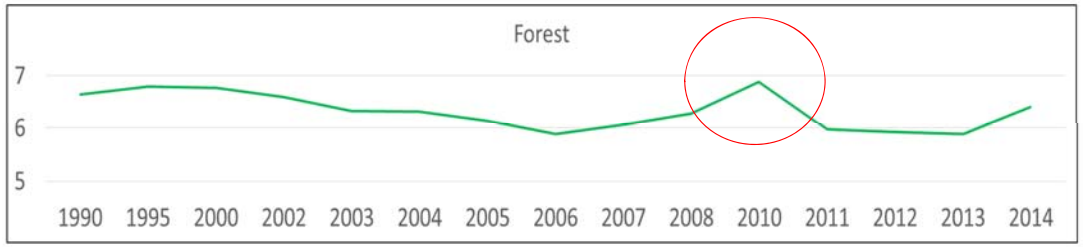
Result of data screening and Recommendable Year

	1990	1995	2000	2002	2003	2004	2005	2006
No DATA (%)	10.59%	14.35%	6.50%	6.53%	8.56%	23.77%	20.86%	23.13%
LANDSAT4 (scene)	26	0	0	0	0	0	0	0
LANDSAT5 (scene)	8	34	0	0	0	0	0	0
LANDSAT7 (scene)	0	0	34	34	34	34	34	34
Missing scenes	0	0	0	0	0	0	0	0
LANDSAT8 (scene)	0	0	0	0	0	0	0	0
Stripping Effect (scene)	0	0	0	0	0	34	34	34
Ratio of Stripping Effect (%)	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**100.00%**	**100.00%**	**100.00%**

	2007	2008	2009	2010	2011	2012	2013	2014
No DATA (%)	26.14%	28.00%	15.85%	6.81%	12.51%	20.85%	16.98%	3.75%
LANDSAT4 (scene)	0	0	0	0	0	0	0	0
LANDSAT5 (scene)	0	0	11	24	15	0	0	0
LANDSAT7 (scene)	34	34	23	9	19	34	13	0
Missing scenes	0	0	0	1	0	0	0	0
LANDSAT8 (scene)	0	0	0	0	0	0	21	34
Stripping Effect (scene)	34	34	23	9	19	34	13	0
Ratio of Stripping Effect (%)	**100.00%**	**100.00%**	**64.60%**	**26.50%**	**55.90%**	**100.00%**	**38.20%**	**0.00%**

3 Including Data Points in Reference Period

Forest cover rate based on 2010 map is like outlier.



Based on the above table and graph, not many options to include data point.

How do we select the data point?

4 Assessment of including Deadwood and Litter as Carbon Pool and Assessment of MODIS Fire Data

Key findings and options for improvements

Issue type (TACCC) and description	Priority level and Key Category	Options for improvement	Notes for implementing improvements
Completeness. Deadwood has been excluded, as well as biomass burning	Short-term Some may be potentially Key Categories	Assess the possibility of using existing data on deadwood (and litter) from field-plots. Assess current MODIS fire data for estimating biomass burning (CO_2 and non-CO_2 emissions).	

4 Assessment of including Deadwood and Litter as Carbon Pool and Assessment of MODIS Fire Data

What will we conduct?

- For the assessment of the possibility of using existing data on deadwood from field-plots, it is necessary to check whether KFS stores the data that can be used to calculate the numerical value for deadwood volume. Also, in the case of calculating the biomass amount of deadwood, it is necessary to determine the allometric equation for the calculation. Meanwhile, if the TWG decide not to use deadwood data, it is no necessary to assess the above-mentioned.
- Since no data on litter from the plots data is recognized, it is impossible for including litter.
- If FAOSTAT data is used for biomass burning, it is no necessary to assess the MODIS fire data. However, if MODIS data is used, for the assessment current MODIS fire data, at first it is necessary to identify how to assess the data, and then it is necessary to find out how to reflect the biomass burning data by MODIS data into the emission estimate, including finding out default value of EF for MODIS fire data as AD.

5 EF from Non-Forest to Forest especially Dense Forest

Key findings and options for improvements

Issue type (TACCC) and description	Priority level and Key Category	Options for improvement	Notes for implementing improvements
Accuracy. Full re-stocking of Carbon Stocks is assumed in the 14-yr period for transitions from non-forest land to Forest land.	Short-term Key Categories	Emission Factors are defined for a 14-yr period, assuming that full re-stocking is achieved in this period for dense forests types may be overestimating removals (See comparison of current EFs vs. IPCC values in Annex 2).	Annual C stock change values may be estimated based on expert judgement. For example, it takes X number of years for a Montane/Dryland/Mangrove forest to reach full biomass re-stocking. Apply these values annually. (Note: Otherwise this might introduce bias in the estimation of REDD+ results.)

5 EF from Non-Forest to Forest especially Dense Forest

Annex 2. Comparison of EFs in the FRL Report and the IPCC defaults.

Forest type	Biomass stocks (t d.m.) as reported in the FRL (AGB+BGB)	Annualized stock increments (t d.m.) (AGB+BGB)	IPCC default (t d.m. yr-1) (AGB only)	Biomass stocks (t d.m.) as reported in the FRL (AGB only)	Annualized stock increments (t d.m.) (AGB only)
Montane, Western Rainforest/Bamboo - Dense	438.11	31.29	2.0 -5.0 [1]	344.97	24.64
Montane, Western Rainforest/Bamboo - Moderate	74.21	5.30		58.43	4.17
Montane, Western Rainforest/Bamboo - Open	29.54	2.11		23.26	1.66
Coastal Forest, Mangroves - Dense	122.38	8.74	9.9 [2]	94.63	6.76
Coastal Forest, Mangroves - Moderate	74.00	5.29		60.45	4.32
Coastal Forest, Mangroves - Open	43.00	3.07		35.47	2.53
Dryland Forest – Dense	112.03	8.00	2.4 [3]	80.32	5.74
Dryland Forest – Moderate	47.52	3.39		34.52	2.47
Dryland Forest- Open	18.12	1.29		14.26	1.02
Plantations- Dense	554.58	39.61	10 [4]	436.68	31.19
Plantations -Moderate	144.20	10.30		113.54	8.11
Plantations - Open	175.54	12.54		138.22	9.87

[1] Tropical Mountain System for Africa, <20 yrs, 2006 IPCC Guidelines (Table 4.9)
[2] Tropical Wet, Wetlands Supplement (Table 4.4)
[3] Tropical Dry for Africa, <20 yrs, 2006 IPCC guidelines (Table 4.9)
[4] Tropical Mountain System for Africa, 2006 IPCC Guidelines (Table 4.10)

Figures in red color are too big difference compared with IPCC defaults

5 EF from Non-Forest to Forest especially Dense Forest

What will we conduct?

- Decide EFs which should be revised? Are 1) Montane, Western Rainforest/Bamboo – Dense, 2) Dryland Forest – Dense, and 3) Plantations- Dense with too big difference compared with IPCC defaults applicable or more data applicable?
- X number of years to reach full biomass re-stocking by each forest type to be applied for the revise will be decided based on expert judgement with reasonable reasons (with peer-reviewed scientific papers).
- Check whether the following calculation method can be used or not.
  - Current CO2 amount for applied forest types will be divided by each X years to reach full biomass re-stocking, which is annual CO2 stock change values. Then, the value times the reference period (for instance, 14 years).

5 EF from Non-Forest to Forest especially Dense Forest

Which EFs should be revised.

EF applied in the FRL

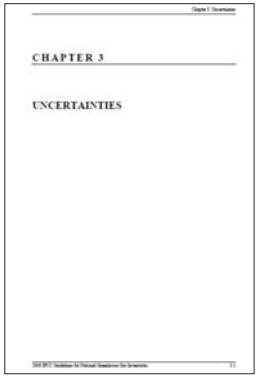
The beginning year of the period			The end year of the period: Montane Forest/Western Rain Forest/Bamboo Dense	Montane Forest/Western Rain Forest/Bamboo Moderate	Montane Forest/Western Rain Forest/Bamboo Open	Coastal Forest and Mangroves Dense	Coastal Forest and Mangroves Moderate	Coastal Forest and Mangroves Open	Dryland Forest Dense	Dryland Forest Moderate	Dryland Forest Open	Plantation Dense	Plantation Moderate	Plantation Open	Cropland	Grassland	Wetland	Other land
Montane Forest /Western Rain Forest/Bamboo	Dense		0	635.64	713.66											765.26	749.31	765.26	765.26
	Moderate		-635.64	0	78.02											129.62	113.67	129.62	129.62
	Open		-713.66	-78.02	0											51.61	35.66	51.61	51.61
Coastal Forest and Mangroves	Dense					0	84.78	139.03								213.96	198.01	213.96	213.96
	Moderate					-84.78	0	54.25								129.18	113.23	129.18	129.18
	Open					-139.03	-54.25	0								74.93	58.98	74.93	74.93
Dryland Forest	Dense								0	113.24	164.91					196.56	180.61	196.56	196.56
	Moderate								-113.24	0	51.68					83.32	67.37	83.32	83.32
	Open								-164.91	-51.68	0					31.64	15.69	31.64	31.64
Plantation	Dense											0	716.82	662.07		968.69	952.74	968.69	968.69
	Moderate											-716.82	0	-54.75		251.87	235.92	251.87	251.87
	Open											-662.07	54.75	0		306.62	290.67	306.62	306.62
Cropland			-765.26	-129.62	-51.61	-213.96	-129.18	-74.93	-196.56	-83.32	-31.64	-968.69	-251.87	-306.62					
Grassland			-749.31	-113.67	-35.66	-198.01	-113.23	-58.98	-180.61	-67.37	-15.69	-952.74	-235.92	-290.67					
Wetland			-765.26	-129.62	-51.61	-213.96	-129.18	-74.93	-196.56	-83.32	-31.64	-968.69	-251.87	-306.62					
Other land			-765.26	-129.62	-51.61	-213.96	-129.18	-74.93	-196.56	-83.32	-31.64	-968.69	-251.87	-306.62					

- EFs shown in [green] color will be revised in case that 1) Montane, Western Rainforest/Bamboo – Dense, 2) Dryland Forest – Dense, and 3) Plantations- Dense are applied.

Trial estimation for Uncertainty of EF

Uncertainty analysis of EF

- The uncertainty analysis of AD and EF was conducted by the 2006 IPCC Guideline (Volume 1 Chapter 3).



CHAPTER 3

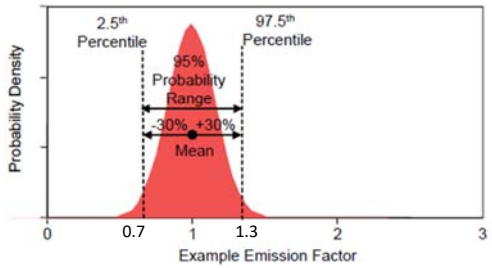
UNCERTAINTIES

Uncertainty analysis of EF

- The results of uncertainty analysis of EF are shown as follows. The estimation describes the ranges of 95 % Probability of the confidence interval.

Figure 3.3 Examples of symmetric and asymmetric uncertainties in an emission factor

(a) Example of a symmetric uncertainty of ±30% relative to the mean

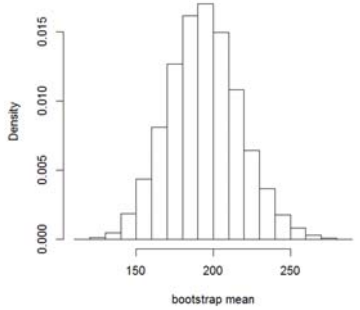


（IPCC 2006）

Uncertainty analysis of EF

- The Bootstrap simulation helps to estimate uncertainty to obtain the confidence interval of the mean in case of the uncertainty of the mean is not a symmetric distribution by the 2006 IPCC Guideline.

Bootstrap by R calculation (10,000 times running)



Uncertainty analysis of EF

- The uncertainty analysis of EF calculated by Bootstrap simulation according to the 2006 IPCC Guideline (Volume 1 Chapter 3) using by "R" software.

The result of Bootstrap by R calculation (10,000 times running)

```
> biomass.h <- c(biomassdata$biomass)
>
> mean.boot <- numeric(10000)
> set.seed(314)
> for (b in 1:10000){
+ i <- sample(1:127,replace =TRUE)
+ biomass.boot <- biomass.h[i]
+ mean.boot[b] <- mean(biomass.boot)}
>
> hist(mean.boot, freq=F,xlab="bootstrap mean",main="")
>
> sort(mean.boot)[c(0.025*10000,0.975*10000)]
[1] 149.8854 241.9887
>
> mean(mean.boot)
[1] 194.0996
```

Figure. Bootstrap by R calculation (10,000 times running)

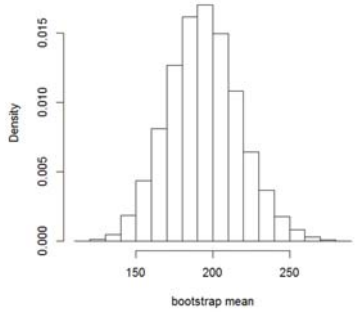


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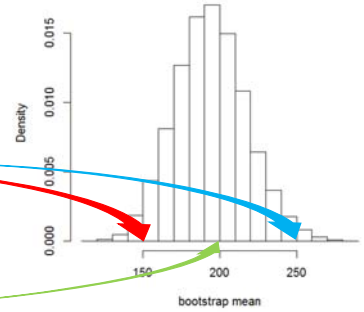
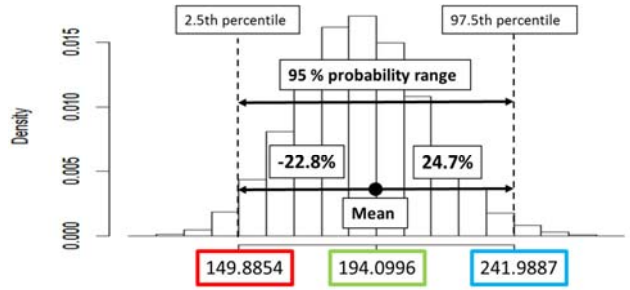
Figure. Bootstrap by R calculation (10,000 times running)



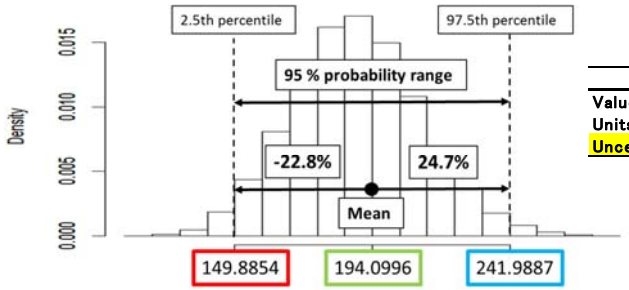
Uncertainty analysis of EF

- The results of uncertainty analysis of EF are shown as follows. The estimation describes the ranges of 95 % Probability of the confidence interval. The mean is 194.0996. Then, the 2.5 Percentile and the 97.5 Percentile are 149.8854 and 241.9887, respectively.



Uncertainty analysis of EF

- These values also describe as plus or minus half the confidence interval width divided by the estimated value of the variable. Lower and Upper limit calculated are -22.8 % and 24.7 %, respectively.



	2.5th percentile	Mean	97.5th percentile
Value	149.8854	194.0996	241.9887
Units	0.772208701	1	1.246724362
Uncertainty	−22.77912989		24.67243621

Thank you for your attention.

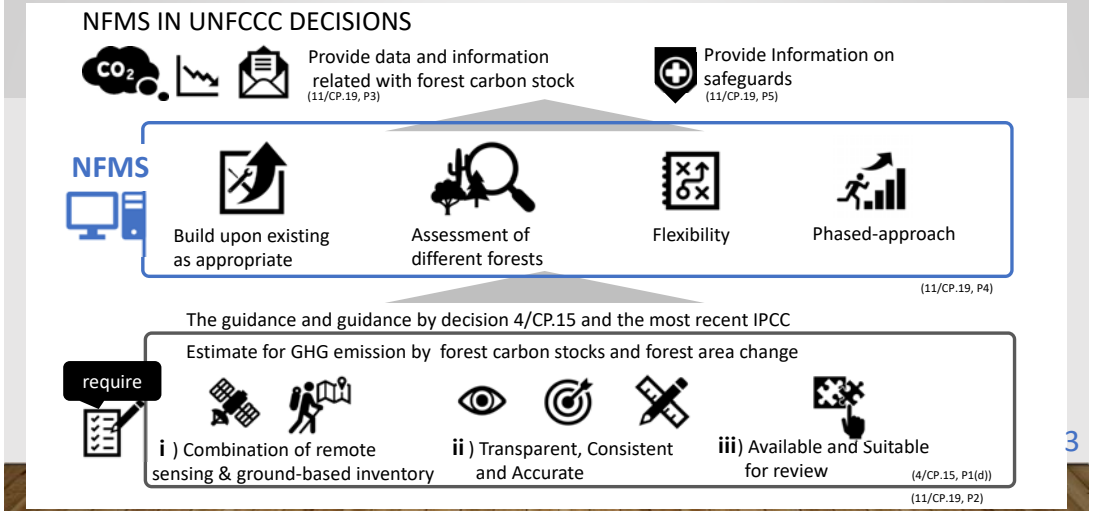
CURRENT STATUS OF NFMS

21TH NOVEMBER 2018

CONTENTS OF THE PRESENTATION

1. Definition of NFMS in UNFCCC
2. Proposed NFMS in Kenya
3. Contents of document NFMS ver.0
4. Monitoring function under development
5. Content under development
6. Provisional task for development NFMS

1. Definition of NFMS in UNFCCC



2. PROPOSED NFMS IN KENYA

NFMS in Kenya will be established from two aspects.

Monitoring function

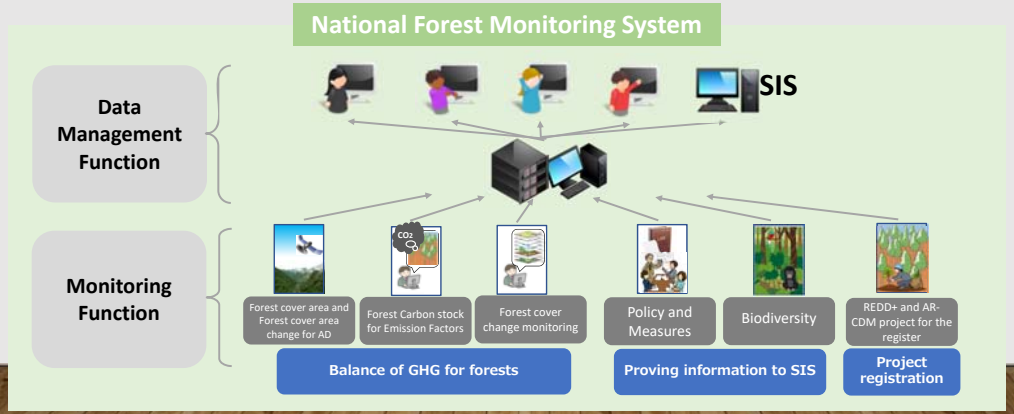
It is included estimation of anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks, forest carbon stock and forest area changes, information of policy and measure, biodiversity and registration of forest related project.

Data management function

It is a database to input the information and data gathered by implementation of the monitoring and provide them for implementing sustainable forest management including REDD+.

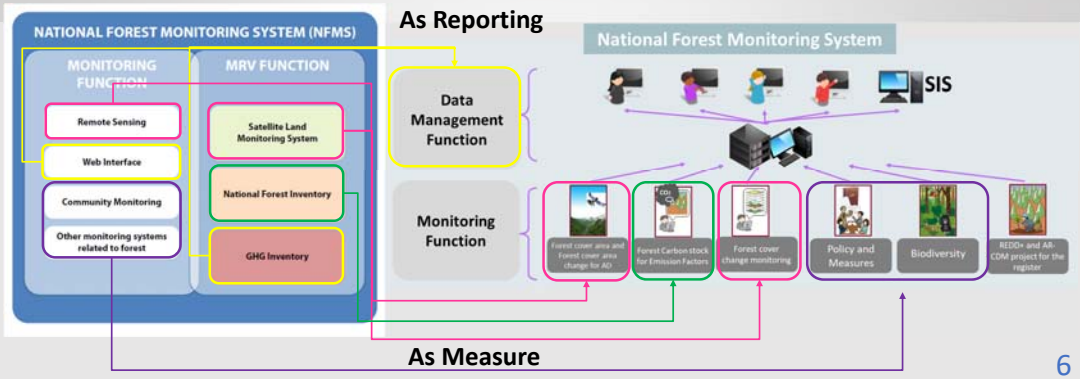
All of NFMS in Kenya will be described in detail in the “NFMS document in Kenya” to ensure transparency.

2. PROPOSED NFMS IN KENYA



2. PROPOSED NFMS IN KENYA

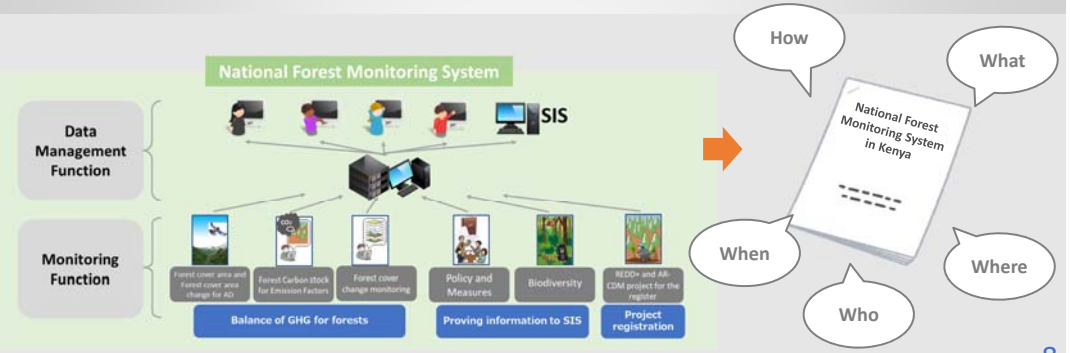
Comparison between UNREDD strategy NFMS and Proposed NFMS



2. PROPOSED NFMS IN KENYA -MONITORING FUNCTION-

Item	Information resource	Methodology
Satellite analysis (AD)	Land use / Land cover map	Methodology is Established based on SLEEK map manual
Forest carbon stock (EF)	National Forest inventory, Allometric equation	Methodology of NFI will be developed based on ICFRA proposal with modification. Equations have been already selected but it should be developed in Kenya as phased approach
Forest area change Monitoring	Optical and radar satellite imageries	Detect land cover changed area
Policy and Measures	NDC, National REDD+ strategy and National Forest Program, etc.	Monitoring Methodology to be developed in Action Plan of National Forest Program etc..
Biodiversity	Protected area, management plan, biodiversity assessment etc.	Methodology should be discussed with KWS and NMK as well.
Project registration	Registration form of REDD+, CDM project	Registration and monitoring system should be developed.

2. PROPOSED NFMS IN KENYA



3. Contents of NFMS document draft ver.0

1/2

Chapter	Contents	
Chapter 1	Background and Purpose	
Chapter 2	UNFCCC requirements	
Chapter 3	Basic conditions of NFMS in Kenya	3.1 Scale
		3.2 Forest definition
		3.3 Forest stratification and classification
		3.4 Land use categorization
		3.5 Carbon pool
		3.6 Scope gas
		3.7 Selected activity
		3.8 Definition of national REDD+ activities
Chapter 4	Conceptual design of the NFMS in Kenya	4.1 Purpose of Kenya's NFMS
		4.2 Composition of NFMS
		4.2.1 Monitoring function
		4.2.2 Data management function
		4.3 Phased approach

3. Contents of NFMS document draft ver.0

2/2

Chapter	Contents	
Chapter 5	Monitoring function	5.1 Forest cover area and forest cover change for AD
		5.1.1 Forest cover area by mapping
		5.1.2 Forest cover change area by mapping
		5.1.3 Forest cover change monitoring
		5.2 Forest Carbon stock for emission factors
		5.3 PaMs
		5.4 Biodiversity
		5.5 REDD+ and AR-CDM project for the register
Chapter 6	Data management function by FIP	6.1 Component and contents of the FIP
		6.2 Access right of each content
		6.3 Linkage with FMIS
		6.4 Update and operation
Chapter 7	Institutional arrangement for NFMS	6.1 Institutional arrangement for monitoring function
		6.2 Institutional arrangement for data management function
Chapter 8	Calendar of NFMS	

4. MONITORING FUNCTION UNDER DEVELOPMENT -5.1.3 FOREST COVER CHANGE MONITORING-

- Purpose : to identify deforestation, forest degradation and/or forest increase area for forest management.
- Note : 5.1.2 Forest cover change area by mapping seems useful for the forest cover change monitoring.
- Procedure : to be identified for what purpose the monitoring result should be used. Then, method of forest cover change monitoring is identified.

5. MONITORING FUNCTION UNDER DEVELOPMENT -5.3 POLICIES AND MEASURES (PAMS)

- Purpose : to manage the monitoring for implementation of forest policy (PaMs) on REDD+
- Note : National REDD+ Strategy (NRS) will be developed with support of UNDP through FCPF. PaMs monitoring in NFMS have a close relationship with NRS.
- Procedure :
  - Developing PaMs monitoring after NRS development basically

However, In Kenya, the National Forest Programme 2016 – 2030 (NFP) was developed as the basis of forest policies. Therefore, NFP will be probably basis of actions to address deforestation, forest degradation and to increase forest in NRS. Hence, it can be discussed for considering method of monitoring of PaMs in advance e.g. how to monitor the degree of achievement of programme strategies of thematic clusters in NFP related to REDD+ activities. In addition, the consideration can be consulted with UNDP.

5. MONITORING FUNCTION UNDER DEVELOPMENT
PROCEDURE OF PAMS MONITORING DEVELOPMENT

Select programme strategies from among the strategies of thematic clusters in NFP
- programme strategies to be related REDD+ activities in Kenya
- What is the selection standard
- Max 20 programme strategies to be selected

Consider the monitoring methodology 1
- Whether the programme strategies selected are implemented or not

Consider the monitoring methodology 2
- How to measure the key indicators
  - Available to use existing the reports?
  - Development of monitoring methodology?

5. MONITORING FUNCTION UNDER DEVELOPMENT
-5.4 BIODIVERSITY MONITORING-

- Purpose : to provide the information on biodiversity for Safeguards Information System (SIS).
- Note : it needs to keep contact in proceeding with KWS and NMK.
- Procedure : to examine how KFS, KWS and NMK are conducting monitoring activities and how to incorporate that information into the NFMS.

5. MONITORING FUNCTION UNDER DEVELOPMENT
-5.5 REDD+ AND AR-CDM PROJECT FOR THE REGISTER-

- Purpose : to avoid double counting of emission reduction for result-based payment by compiling greenhouse gas reduction efforts by project in NFMS.
- Note : One of the methods for nested approach
- Procedure : It will be identified what kinds of items of project should be provided in the FIP. Then it should be decided what kinds of data in the projects should be monitored.

5. Monitoring function under development

Item in the EF monitoring as example

- **Sampling Design of NFI**

ICFRA proposal: Cluster sampling method

- Cluster design is as follows. However, since SLEEK stratification is used that means, it is needed to decide how the cluster design will be adjusted, e.g. left side figure is for forest except for mangrove, right side figure is for mangrove. In addition, cluster method itself should be re-considered whether it is applied or not because of possibility that more than two forest types are mixing in a cluster.

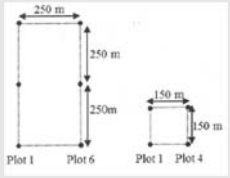


Figure . Cluster designs in Strata 1-3 (left) by ICFRA and in Stratum 4 (right).

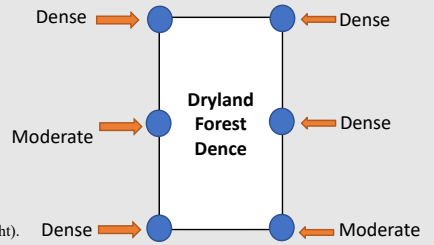


Figure . Example of cluster with more than two forest type mixed

In this case, how can the data be compiled?
Moderate data is compiled as Dense forest or moderate forest?
Otherwise no cluster method applied?

5. CONTENT UNDER DEVELOPMENT -CHAPTER7 INSTITUTIONAL ARRANGEMENT FOR NFMS-

- Note : Maybe institutional arrangement for implantation of monitoring will be established in the NRS. Therefore, the institutional arrangement in the NFMS should follow the institutional arrangement to be mentioned in NRS.

5. CONTENT UNDER DEVELOPMENT -CHAPTER8 CALENDAR OF NFMS-

Year	Activity Data		Emission Factor		FREL/FRL	Submission of BUR	Remarks
	Mapping	Update by annual forest cover monitoring	NFI	Update by Permanent plot			
2017	Year 2000, 2014						
2018							
2019					○ (Period 2000-2014)		
2020							Paris Agreement come into force
2021							
2022							
2023							
…							
…							

6. PROVISIONAL TASK FOR DEVELOPMENT NFMS

Item		Task
Monitoring Function	Satellite analysis (AD)	• Revise SLEEK map manual
	Forest carbon stock (EF)	• Complete NFI's methodology • Decide NFI Schedule • Development of Tree volume equation and biomass equation in Kenya
	Forest cover change monitoring	• Identify the purpose of using • Identify method of forest cover change monitoring
	Policy and Measures	• Discuss for considering method of monitoring of PaMs
	Biodiversity	• Examine how KFS, KWS and NMK are conducting monitoring activities
	Project registration	• Identify what kinds of data/information items should be provided in the FIP
Data Management Function		• Develop the linkage with FMIS and system of update and operation on FIP
Institutional arrangements for NFMS		• Have a close relationship with NRS
Calendar of NFMS		• Decide schedule of future monitoring for AD, EF (NFI), and others

Discussion on Work Plan for Further Improvement of FRL

REDD+ TWG Meeting

2018. Sep. 21

Proposed work plan (1)

Action	Year 2018				Year 2019	Responsible Organization
	Sep.	Oct.	Nov.	Dec.		
1. Uncertainty of AD, EF and FRL						
1.1 Accuracy assessment and uncertainty of AD						
1.1.1 Check of detailed methodology for assessing the uncertainty	→					KFS, DRSRS, RCMRD, Support by JICA project?
1.1.2 Calculation necessary duration of the work and budget for accuracy assessment of AD	→					KFS, Support by JICA project?
1.1.3 Necessary institutional arrangement for conducting the assessment work		→				KFS, DRSRS, RCMRD?
1.1.4 Conducting the assessment work*		→	→	→		KFS, DRSRS, RCMRD?
1.1.5 Estimate the accuracy and uncertainty			It will be done after finish of 1.1.4			KFS, Support by JICA project?

*If the work will not be finished by end of November, maybe FRL report will not be submitted to UNFCCC in January 2019.

Proposed work plan (2)

Action	Year 2018				Year 2019	Responsible Organization
	Sep.	Oct.	Nov.	Dec.		
1.2 Uncertainty of EF						
1.2.1 Discussion of the result of trial estimation on uncertainty of EF	→					REDD+ TWG?
1.3 Uncertainty of FRL						
1.3.1 Estimation of uncertainty of FRL		It will be done after finish of 1.1.5				KFS, Support by JICA project ?

Proposed work plan (3)

Action	Year 2018				Year 2019	Responsible Organization
	Sep.	Oct.	Nov.	Dec.		
2. Emission estimate of forest degradation						
2.1 Deciding which data on wood-removals and the occurrence of disturbances is used.	→					KFS, KEFRI, the Universities, Support by JICA project and other stakeholders
2.2 If MODIS fire data is used, please see "Proposed work plan (5)"						
2.3 Calculation of emission estimate for forest degradation	→ In case of no use of MODIS		→ In case of use of MODIS			KFS, Support by JICA project
3. Including Data Points in Reference Period						
3.1 Deciding which data point(s) should be selected.	→					REDD+ TWG?

Proposed work plan (4)

Action	Year 2018				Year 2019	Responsible Organization
	Sep.	Oct.	Nov.	Dec.		
4. Assessment of including Deadwood and Litter as Carbon Pool and Assessment of MODIS Fire Data						
4.1 Assessment of including Deadwood and Litter as Carbon Pool						
4.1.1 Checking whether KFS stores the data that can be used to calculate the numerical value for deadwood volume	→	→				KFS, Support by JICA project?
4.1.2 Determining the allometric equation for the calculation of biomass values of deadwood		→	→			KFS, KEFRI, the Universities, Support by JICA project?
4.1.3 Calculation of EF including deadwood in case of necessary data/information available			→	→		KFS, Support by JICA project

Proposed work plan (5)

Action	Year 2018				Year 2019	Responsible Organization
	Sep.	Oct.	Nov.	Dec.		
4.2 Assessment of MODIS Fire Data						
4.2.1 Identifying how to assess the MODIS fire data	→					KFS, KEFRI, the Universities, Support by JICA project and other stakeholders?
4.2.2 Assessing the MODIS fire data		→	→			KFS, KEFRI, the Universities, Support by JICA project?
4.2.3 Identifying how to reflect the biomass burning data into the emission estimate		→	→			KFS, KEFRI, the Universities, Support by JICA project and other stakeholders?
4.2.4 Calculation of emission estimate of forest degradation based on MODIS fire data and the default values of EF			→	→		KFS, KEFRI, the Universities, Support by JICA project and other stakeholders?

Proposed work plan (6)

Action	Year 2018				Year 2019	Responsible Organization
	Sep.	Oct.	Nov.	Dec.		
5. EF from Non-Forest to Forest especially Dense Forest						
5.1 Deciding EFs which should be revised	→					REDD+ TWG?
5.2 Deciding the number of years in which the forest type of EF to be revised reach matured forest.	→	→				KFS, KEFRI, the Universities, Support by JICA project?
5.3 Deciding the calculation method of EF	→	→				KFS, KEFRI, the Universities, Support by JICA project?
5.4 Calculation of emission estimate		→	→			KFS, Support by JICA project?

MINUTES OF REDD+ TWG MEETING HELD ON 16TH AND 17TH JULY 2019.

The 5th REDD+ Technical Working Group Meeting of

Capacity Development Project for Sustainable Forest Management

(CADEP-SFM)

Date: 16th and 17th July 2019.

Venue: Masada Hotel, Naivasha

Purpose: Discussion on Kenya's Progress in Forest Reference Level (FRL) development.

Tuesday 16th July		
Time	**Activity**	**Presenter**
8.00 am -8.30 am	Registration	Florence
8.30 am – 8.45 am	Opening remarks	Alfred Gichu
8.45 am -9.00 am	Introduction	Peter Nduati
9.00 am- 9.30 am	FRL setting	Alfred Gichu
9.30 am -10.15 am	Activity Data	Faith Mutwiri
10.15 am – 10.30 am	Plenary	Peter Nduati
10.30 am- 11.00 am	Health break	
11.00 am – 11.30 am	Assigning AD to REDD+ Activities	George Tarus
11.30 am – 12.00 pm	EF (Stock Factors)	Peter Sirayo
12.00 pm – 12.30 pm	EF (Growth factors)	Peter Sirayo
12.30 pm – 1.00 pm	Plenary	Mwangi Kinyanjui
1.00 pm – 2.00 pm	Lunch break	
2.00 pm – 2.30 pm	Assigning Emission Factors to REDD+ Activities	Mwangi Kinyanjui
2.30 pm – 3.00 pm	Presentation of emissions	Peter Nduati
3.00 pm -4.00 pm	Plenary	Alfred Gichu
4.00 pm	Tea break	

Wednesday 17th July		
Time	**Activity**	**Presenter**
8.30 am -9.00 am	Recap of Previous days discussions/agreements	Prof Balozi
9.00 am – 9.30 am	National Circumstances	Jamleck Ndambiri and Alfred Gichu
9.30 am – 10.00 am	Projections of Emissions	Jamleck Ndambiri and Alfred Gichu
10.00am -10.30 am	Plenary	Alfred Gichu
10.30 am – 11.00 am	Tea break	
11.00 am- 11.30 am	Uncertainty of the FRL	Faith Mutwiri/Kinyanjui
11.30 am – 12.00 pm	Future improvements	Alfred Gichu
12.00 pm -1.00 pm	Plenary	Peter Nduati
1.00 pm	Lunch break	
2.00 pm	Departure	

The meeting commenced at 10:05 am with Mr. Alfred Gichu as the Chairperson and Ms. Florence Tuukuo as the secretary.

In Attendance were: (LIST OF PARTICIPANTS)

Apologies

1. Jane Wamboi – KWS

2. Phoebe Oduor – RCMRD

3. James Kimondo – KEFRI

Agenda for the meeting Included;

1. Introduction
2. FRL setting
3. Activity Data
4. Emission Factors
5. Emission Estimates
6. National Circumstances
7. Projections of Emissions
8. Uncertainty of the FRL
9. Future improvements
10. AOB

MIN 1/16/07/2019 INTRODUCTION

Mr. Alfred (National REDD+ Coordinator) welcomed the participants to the meeting, he indicated that the discussions were geared towards informing TWG members about the amendments that have been done to the initial draft of FRL since review by wider stakeholders. The comments and recommendations given by the stakeholders were used to improve the previous draft hence the TWG was convened to update the members on the current draft and enable them to own as well as add value to the document as a baseline for Kenya's forest sector reference level. He thus invited the members to fully participate in the discussions for further improvement before the document can be finalized for later submission to UNFCCC. This was followed by a self-introduction session where all the participants mentioned their roles in the various institutions.

MIN 2/16/07/2019 FRL SETTING

A brief introduction of Capacity Development Project for Sustainable Forest Management (CADEP-SFM) was made highlighting the overall goal of the project as promotion of sustainable forest management in Kenya towards the national forest cover target of 10% by 2030. The project has 5 components which work on different aspects to achieve the overall goal. Component 3 of the CADEP-SFM Project which is REDD+ Readiness and is being implemented by KFS has two goals; 1) To design, develop and operationalize National Forest Management System (NFMS) in addition to Setting and supporting eventual submission Forest Reference Level (FRL). Kenya made an attempt to submit FRL in 2017 but it was not successful because of the many comments and recommendations from external reviewers hence there was an agreement to re-check the document, improve the data and make a better document to submit to UNFCCC.

REDD+ has four elements including; Safeguards Information Systems (SIS), National REDD+ Strategy (NRS), National Forest Management System (NFMS) and Forest Reference Level (FRL). The four elements are to be delivered as a package, of the four elements, only FRL is submitted to the UNFCCC to ensure consistency check with other country documents and for quality control. Kenya wishes to voluntarily submit FRL to the United Nations Framework Convention on Climate Change based on (UNFCCC decision 1/CP.16 paragraph 71 (b) and decision 12/CP.17 paragraph 8 and 10). This is steered towards

- Reducing pressure to clear forests for agriculture, settlements and other land uses;
- Promoting sustainable utilization of forests by promoting efficiency and energy conservation;
- Improving governance in the forest sector -by strengthening national capacity for Forest Law Enforcement, Governance (FLEG)- advocacy and awareness;
- Enhancement of carbon stocks through afforestation /Reforestation, and fire prevention and control.

MIN 2.1/16/07/2019 FRL

FRL is defined as benchmarks for assessing each country's performance" in implementing REDD+ activities. It is informed by calculation of historical emissions which are then used to estimate future emissions based of Business as Usual (BAU) scenarios. If the emissions are reduced in the future based on BAU projections, the country can receive results based financial payments from Green Climate Fund (GCF) or other external institutions such as World Bank. The following building blocks have been agreed upon by TWG:

i. Forest Definition- the definition is based on 3 basic parameters; 0.5 ha, 15% canopy cover and 2m high at maturity.

ii. REDD+ activities: Kenya's FRL focuses on four activities namely; Reducing emissions from deforestation (Deforestation), Reducing emissions from forest degradation (Forest Degradation), Sustainable management of forest and Enhancement of forest carbon stocks

iii. Carbon Pools- only Above-ground biomass and Below-ground biomass are considered in the case of Kenya. Soil Organic Carbon pool shall be considered later because the FRL takes a stepwise approach.

iv. Scale – National Level

v. Green House Gases – CO_2, the other GHGs emitted from forests shall be factored in later after the first submission.

The development of FRL used maps that were developed during the SLEEK Program to ensure there is consistency and sustainability. These maps have been continually improved through stakeholder consultations by use of recent technologies and expertise knowledge. There is also an available technical manual on the process of mapping which supports the necessary verification process.

Selection of Reference Period: The choice of the two years was based on; accuracy, the maps chosen were to have minimal stripping effect and cloud cover the second consideration was on consistency, short epochs would have resulted into errors in mapping land representation also the maps chosen have to ensure consistency between National Inventory report(NIR), SLEEK and FRL. This conditions therefore, led to selection of 2002 and 2008 as the reference period.

Policy Considerations this entails government decisions and actions from the year 2002 which included critical discussions at national level hence development of Vision 2030 targets. Based on these policies, FRL reference period was decided to start at 2002 which falls within the recommendation of GCF were the period should not be less than 5 years and not more than 20 years for a country to acquire finance-based payments.

Plenary

Conservation is not considered as a REDD+ activity in Kenya because IPCC recommends that High Forest Low Deforestation countries only should consider conservation as a REDD+ activity. But Kenya might include it later in the stepwise approach.

BAU entails the current situation of forest sector without REDD+, this is used to project about future forest conditions based on incentivizing activities to change BAU including policies that have been proposed and others that may be proposed later.

Soil Organic Carbon has not been captured as a carbon pool for Kenya due to lack of data also, the use of default values requires that the country would have some data on soil which has not been implemented. It was also noted according to IPCC guidelines that changes in SOC occur after a period of 20 years, given that the reference period is 16 years, no major changes will have occurred.

MIN 3/16/07/2019 ACTIVITY DATA

Various institutions have continually been involved in forest cover map development, this work is strongly guided by a Technical and Process manual. The participants were taken through a step by step procedure on how the maps were developed. This included:

1) ***Testing of mapping methods***- involved testing Four mapping methods for developing an optimal method for land cover and forest cover mapping and change detection after which Random forest was selected.
2) ***Data acquisition***- Landsat data from the USGS website was selected following the technical manual guidance because it is freely available, historical images are available, has medium resolution and it is already pre- processed.
3) ***Data preparation-*** included; Cloud and Shadow masking, Terrain illumination Correction, data processing and reprojection.
4) ***Land Use Land Cover Classification-*** Land cover classes for LCC Mapping guided by the IPCC classification. These resulted into 6 classes namely; Forest, Cropland, Grassland, Wetland, Settlement and Other lands.
5) ***Classification using Random Forests –*** involved running R-Scripts for QAQC – Both internal and External
6) ***Accuracy Assessment_*** checking for the correctness of the map using high resolution images and aerial photography and CPN (Conditional Probability Network).
7) ***Image filtering -*** was done to correspond with a country's forest definition
8) ***Quality Assessment-*** data screening to assess for quality of the maps for purposes of change detection and reporting.

The mapping process produced results on proportion of land cover from 2002 to 2018 based on the LULC classes which enabled analysis of the trend of land cover between 2002 and 2018. From the trend, Forest cover has continually decreased over time; with an average of 13,775 hectares of forest land being lost per year between 2002 and 2018. These Findings in line with other global observations.

These results mean that Kenya is on slow deforestation path and requires a strategy to halt and reverse deforestation and forest degradation hence need to propose additional and transformative measures to meet Constitutional obligations and implement global commitments on Climate change.

Plenary

The current graph on land cover trend has a spike at 2010, a suggestion was given to give detailed explanation on what could have happened or alternatively have another trend without the spike.

There was a concern that using only 2002 and 2018 as the reference years was not representing trends and dynamics of land cover appropriately, thus suggesting to use a year in between. However, it was noted that using a short epoch results to exaggerated emissions moreover, other countries have chosen 2-year reference points, in addition, all the 16 years make the final average.

There should be proper description on the reasons for decreasing forest cover, what caused the decrease, could be lack of ground truthing; in response it was stated that on going work on accuracy assessment will provide concrete explanation on afforestation, reforestation and deforestation in all private and public areas.

On the issue of forest definition based on tree cover or forest cover; a task force recommended for revision of the definition, however it was pointed out that a lot of data may need to be collected for such adjustments in the definition this would not be in line with the goal to submit FRL in March 2020. The TWG needs to bring on board relevant stakeholders and provide explanation for methodologies used to justify the numbers obtained.

A recommendation was given to have another map without the outliers to depict how the land cover trend has changed over time.

MIN 4/16/07/2019 ASSIGNING AD TO REDD+ ACTIVITIES

Forests have been categorized into four strata/ecozones based on climate and Altitude including; Montane and Western Rain forests, Coastal and Mangrove forests, Dryland forests and Plantation forests. These strata have been further subdivided by canopy cover; dense ≥ 65%, moderate 40-65% and open 15-40%. Non-forest was categorized as cropland, Grassland, Wetland then Settlement and Other Lands. Activity data was assigned to the various strata using a land cover change matrix whereby each change corresponds to a REDD+ activity from the four REDD+ activities considered in the case on Kenya. This was followed by definitions of the activities in accordance with transition from one land cover class to another. Statistics for the transitions were assigned accordingly in a land cover change matrix which led to calculation of total area of transition for each REDD+ activity. In addition, annual rates of transition for each stratum and each REDD+ activity were computed. To conclude the section, the area of forestland remaining forest land between 2002 and 2018 was also calculated.

Plenary

A proposal was given to also compute the changes for non-forest converted to Forest and compile them in a table in order to fully understand the trend in land cover.

A detailed explanation should be given on how policy interventions (which are assumption based because there is no way of determining if they are being effected) assisted the forest sector especially after 2002 given that the effect of policies takes a considerable amount of time.

Mapping on Plantation Forest not only captures public plantations but also private plantations because the proper boundaries have not yet been established. In the same way, Montane Forests also include other forests in addition to public forests for instance community forests. Moreover, it was pointed out that NRS should propose activities that haul and reverse deforestation.

Since REDD+ in Kenya takes a stepwise approach, the reference period should be used for now but in future an additional year should be considered ; if this work is to be conducted at the present time, more work will be added on accuracy assessment team which makes it difficult to make submission as per the timelines.

If questions arise from the TA after submission of RFL to UNFCCC the TWG should be well placed to respond to the comments, concerns and recommendations, at this point, the reason for the various decisions made shall be given if they will not be clear from the appendices and footnotes in minutes and the FRL document.

MIN 5/16/07/2019 EMISSION FACTORS AND ASSIGNING EF TO REDD+ACTIVITIES

Emission factors were computed from stock change based on pilot NFI data. Based on default values and pilot NFI data; biomass stock (AGB and BGB), carbon stock and CO_2 were computed (using allometric equations) for each stratum. The criteria used for choosing **stock** change emission factors was outlined, such as Stock was obtained from Pilot NFI and allometric equations as simple average of plot data for each stratum, whereas root/shoot ratio, carbon fraction for AGB/ BGB, carbon factor and default factors were obtained from IPCC 2006 guidelines.

Emission Factors for Calculating sequestration due to afforestation (based on IPCC for forests Less than 20yrs) and Emission Factors for Calculating sequestration due to enhancement (based on IPCC for forests More than 20yrs) were computed. This was followed by assigning of EF for each REDD+ activity based on their definitions. For deforestation and Forest Degradation, instantaneous oxidation was assumed. Therefore, the EF is the difference between the CO2 value of the initial forest canopy class and the CO2 value of the new forest canopy class within a stratum. For Sustainable management of forest, A stock change method was applied and the EF calculated as the difference between the CO_2 value of the pervious non-forest to the CO_2 value of a plantation based on growth rate. In Enhancement, A growth factor was adopted for each stratum to give the amount of CO_2 gained in a planted forest (for a period less than 20 years) and give the amount of CO_2 gained in an existing forest (for a period more than 20 years). Capping was done to retain the stock of the specific canopy class in cases where calculation of growth resulted to a stock which is more than the stock factor. Additional factors considered include; expert knowledge which provided information on stock difference, availability and quality of data. Additionally, growth factors were used for different growth rates of each stratum. EF for the four REDD+ activities were complied in a matrix.

Plenary

Proper documentation should be done to give concrete reasons on the decisions made regarding EF in order to make it understandable for reviewers. Also, all assumptions made in development of FRL should be well captured to cater for questions that may arise from External Reviewers as well as Technical Assessment.

A proposal was given to have a table on land cover capacity for each forest strata, moreover, a concern was raised that the on-going accuracy assessment work may not depict the real situation on the ground.

Based on the day's discussions, the following aspects of FRL were agreed upon;

1) **Transparency**- detailed explanation should be given on why the reference period was chosen.
2) **Consistency**- methodologies used in development of the FRL can be followed by another party and produce the same results.
3) **Completeness**- there is need for more capacity building based on reviews done.
4) **Comparability**- data used for FRL is comparable with other country data and IPCC default values.

MIN 6/16/07/2019 Recap of Day 1

A recap of the main points for the previous day was done by Prof. Balozi, highlighting that 9 presentations had been made and were aimed at informing TWG members on the approaches used to calculate Forest cover, Biomass stocks, C-stocks and Emissions (CO_2). The objectives were outlined as:

i. Brief Introduction of the REDD+ journey in Kenya
ii. Short overview and aims of the Capacity building collaboration project with JICA (JOFCA)
iii. Inform TWG members on the approaches used to calculate Forest cover, Biomass stocks, C-stocks and Emissions (CO_2)
iv. Members to critique, add value and own the report

A brief summary of the contents for each presentation was given. Members agreed that the methodology used to estimate Emission levels for Kenya showed high:

- Transparency
- Consistency
- Completeness
- Comparability

TWG Members also adopted the methodology and the results thus;

- Forest cover has been on the decline during the period 2002 – 2018 to the tune of 13, 775 ha/year
- The calculated Kenya Emission levels for 2002 – 2018 are 15,310,080 tones CO_2/year, compared to the Global estimate of 14 million tonnes CO_2/yr.

In conclusion, he posed a question to the participants if the draft of FRL was ready for the next step including stakeholder's participation and handing over to the Ministry where the members agreed it was ready nevertheless all additional suggestions should be taken into consideration.

MIN 7/16/07/2019 FRL UNCERTANITY

Error matrices were created for 2002 and 2018 maps to calculate their uncertainty. The 2002 map had an uncertainty of 87.02% while the 2018 map has an uncertainty of 76. 04%. Further calculations were made to check the correctness of 2018 map, the result gave 76.04% overall classification accuracy. With limited data, like in the case of Kenya from pilot NFI, IPCC proposes use of Bootstrap simulation in uncertainty analysis. After this analysis, statistics of accuracy were computed for each stratum as guided by classification of forests in Kenya.

For calculation of FRL uncertainty the formula used combines uncertainty of AD and uncertainty of EF as follows;

Calculated as
Uncertainty (%) =√ ([Uncertainty of AD (%)]^2 [+ Uncertainty of EF (%) ^2)

Plenary

From the error matrices for 2002 and 2018 maps, the difference in percentage seems to contradict the expectation because with advancement in technology and data acquisition techniques, it would be expected that the 2018 map would depict higher percentage than 2002 map. It was explained that the more the data the bigger the number of changes from on class to another hence with 2018 having 270 points as compared to 2002 which had 81 points. A recommendation was given to recheck the 2002 map and possibly increase the numbers of points for better comparison with 2018.

MIN 8/16/07/2019 Calculated Emissions

Emissions for 2002-2018 were calculated corresponding to each stratum and each REDD+ activity these include; annual emissions, net emissions and emission numbers for the reference period. In addition, an illustration was given using a graph for the average annual emissions of each activity and the net emissions (15,310,080.15).

MIN 9/16/07/2019 National Circumstances

In order to understand where GHGs are emitted from, a presentation on National Circumstances was given, it provided an explanation on average emissions from each stratum. An outline of policies relevant to Forest conservation was described together with activities that can help improve forest conservation hence increase forest cover, a graphical illustration was given which projected that if forest cover is increased at 204,727 ha per year without losing forest to non-forest uses, it would be possible to attain Vision 2030 target of 10% forest cover. However, there are hinderances and barriers to achieving this target which include increase in population and there is no methodology for relating emissions with population increase. A proposal is given in this section about future emissions based on the current average historical emissions 15,310,080 Tonnes of CO_2 Per year

Plenary

A suggestion was given to use regression method to explain how the future is likely to look like for the four REDD+ activities, this will illustrate how changes are likely to happen.

Projections should be made for individual activities so that if a buyer is interested in a single REDD+ for finance-based payment, no further work would be required. This will also ensure that the Nationally Determined Contribution is catered for. In addition, for monitoring purposes it makes the work much easier in monitoring of project specific activities.

To make REDD+ more understandable, indicators should be developed for monitoring REDD+ policy measures.

After a lengthy discussion on what should be included in National Circumstance section, it was pointed out that GCF does not allow incorporation of National Circumstance for Low Forest High Deforestation countries in projections hence the use of average method is more appropriate for Kenya, also no scientific evidence for National Circumstances is available for Kenya. But the section should educate the global community about Kenya's forest sector.

MIN 10/16/07/2019 Future Improvements

The following points were identified for future improvements;

1) There is need for a National Forest inventory to improve on EF. This includes establishment of growth models
2) An improvement of the Land cover Mapping program would make the maps more accurate
3) Research should be targeted on emissions from

    a. Non-CO2 emissions like CH4 and N2O

    b. Other Carbon Pools – HWP, Soil OM, Dead wood, Litter

4) Improvement of data collection methods may justify the use of Gain Loss method against the currently used Stock Change method

Plenary

There should be permanent sample points for data collection in the case of Activity Data.

An emphasis was put on including a chapter on National Circumstance in FRL for Kenya.

On Activity Data, clarifications should be given on the various numbers used in the various tables and matrices.

Carbon Fractions should be developed to reflect the real situation of Kenya's forest and for proper inclusion in the FRL.

AOB

1. Timeline for submission of FRL was given as follows; the submission of FRL shall be done by 2nd January 2020, which will be followed by centralized Technical Assessment in Bonn Germany until March 2020, after that Kenya will be given a chance to respond to comments of Technical Assessment with a report by TA expected to be published by end of November 2020.
2. A consideration of an additional year was suggested as it would enable better visualization of the historical changes from one land use class to another.

Participants list of REDD+ TWG on16th and 17th July

No	ID	NAME	EMAIL ADDRESS	Organization
1	1	Alfred Gichu		KFS
2	2	Ali Mwanzei		SLEEK
3	3	Anne Omambia		NEMA
4	4	Anthony Macharia		Survey of Kenya
5	5	Balozi Kirongo		University of Eldoret
6	7	Charles Ndegwa		DEKUT
7	10	Faith Mukabi		KFS
8	12	George Tarus		KFS
9	16	Merceline Ojwala		DRSRS
10	17	Miviti Reson		MoEF
11	18	Mwangi Githiru		Wildlife Works
12	19	Mwangi Kinyanjui		KARATINA
13	20	Ndambiri J.K		KFS
14	21	Ngugi John		KEFRI
15	23	PETER NGUGI		KFS
16	24	Peter Sirayo		KFS
17	26	Stephen Kiama		KEFRI
18	27	Zawadi Donna		KFS
19	-	Judy Ndichu		UNDP
20	-	Keiichi Takahata		CADEP-SFM
21	-	Kazuhisa KATO		CADEP-SFM
22	-	SATO Kei		CADEP-SFM
23	-	Yoshihiko SATO		CADEP-SFM
24	35	Florence Tuukuo		CADEP-SFM
25	36	Mike Izava		CI
26	37	Yvonne Nyokabi		LECRD

The National Forest Reference Level for REDD+ Implementation

DISCUSSION ISSUES BY THE TWG

July 2019

OUTLINE

This presentation is made in 9 Sections.

1. Introduction
2. FRL setting
3. Activity Data
4. Emission Factors
5. Emission Estimates
6. National Circumstances
7. Projections of Emissions
8. Uncertainty of the FRL
9. Future improvements

Programme

Time	Activity	Presenter
	Tuesday 16th July	
8.00 am -8.30 am	Registration	Florence
8.30 am – 8.45 am	Opening remarks	Alfred Gichu
8.45 am -9.00 am	Introduction	Peter Nduati
9.00 am- 9.30 am	FRL setting	Alfred Gichu
9.30 am -10.15 am	Activity Data	Faith Mutwiri
10.15 am – 10.30 am	Plenary	Peter Nduati
10.30 am- 11.00 am	Health break	
11.00 am – 11.30 am	Assigning AD to REDD+ Activities	George Tarus
11.30 am – 12.00 pm	EF (Stock Factors)	Peter Sirayo
12.00 pm – 12.30 pm	EF (Growth factors)	Peter Sirayo
12.30 pm – 1.00pm	Plenary	Mwangi Kinyanjui
1.00pm – 2.00pm	Lunch break	
2.00 pm – 2.30 pm	Assigning Emission Factors to REDD+ Activities	Mwangi Kinyanjui
2.30pm – 3.00pm	Presentation of emissions	Peter Nduati
3.00pm -4.00pm	Plenary	Alfred Gichu
4.00pm	Tea break	
	Wednesday 17th July	
8.30 am -9.00am	Recap of Previous days discussions/agreements	Prof Balozi
9.00 am – 9.30am	National Circumstances	Jamleck Ndambiri and Alfred Gichu
9.30 am – 10.00 am	Projections of Emissions	Jamleck Ndambiri and Alfred Gichu
10.00am -10.30am	Plenary	Alfred Gichu
10.30 am – 11.00 am	Tea break	
11.00- 11.30 am	Uncertainty of the FRL	Faith Mutwiri/Kinyanjui
11.30 am – 12.00 pm	Future improvements	Alfred Gichu
12.00pm -1.00 pm	Plenary	Peter Nduati
1.00pm	Lunch break	
2.00pm	Departure	

Capacity Development Project for Sustainable Forest Management in the Republic of Kenya

- With support from JICA, the CADEP project has several Components
- Component 3 the REDD+ Readiness Component aims at supporting Kenya's Submission of the FRL

Why should Kenya participate in REDD+?

- Realization of constitutional requirement and vision 2030 objectives of increasing forest cover to a minimum of 10%;
- Government efforts in designing policies and measures to protect and improve its remaining forest resources in ways that improve local livelihoods and conserve biodiversity;
- Access to international climate finance to support investments in the forestry sector;
- Realization of the National Climate Change Response Strategy (NCCRS) goals.
- Contribution to global climate change mitigation and adaptation efforts as illustrated in Kenya's NDC.

Focus areas for REDD+

- Reducing pressure to clear forests for agriculture, settlements and other land uses;
- Promoting sustainable utilization of forests by promoting efficiency and energy conservation;
- Improving governance in the forest sector -by strengthening national capacity for Forest Law Enforcement, Governance (FLEG)- advocacy and awareness;
- Enhancement of carbon stocks through afforestation /Reforestation, and fire prevention and control.

Introduction by Peter Nduati

- Kenya wishes to voluntarily submit to the United Nations Framework Convention on Climate Change (UNFCCC decision 1/CP.16 paragraph 71 (b) and decision 12/CP.17 paragraph 8 and 10)
- The Forest Reference Level (FRL) is part of the requirements for participation in REDD+. Others are
  - REDD+ Strategy
  - SIS
  - NFMS

THE FOREST REFERENCE LEVEL

By Alfred Gichu

What is FRL?

- Are “benchmarks for assessing each country’s performance” in implementing REDD+ activities.
- Involves Calculation of historical emissions which can be used to estimate future emissions based on BAU Scenarios
- A Reduction in emissions in future based on this BAU scenario can be translated into a Results based payment

Building blocks for the FRL – approved in previous TWG meetings

- Forest definition – has been approved in previous TWG meetings
- Identification of REDD+ Activities
  - Reducing emissions from deforestation (Deforestation)
  - Reducing emissions from forest degradation (Forest Degradation)
  - Sustainable management of forest
  - Enhancement of forest carbon stocks
- Carbon Pools
  - Above-ground biomass
  - Below-ground biomass
- Scale – National Level
- Green House Gases – CO2

Use of the SLEEK Land cover maps

- The FRL used the SLEEK maps due to their consistency and sustainability
- The maps have been developed through a wide stakeholder consultation process and have undergone technical assessments based on recent technology and expertise
- A detailed technical manual is available which supports the necessary verification process
- The SLEEK maps have also been used in the NIR which allows consistency between FRL and NIR
- SLEEK Land cover maps have Time series maps since 1990.

Selection of Reference Period – Technical considerations

- Accuracy – Minimal stripping and cloud cover (Less than 10%)
  - Failure of the Landsat 7 in year 2003 does not avail good images until 2014 when Landsat 8 was used for mapping
- Consistency – Short epochs may result to errors in mapping land representation e.g.
  - FL-CL-FL-FL
  - CL-FL-CL-CL

Appropriate LANDSAT images for developing Activity

	2000	2002	2003	2004	2005	2006	2007	2008
No DATA (%)	6.50%	6.53%	8.56%	23.77%	20.86%	23.13%	26.14%	28.00%
LANDSAT4 (scene)	0	0	0	0	0	0	0	0
LANDSAT5 (scene)	0	0	0	0	0	0	0	0
LANDSAT7 (scene)	34	34	34	34	34	34	34	34
Missing scenes	0	0	0	0	0	0	0	0
LANDSAT8 (scene)	0	0	0	0	0	0	0	0
Stripping Effect (scene)	0	0	0	34	34	34	34	34
Ratio of Stripping Effect (%)	**0.00%**	**0.00%**	**0.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

	2009	2010	2011	2012	2013	2014	2015	2018
No DATA (%)	15.85%	6.81%	12.51%	20.85%	16.98%	3.75%	4.00%	4.30%
LANDSAT4 (scene)	0	0	0	0	0	0	0	0
LANDSAT5 (scene)	11	24	15	0	0	0	0	0
LANDSAT7 (scene)	23	9	19	34	13	0	0	0
Missing scenes	0	1	0	0	0	0	0	0
LANDSAT8 (scene)	0	0	0	0	21	34	34	34
Stripping Effect (scene)	23	9	19	34	13	0	0	0
Ratio of Stripping Effect (%)	**64.60%**	**26.50%**	**55.90%**	**100.00%**	**38.20%**	**0.00%**	0.00%	0.00%

Selection of Reference Period– Additional Considerations

- The implementation of recent Forest Acts i.e.
  - Forest Act 2005 introduced new dimensions in management of forests (PFM, KFS institutions., Management of forests, Excisions modalities etc
  - Forest Conservation and Management Act of 2016 – introduced biodiversity conservation, better management structures
- The coming of a new government in the year 2002 brought in planning of large scale development under the Vision 2030 targets. This came with urbanization and infrastructural growth, improved access into formerly pristine vegetation which exposes the many forests.
- By 2010, a new constitution was enacted and governance structures under devolved governments instituted. These changes have affected management and conservation of forests both positively and negatively. For example, proposals to increase agricultural land encroaches into former marginal lands where dryland forests existed. Similarly developmental targets in the construction industry expose forests to further degradation because they are a major source of construction material
- The period after the year 2002 has experienced enactment of many environmentally friendly policies that may favour forest conservation.
  - The National Climate Change Strategy of 2010, Kenya Climate Change Act 2016, National climate Change Framework Policy 2016 and Climate Change Action Plan 2018 among others. Land related polices include the Kenya Land Registration Act of 2012, The National Land Use policy of 2016 and the Kenya Land Act of 2016. Similarly, the Farm forest rules of 2009, the gazettement of the Kenya Water towers Agency in 2012 and the Enactment of the Wildlife Management and Conservation Act 2016 are some of the recent policies that favour forest conservation

Selection of Reference Period – External Considerations

GCF guidelines of more than 5 years and less than 20 years

FLR from other countries have a range described above

2002 – 2018 was identified as the reference period

ACTIVITY DATA

By Faith Mutwiri

Institutions Involved in Forest Cover Mapping

- A multi-institutional process with members from;
  - Kenya Forest Service (KFS)
  - Directorate of Resource Survey and Remote Sensing (DRSRS)
  - Survey of Kenya (SoK)
  - Kenya Forestry Research Institute (KEFRI)
  - National Environment Management Authority (NEMA)
  - Kenya Wildlife Service (KWS)
  - Regional Centre for Mapping of Resources and Development (RCMRD)
  - African Wildlife Foundation (AWF)
  - Environmental Research Mapping and Information Systems in Africa (ERMIS Africa)
  - Jomo Kenyatta University of Agriculture and Technology (JKUAT)
  - Dedan Kimathi University
  - Karatina University
- Work strongly guided by a Technical and process manual.

Step by Step mapping method

1. Testing of mapping methods
   - **Four mapping methods for** developing an optimal method for land cover and forest cover mapping and change detection tested;
     - **Decision tree classifier,**
     - **Random Forest Classification,**
     - **Supervised Classification – Maximum Likelihood;**
     - **Disaggregation and aggregation of land covers**
   - **Random forest was selected as it is open source, has higher accuracy, stores uncertainty .**

Step by Step mapping method

2. Data acquisition
   - **Land Sat data from the USGS website was selected following the technical manual guidance**
     - **Availability at the USGS archive**
     - **Date of acquisition (Season)**
     - **Cloud cover percentage**

   Landsat was selected because it is freely available, historical images are available, has medium resolution and it is already pre- processed.

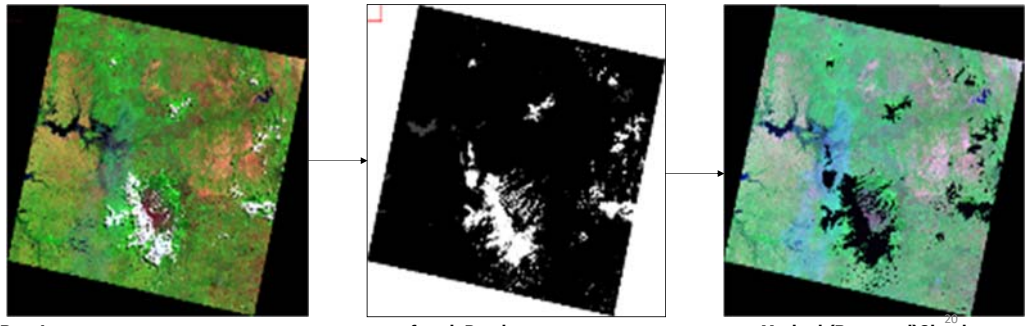
Image Quality Assessment Report_2018.docx

Step by Step mapping method

3. Data preparation
   a) Cloud and Shadow masking

   Masking (Removing) all clouds and their shadow

   - **Used "cfmask" band from USGS**



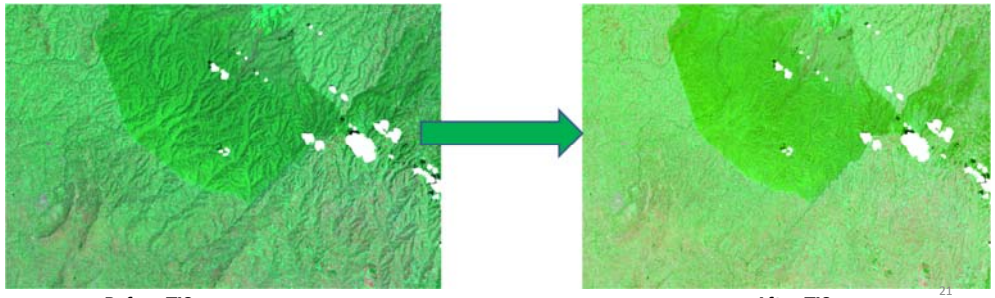
Raw Image **cfmask Band** **Masked (Removed)Cloud**

Step by Step mapping method

3. Data preparation

b) Terrain illumination Correction

- **Affected by variations in slope and aspect**
- **The process corrects terrain illumination effects so that the same land cover will have a consistent digital signal**



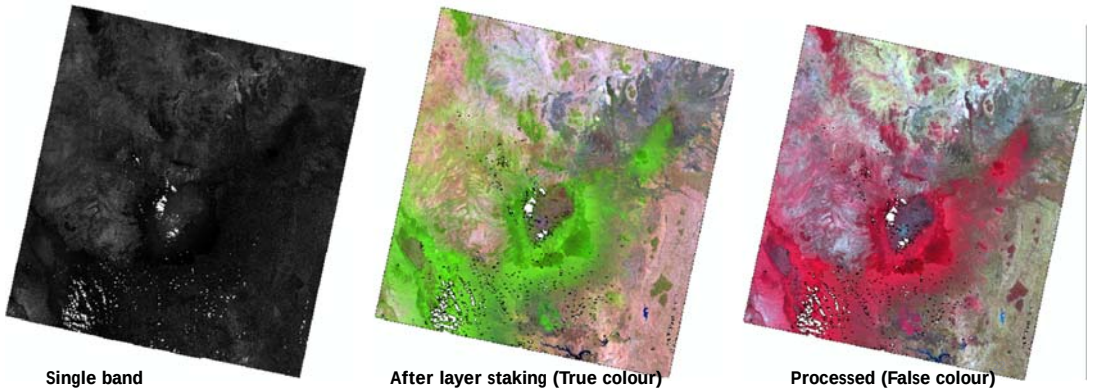
Before TIC

After TIC

Step by Step mapping method

3. Data preparation

- **Data processing followed Standard procedure from Survey of Kenya e.g. Layer stacking, Projection systems etc**
- **Reprojection from UTM WGS 84 to UTM Arc1960 37 South**



Single band

After layer staking (True colour)

Processed (False colour)

3. Land Use Land Cover Classification

- **Land cover classes for LCC Mapping guided by the IPCC classification**

I. Forest
1. Dense Forest > 65% canopy cover
2. Moderate Forest 40 – 65% canopy cover
3. Open Forest 15 – 40% canopy cover

II. Cropland
1. Annual Cropland
2. Perennial cropland

III. Grassland
1. Open Grassland
2. Wooded grassland

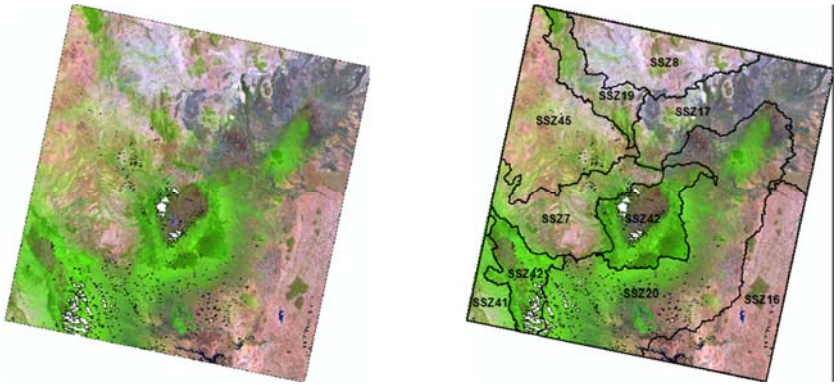
IV. Wetland
1. Open Water
2. Vegetated wetland

V. Settlement *(use of Auxiliary Data)*

VI. Other lands

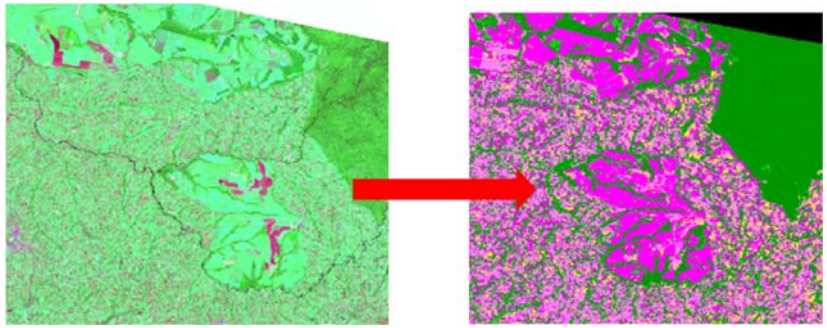
Stratification – spectral stratification zones

- **Land use land cover variations in Kenya**
- **Spectral Stratification Zones (SSZ) were initially based on Kenya's Agro-Ecological Zones later modified**



4. Classification using Random Forests

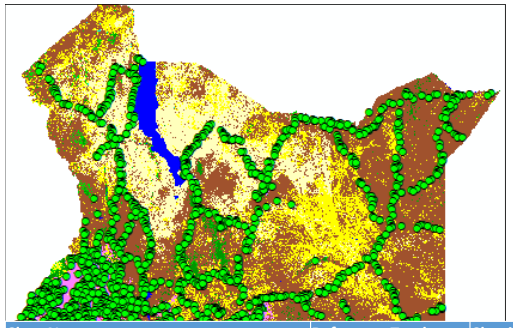
- **Running R-Scripts**



Landsat Image *Output: Classified Image*

❖ QAQC – Both internal and External

❖ 2018_P168R062_QA_CORRECTIONS_20112018_V1.xlsx



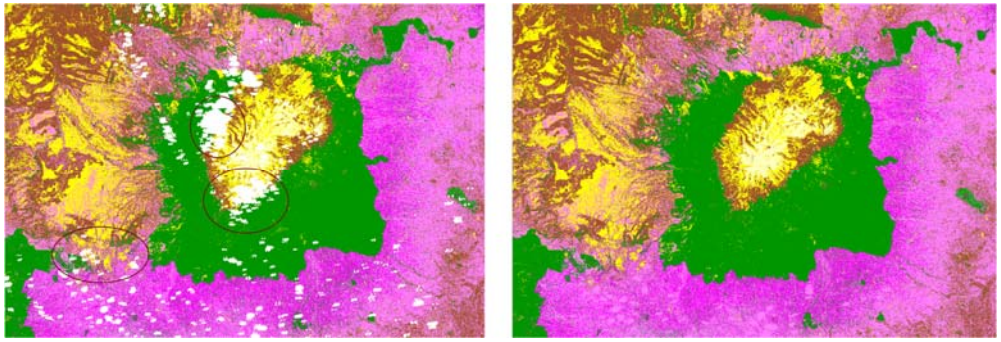
5. Accuracy Assessment

- **Checking the correctness of the map**
- **Sampling Procedure - *Proportionate stratified random***
- ***Use of High resolution images and Aerial photography***

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Dense Forest	270	232	171	63.33%	73.71%
Moderate Forest	213	174	87	40.85%	50.00%
Open Forest	152	118	51	33.55%	43.22%
Wooded Grassland	1084	1157	945	87.18%	81.68%
Open Grassland	499	599	413	82.77%	68.95%
Perennial Cropland	216	230	169	78.24%	73.48%
Annual Cropland	875	846	696	79.54%	82.27%
Vegetated Wetland	86	61	50	58.14%	81.97%
Open Water	41	36	30	73.17%	83.33%
Otherland	212	195	162	76.42%	83.08%
Totals	3648	3648	2774		
Overall Classification Accuracy =		76.04%			

5. CPN (Conditional Probability Network)

- **Due to data gaps a mathematical model known as a conditional probability network (CPN) is used to fill.**
- **It uses the time series maps and the probability bands developed during classification**

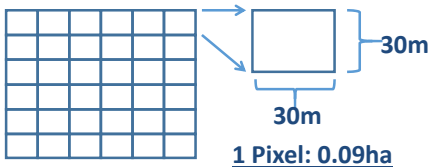


Before gap filling **After filling with CPN**

6. Image filtering

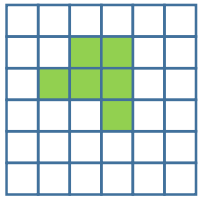
Image filtering is done to correspond with a country's forest definition.

In Kenya, a forest is defined with a minimum 0.5ha ,2m height and 15% canopy



1 Pixel: 0.09ha

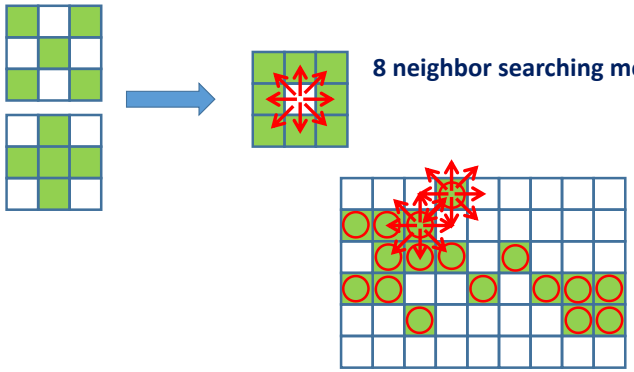
LANDSAT Imagery



Forest area size: 0.54ha

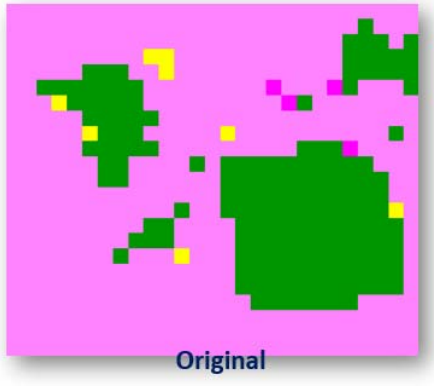
Cluster Method

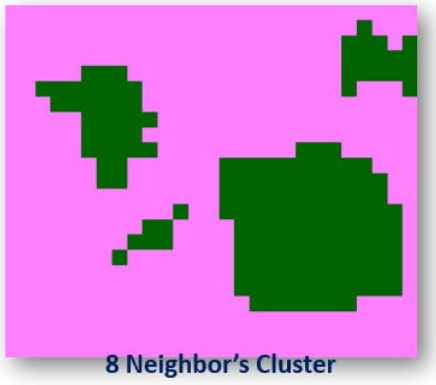
Searching for the forest cluster as same group



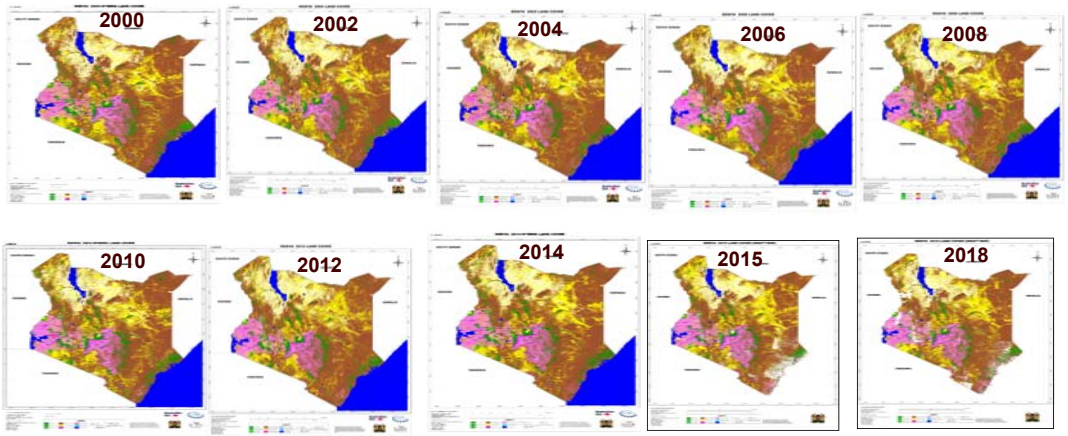
8 neighbor searching method

Example of Elimination





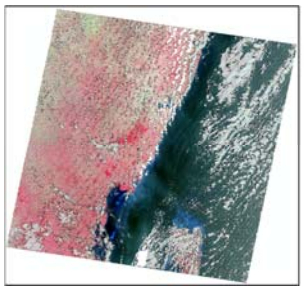
Land cover Time Series (2000 – 2018)



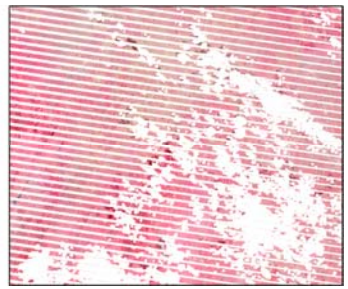
Quality Assessment

Data screening

- The quality of Land Cover/ Land Use Map by image classification is affected by the quality of satellite image.
- Maps are assessed for quality for purposes of change detection and reporting;
- From end of May 2003 upto 2013 Landsat images had a stripping effect.



Cloudy Image



Stripped image

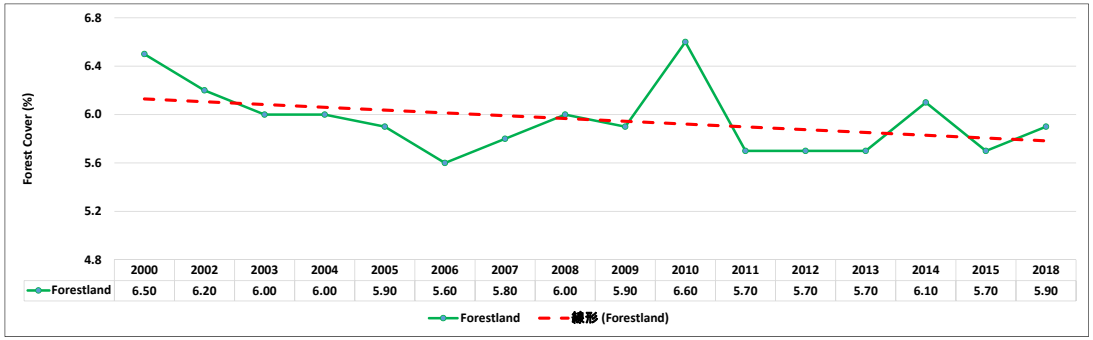
Proportion Land Cover 2002 - 2018

Land Cover	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2018
Forestland	3,669,768	3,574,546	3,548,995	3,469,979	3,319,978	3,444,409	3,566,153	3,481,804	3,878,470	3,394,795	3,364,511	3,343,669	3,582,861	3,383,882	3,462,536
Grassland	42,432,707	43,167,967	42,197,484	42,704,393	41,585,652	41,191,181	41,420,620	42,013,148	41,074,136	41,539,048	41,772,390	40,647,171	41,210,459	42,007,187	41,252,109
Cropland	5,277,516	4,496,990	5,264,533	4,959,535	6,098,743	6,497,516	5,960,539	5,952,985	6,062,784	6,599,941	5,773,879	6,544,047	6,201,378	6,768,042	6,740,173
Wetland	1,242,034	1,226,615	1,211,282	1,236,029	1,218,326	1,272,325	1,227,631	1,244,490	1,261,298	1,233,722	1,298,280	1,269,708	1,262,557	1,263,375	1,267,532
Otherland	6,581,764	6,737,669	6,981,495	6,833,853	6,981,089	6,798,358	7,028,845	6,511,362	6,927,099	6,436,282	6,994,728	7,399,193	6,946,533	5,781,302	6,481,438
TOTAL	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788	59,203,788

Proportion Land Cover 2002 - 2018

Land Cover	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2018
Forestland	6.20	6.00	6.00	5.90	5.60	5.80	6.00	5.90	6.60	5.70	5.70	5.70	6.10	5.70	5.90
Grassland	71.70	72.90	71.20	72.10	70.20	69.60	70.10	70.90	69.40	70.10	70.70	68.70	69.60	71.00	69.70
Cropland	8.90	7.60	8.90	8.40	10.30	10.90	10.00	10.10	10.20	11.20	9.60	11.10	10.50	11.40	11.40
Wetland	2.10	2.10	2.10	2.10	2.10	2.20	2.00	2.10	2.10	2.10	2.20	2.00	2.10	2.10	2.00
Otherland	11.10	11.40	11.80	11.50	11.80	11.50	11.90	11.00	11.70	10.90	11.80	12.50	11.70	9.80	11.00
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Trends in Forest cover 2002 - 2018



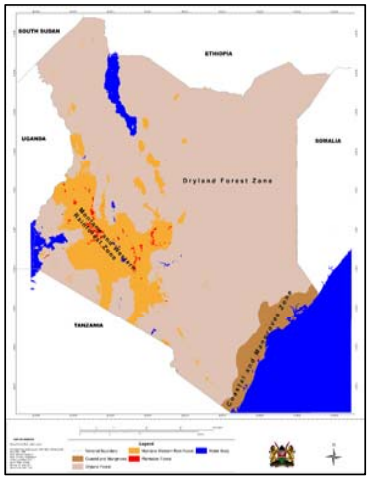
Key Observations in Forest Cover Changes 2000-2018

- Forest cover has continually decreased over time;
- An average of 13,775 hectares of forest land lost per year between 2002 and 2018. Findings in line with other global observations;
- Kenya still on a slow deforestation path and requires a strategy to halt and reverse deforestation and forest degradation;
- Current trajectory suggests the need to propose additional and transformative measures to meet Constitutional obligations and implement global commitments on Climate change;
- Agriculture and settlements major drivers of deforestation in the country.

Assigning Activity Data to Land cover changes

By George Tarus

Stratification of the Forests



Forests have been categorized into strata/ecozones based on climate and Altitude (Wass, 1995)

- Montane Kenya (Mt Kenya, Mau, cherangany, aberdares, Mt Elgon, Leroghi, Matthews range etc) and Western Rain forests – (Kakamega & Nandi forests)
- Coastal (Arabuko sokoke, Boni, Shimba hills etc) and Mangrove forests
- Dryland forests – found in the dry areas
- Plantation forests – Described as management zone set aside by KFs for Public plantation forestry

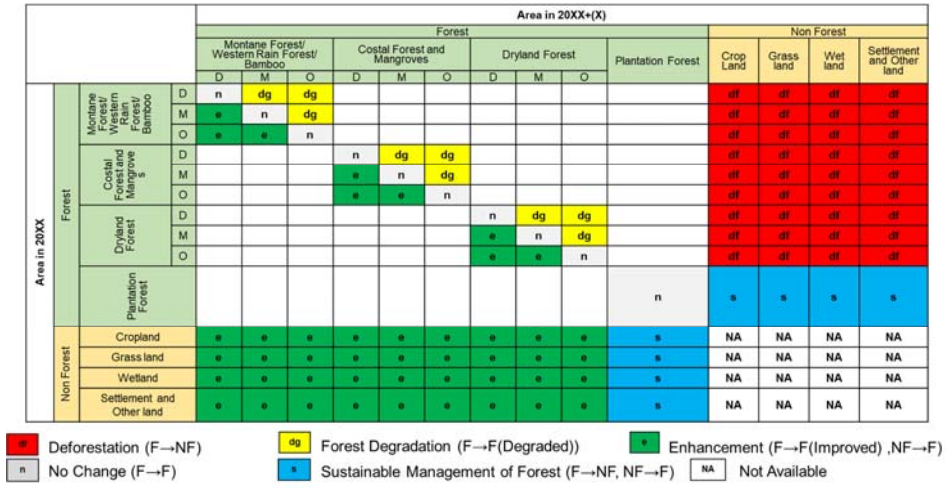
Land Cover Classes for FRL

Land Category	First level stratification	Second level stratification
Forest	Montane/western rainforest/bamboo	Dense (canopy cover ≥65%)
		Moderate (Canopy cover 40-65%)
		Open (Canopy cover 15-40%)
	Coastal and Mangrove forests	Dense (canopy cover ≥65%)
		Moderate (Canopy cover 40-65%)
		Open (Canopy cover 15-40%)
	Dryland forest	Dense (canopy cover ≥65%)
		Moderate (Canopy cover 40-65%)
		Open (Canopy cover 15-40%)
	Plantation forest	Plantation forest
Non forest	Cropland	
	Grassland	
	Wetland	
	Settlement and Other lands	

Illustration of Areas based on land cover mapping

Forest Strata	Forest Substrata	2002		2018	
		Area_ha	%	Area_ha	%
Montane and Western Rain Forest	Dense Forest	1,116,214	1.89	1,050,094	1.77
	Moderate Forest	216,631	0.37	200,092	0.34
	Open Forest	154,288	0.26	106,132	0.18
	Sub total	1,487,134	2.51	1,356,317	2.29
Coastal and Mangrove	Dense Forest	168,817	0.29	266,706	0.45
	Moderate Forest	342,357	0.58	215,189	0.36
	Open Forest	38,220	0.06	17,764	0.03
	Sub total	549,393	0.93	499,658	0.84
Dryland Forest	Dense Forest	701,511	1.18	826,551	1.40
	Moderate Forest	455,035	0.77	398,833	0.67
	Open Forest	397,515	0.67	316,121	0.53
	Sub total	1,554,061	2.62	1,541,505	2.60
Plantation Forest		79,180	0.13	65,055	0.11
Total forestland		3,669,768	6.20	3,462,536	5.85
Cropland		5,277,516	8.91	6,740,173	11.38
Grassland		42,432,706	71.67	41,252,109	69.68
Wetland		1,242,033	2.10	1,267,531	2.14
Settlement & Otherland		6,581,764	11.12	6,481,438	10.95
Total National Level		59,203,787	100	59,203,787	

Land cover change Matrix



Assigning Activity Data to REDD+ Activities - Definitions

- Deforestation is conversion of Forests to Non forests in all canopy classes of Montane/Western Rain forest, Coastal and mangrove forests and Dryland forests and is indicated by Red colour
- Forest Degradation is conversion of a forest from a higher canopy class to a lower canopy class for all forests in the strata/ecozones of Montane/Western Rain forests, Coastal and mangrove forests and Dryland forests and is indicated by yellow colour
- Enhancement of Carbon stocks is the conversion of Non forests into forests (afforestation and reforestation) and the improvement of forests from a lower canopy class to a higher canopy class in the strata/ecozones of Montane/Western Rain forests, Coastal and mangrove forests and Dryland forests and is indicated by green colour.
- Sustainable management of forests is the conversion of non-forests into forests and sustainable harvesting (forests into non forests) in public plantation forest areas managed by Kenya Forest Service (KFS) and is indicated by blue colour. This aims at reducing backlogs by replanting and increasing productivity of the public plantation forests.

Assigning Activity Data to REDD+ Activities - Definitions

- Forestlands remaining forestland in the strata/ecozones of Montane/Western Rain forests, Coastal and mangrove forests and Dryland forests which were mapped with a canopy remaining in the same canopy level in the two mapping years (2002 and 2018) do not imply any carbon stock changes and have not been assigned any colour. Similarly plantation forests that did not change in the two time instances (2002 and 2018) do not imply any carbon stock changes and have not been assigned any colour.
- Conversions among non-forests e.g. cropland converted to wetland do not imply any emissions and have not been assigned any colour

Land cover changes 2002-2018

			2018													
			Montane & Western Rain Forest			Costal and Mangroves Forest			Dryland Forest			Plantation	Cropland	Grassland	Wetland	Settlement & Otherland
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open					
2002	Montane & Western Rain Forest	Dense	772,025	46,912	16,427								167,916	111,437	457	1,039
		Moderate	60,757	59,277	12,190								30,410	53,521	389	87
		Open	23,898	17,630	21,139								13,581	77,873	36	131
	Costal and Mangrove Forest	Dense				84,317	32,686	739					3,747	46,315	712	301
		Moderate				80,975	85,893	3,609					14,242	155,399	1,256	984
		Open				6,195	12,707	367					3,056	15,696	72	126
	Dryland Forest	Dense							216,624	56,911	27,255		50,285	342,844	2,887	4,614
		Moderate							110,576	81,909	27,881		26,971	203,209	2,601	1,828
		Open							40,230	28,313	40,490		10,496	270,156	2,138	5,646
	Plantation											47,740	22,816	8,587	20	17
	Cropland		72,777	8,191	5,583	809	731	127	21,260	8,752	7,273	8,631				
	Grassland		119,848	67,872	50,280	93,653	82,323	12,861	432,319	219,841	202,697	8,652				
	Wetland		238	66	15	555	565	49	2,522	1,074	1,302	20				
	Settlement and Other land		550	143	497	201	284	11	2,921	1,992	9,180	13				

Transition areas (ha) per REDD+ Activity and strata

Forest strata	Total Areas (No of ha per year) of different REDD+ Activities in the reference period 2002-2018				
	Deforestation	Degradation	Sustainable management	Enhancement	
				Afforestation and Reforestation	Canopy improvement
Montane &Western Rain Forest	456,877	75,529	-	326,061	102,285
Costal & Mangrove Forest	241,904	37,034	-	192,169	99,877
Dryland Forest	923,674	112,047	-	911,134	179,119
Plantation	-	-	31,440		-
Total	1,622,455	224,610	31,440	1,446,679	381,282
% affected in Reference period	2.74	0.38	0.05	2.44	0.64

Annual Transition rates per strata and REDD+ Activity

Forest strata	Annual Areas (No of ha per year) of different REDD+ Activities in the reference period 2002-2018				
	Deforestation	Degradation	Sustainable management	Enhancement	
				Afforestation and Reforestation	Canopy improvement
Montane &Western Rain Forest	28,555	4,721	0	20,379	6,393
Costal & Mangrove Forest	15,119	2,315		12,011	6,242
Dryland Forest	57,730	7,003		56,946	11,195
Plantation	0	0	1,965		0
Total	101,403	14,038	1,965	90,417	23,830
% of National land area	0.171	0.024	0.003	0.153	0.040

Forestlands remaining forestlands

Strata	Forest Subcategory	Area_(ha) in year 2002	Forestland remaining forestland 2018	
			Area (ha)	Percentage
Montane and Western Rain Forest	Dense Forest	1,116,214	856,680	76.75
	Moderate Forest	216,631	123,819	57.16
	Open Forest	154,288	49,757	32.25
	Sub total	**1,487,134**	**1,030,256**	**69.28**
Coastal and Mangrove	Dense Forest	168,817	171,488	101.58
	Moderate Forest	342,357	131,286	38.35
	Open Forest	38,220	4,715	12.34
	Sub total	**549,393**	**307,489**	**55.97**
Dryland Forest	Dense Forest	701,511	367,430	52.38
	Moderate Forest	455,035	167,133	36.73
	Open Forest	397,515	95,625	24.06
	Sub total	**1,554,061**	**630,189**	**40.55**
Plantation Forest		**79,180**	**65,055**	**82.16**
Total Forestland		**3,669,768**	**2,032,990**	**55.40**

Emission Factors

By Peter Sirayo And Mwangi Kinyanjui

Emission factors from stock change

Based on pilot NFI data as previously agreed

Example of Pilot NFI data

		Tree	bamboo	Climber	Total	Tree	bamboo	Total	Total	Tree	bamboo	Total	Total	Total	Total		
Vegetatio	D/M/O	m3ha	bm3ha	cm3ha	cm3ha	above_bic	bbiomass	AGB	AGB C sto	Below_bic	Below_bic	BGB	BGB C sto	Biomass	C stock to	county	district
Montane	Dense	263.89	1.61		265.49	208.38	0.98	217.24	102.10	77.10	0.36	80.38	37.78	297.62	139.88	Nyeri	Nyeri
Montane	Dense	1,513.97	-	-	1,513.97	1,146.39	-	1,146.39	538.80	424.16	-	424.16	199.36	1,570.56	738.16	Nyeri	Nyeri
Montane	Dense	105.90	-	-	105.90	87.87	-	87.87	41.30	32.51	-	32.51	15.28	120.38	56.58	Nyeri	Nyeri
Montane	Dense	195.91	-		195.91	160.50	-	163.67	76.92	59.39	-	60.56	28.46	224.22	105.38	Nyeri	Nyeri
Montane	Dense	246.38	-	-	246.38	200.15	-	200.15	94.07	74.05	-	74.05	34.81	274.20	128.88	Nyeri	Nyeri
Montane	Dense	361.74	-	-	361.74	288.13	-	288.13	135.42	106.61	-	106.61	50.11	394.74	185.53	Nyeri	Nyeri
Montane	Dense	646.28	-	-	646.28	511.25	-	511.25	240.29	189.16	-	189.16	88.91	700.41	329.19	Nyeri	Nyeri
Montane	Dense	532.79	-		532.79	427.02	-	429.13	201.69	158.00	-	158.78	74.63	587.91	276.32	Nyeri	Nyeri
Montane	Dense	72.25	-	-	72.25	60.93	-	60.93	28.63	22.54	-	22.54	10.59	83.47	39.23	Nyeri	Nyeri

Calculation of emission factors

Forest strata	Canopy Coverage	ABG	BGB	TOTAL		
		Biomass stock (Tonnes/ha)	Biomass stock (Tonnes/ha)	Biomass stock (Tonnes/ha)	Carbon Stock (Tonnes/ha)	CO_2 (Tonnes/ha)
Montane & Western Rain	Dense	344.97	127.64	472.61	222.13	814.47
	Moderate	58.43	21.62	80.05	37.62	137.96
	Open	23.26	8.61	31.87	14.98	54.92
Coastal & Mangrove	Dense	94.63	18.93	113.55	53.37	195.69
	Moderate	60.45	12.09	72.54	34.09	125.01
	Open	35.47	7.09	42.57	20.01	73.36
Dryland	Dense	80.32	22.49	102.81	48.32	177.18
	Moderate	34.52	9.67	44.19	20.77	76.15
	Open	14.26	3.99	18.26	8.58	31.47
Plantation	Plantation	324.79	87.69	412.48	193.87	710.84
Cropland		0	0	0	0	0
Grassland					8.7	14.99
Wetland		0	0	0	0	0
Settlements & Otherlands		0	0	0	0	0

Choice of stock change emission factors

1. Stock was obtained from Pilot NFI and allometric equations as simple average of plot data for each strata
2. Shoot Root based on IPCC guidelines per forest biome
3. Carbon fraction for AGB and BGB is from IPCC = 0.47
4. CO_2 Calculated from molecular formula of 44/12 (IPCC guideline)
5. The Cropland Carbon Factor obtained from IPCC default values for tier 1 reporting: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Chapter 5 (Cropland) Table 5.8: Default Biomass Stocks Present On Cropland , After Conversion From Forestland
6. The Grassland Carbon Factor obtained from IPCC default values for Tropical Dry Grasslands: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4: Chapter 6 (Grassland) Table 6.4: Default Biomass Stocks Present On Grassland , After Conversion From Other Land Use
7. Default factors from Wetland, Settlement & Otherlands from IPCC tier 1 reporting

Choice of Root /shoot Ratios

Forest strata	Root shoot ratio	Source in IPCC 2006 guidelines
Montane	0.37	Table 4.4. for Tropical rainforest
Dryland	0.28	Table 4.4. above-ground biomass >20 tonnes ha-1 for Tropical Dryland forests
Coastal and Mangrove	0.2	Table 4.4. above-ground biomass <125 tonnes ha^{-1} for Tropical moist deciduous forest
Plantation	0.27	Table 4.4. for Tropical Mountain systems

Emission Factors for Calculating sequestration due to afforestation (based on IPCC for forests Less than 20yrs)

Forest strata	Biomass gain (Tonnes)			Carbon from Biomass	CO_2 sequestered (Tonnes/	
	IPCC table 4.9 equivalent AGB value	BGB	Total		One year	16 years
Montane	10	3.70	13.70	6.44	23.61	377.75
Dryland	2.4	0.67	3.07	1.44	5.29	84.71
Coastal	5	1.00	6.00	2.82	10.34	165.44
Plantation	10	2.70	12.70	5.97	21.89	350.18

NB: AGB equivalents in IPCC Table 9 were selected based on forest categories used for Root/Shoot Ratios

Emission Factors for calculation Sequestration due to Canopy enhancement (Based on IPCC for forests more than 20 yrs)

Forest strata	Biomass gain (Tonnes)			Carbon from Biomass	CO_2 sequestered (Tonnes/	
	IPCC table 4.9 equivalent AGB value	BGB	Total		One year	16 years
Montane	3.1	1.15	4.25	2.00	7.32	117.10
Dryland	1.8	0.50	2.30	1.08	3.97	63.53
Coastal	1.3	0.26	1.56	0.73	2.69	43.01
Plantation	10	2.70	12.70	5.97	21.89	350.18

NB: AGB equivalents in IPCC Table 9 were selected based on forest categories used for Root/Shoot Ratios

Emission Calculations - Deforestation

- Deforestation which is conversion of a forest to a non-forest in Montane/Western Rain forests, Coastal and mangrove forests and Dryland forests .
  - Instantaneous Oxidation was assumed for all deforestation. Therefore the EF is the difference between the CO_2 value of the initial forest strata/canopy class and the CO_2 value of the non-forest
  - All forest conversions into Croplands, Wetlands and Settlements& Otherlands attain a CO_2 value of Zero after conversion. The EF is the difference between the CO_2 of the former forest and zero
  - All forest conversions into Grasslands attain a CO_2 value of 14.99 Tonnes/ha after conversion. The EF is the difference between the CO_2 of the former forest and 14.99 Tonnes/ha

NB: No data on HWP - Most of the activities that convert forests to non-forests may result to instantaneous oxidation)

Emission Calculations – Forest Degradation

- Forest Degradation is the conversion of a forest from a higher canopy class to a lower canopy class in Montane/Western Rain forests, Coastal and mangrove forests and Dryland forests
  - Instantaneous Oxidation was assumed for all degradation. Therefore the EF is the difference between the CO_2 value of the initial forest canopy class and the CO_2 value of the new forest canopy class within a strata

NB: Data on drivers of degradation is not reliable enough to estimate emissions as shown in a preliminary study to this work - Options For Estimating GHG Emissions/Sinks From Forest Degradation, Forest Fires And Forest Revegetation. A Report To Support Establishment Of Kenya's Forest Reference Level

Emissions from Sustainable management of forests

- In Sustainable management of forest which is the conversion of non-forests into forestlands in areas designated as Plantation zones, EF were calculated as follows
  - A stock change method was applied and the EF calculated as the difference between the CO_2 value of the pervious non-forest to the CO_2 value of a plantation based on growth rate.
  - A Conversion of a cropland, Wetland and Settlements & Otherlands into a forestland changes carbon stocks from a zero CO_2 value to a CO_2 value to 350.18 Tonnes/ha
  - A conversion of a grassland to a forestland changes carbon stocks from a CO_2 value of 14.99 Tonnes/ha to a CO_2 value of 350.18 Tonnes/ha

NB: Future Definitions of sustainable management of forests may include plantation forests remaining plantations where stock improvement is considered. This requires periodic inventories

Enhancement of Carbon Stocks due to afforestation

- Enhancement of Carbon stocks due to conversion of non-forests into forests in Montane/Western Rain forests, Coastal and mangrove forests and Dryland forests was calculated as follows
  - A growth factor was adopted for each strata to give the amount of CO_2 gained in a planted/young forest (in this case a forest that is less than 20 years) in the 16 year period.
  - In case the calculation of growth results to a stock which is more than the stock factor of the specific canopy class, a capping was done to retain the stock of the specific canopy class.
  - The EF for conversion of Croplands, Wetlands and Settlements & Otherlands into forestlands was the difference between zero and the CO_2 value after growth of 16 years
  - The EF for conversion of grasslands into Forestlands was the difference between a CO_2 value of 14.99 Tonnes/ha and the CO_2 value of the forest after 16 years of growth

Enhancement of carbon stocks due to canopy improvement

- Enhancement of Carbon stocks due to improvement of Canopy in forests from a lower canopy class to a higher canopy class in Montane/Western Rain forests, Coastal and mangrove forests and Dryland forests was calculated as follows
  - A growth factor was adopted for each strata (Table 13) to give the amount of CO_2 gained in an existing forest (in this case a forest that is more than 20 years) in the 16 year period
  - The EF was calculated as the difference between the previous CO_2 value (for year 2002) and the new CO_2 value after forest enhancement (year 2018). In case the calculation of growth results to a stock which is more than the stock factor of the specific canopy class, a capping was done to retain the stock of the specific canopy class.

NB: IPCC Table 4.9 classifies forests into less than 20 years or more than 20 years to determine Growth rate Factors

Emission factors for various REDD+ activities

			Year 2018													
			Montane &Western Rain Forest			Coastal & Mangroves Forest			Dryland Forest			Plantation	Cropland	Grassland	Wetland	Settlement & Other land
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open					
Year 2002	Montane &Western Rain Forest	Dense	0	676.51	759.54								814.47	799.48	814.47	814.47
		Moderate	-117.10	0	78.02								137.96	122.96	137.96	137.96
		Open	-117.10	-117.10	0								54.92	39.93	54.92	54.92
	Coastal & Mangroves Forest	Dense				0	70.68	122.33					195.69	180.69	195.69	195.69
		Moderate				-43.01	0	51.65					125.01	110.02	125.01	125.01
		Open				-43.01	-43.01	0					73.36	58.37	73.36	73.36
	Dryland Forest	Dense							0	101.03	145.72		177.18	162.19	177.18	177.18
		Moderate							-63.53	0	44.69		76.15	61.16	76.15	76.15
		Open							-63.53	-44.69	0		31.47	16.47	31.47	31.47
	Plantation											0	710.84	695.85	710.84	710.84
	Cropland		-377.75	-137.96	-54.92	-165.44	-125.01	-73.36	-84.71	-76.15	-31.47	-350.18				
	Grassland		-362.76	-122.96	-39.93	-150.45	-110.02	-58.37	-69.71	-69.71	-16.47	-335.19				
	Wetland		-377.75	-137.96	-54.92	-165.44	-125.01	-73.36	-84.71	-76.15	-31.47	-350.18				
	Settlement & Other land		-377.75	-137.96	-54.92	-165.44	-125.01	-73.36	-84.71	-76.15	-31.47	-350.18				

Calculated Emissions

By Peter Nduati

Calculated emissions (CO_2 Tonnes) for 2002-2018

			2018												
			Montane &Western Rain Forest			Coastal & Mangroves Forest			Dryland Forest			Plantation	Cropland	Grassland	Wetland	Settlement & Other land
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open	Dense				
2002	Montane &Western Rain Forest	Dense	0	31,736,525	12,477,157	0	0	0	0	0	0	0	136,762,236	89,091,210	372,448	845,980
		Moderate	-7,114,866	0	951,082	0	0	0	0	0	0	0	4,195,328	6,581,133	53,687	11,994
		Open	-2,798,557	-2,064,586	0	0	0	0	0	0	0	0	745,902	3,109,560	1,982	7,173
	Coastal & Mangroves Forest	Dense	0	0	0	0	2,310,209	90,364	0	0	0	0	733,271	8,368,789	139,345	58,912
		Moderate	0	0	0	3,483,090	0	186,401	0	0	0	0	1,780,320	17,096,234	156,948	122,960
		Open	0	0	0	-266,492	-546,581	0	0	0	0	0	224,178	916,188	5,269	9,237
	Dryland Forest	Dense	0	0	0	0	0	0	0	5,749,746	3,971,560	0	8,909,699	55,605,986	511,516	817,498
		Moderate	0	0	0	0	0	0	-7,024,777	0	1,245,926	0	2,053,907	12,428,354	198,082	139,180
		Open	0	0	0	0	0	0	-2,555,776	-1,265,251	0	0	330,272	4,450,200	67,272	177,640
	Plantation		0	0	0	0	0	0	0	0	0	0	16,218,635	5,974,977	14,395	11,835
	Cropland		-27,491,874	-1,130,006	-306,648	-133,887	-91,322	-9,323	-1,800,840	-666,519	-228,847	-3,022,573				
	Grassland		-43,476,376	-8,345,774	-2,007,720	-14,089,882	-9,056,791	-750,712	-30,137,915	-15,325,644	-3,338,968	-2,899,889				
	Wetland		-89,992	-9,163	-826	-91,779	-70,689	-3,559	-213,648	-81,766	-40,964	-6,871				
	Settlement & Other land		-207,727	-19,729	-27,301	-33,174	-35,507	-832	-247,428	-151,695	-288,869	-4,412				

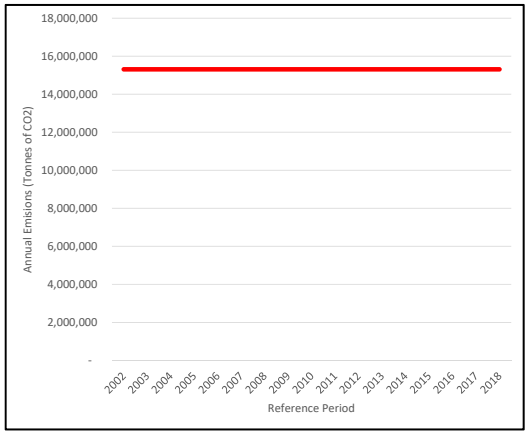
Annual emissions (CO_2 Tonnes) in the Reference period

			2018													
			Montane &Western Rain Forest			Coastal & Mangroves Forest			Dryland Forest			Plantation	Cropland	Grassland	Wetland	Other land
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open	Dense				
2002	Montane &Western Rain Forest	Dense	0	1,983,533	779,822	0	0	0	0	0	0	0	8,547,640	5,568,201	23,278	52,874
		Moderate	-444,679	0	59,443	0	0	0	0	0	0	0	262,208	411,321	3,355	750
		Open	-174,910	-129,037	0	0	0	0	0	0	0	0	46,619	194,347	124	448
	Coastal & Mangroves Forest	Dense	0	0	0	0	144,388	5,648	0	0	0	0	45,829	523,049	8,709	3,682
		Moderate	0	0	0	-217,693	0	11,650	0	0	0	0	111,270	1,068,515	9,809	7,685
		Open	0	0	0	-16,656	-34,161	0	0	0	0	0	14,011	57,262	329	577
	Dryland Forest	Dense	0	0	0	0	0	0	0	359,359	248,222	0	556,856	3,475,374	31,970	51,094
		Moderate	0	0	0	0	0	0	-439,049	0	77,870	0	128,369	776,772	12,380	8,699
		Open	0	0	0	0	0	0	-159,736	-79,078	0	0	20,642	278,138	4,205	11,103
	Plantation	Dense	0	0	0	0	0	0	0	0	0	0	1,013,665	373,436	900	740
	Cropland		-1,718,242	-70,625	-19,166	-8,368	-5,708	-583	-112,553	-41,657	-14,303	-188,911				
	Grassland		-2,717,274	-521,611	-125,483	-880,618	-566,049	-46,919	-1,883,620	-957,853	-208,686	-181,243				
	Wetland		-5,625	-573	-52	-5,736	-4,418	-222	-13,353	-5,110	-2,560	-429				
	Other land		-12,983	-1,233	-1,706	-2,073	-2,219	-52	-15,464	-9,481	-18,054	-276				

Emissions Numbers (CO_2 Tonnes)

REDD+ Activity	CO_2 Emissions (Tonnes)	
	Total for 2002-2018	Average for 2002-2018
Deforestation	357,079,888.71	22,317,493.04
Degradation	58,718,969.66	3,669,935.60
Sustainable management of forest	16,286,097.93	1,017,881.12
Enhancement	-187,123,673.96	-11,695,229.62
Total (Emission estimates (Net))	244,961,282.33	15,310,080.15

Illustration of the average annual emissions - Net and Per REDD+ Activity



National Circumstances

By Alfred Gichu and Jamleck Ndambiri

Where are our emissions coming from?

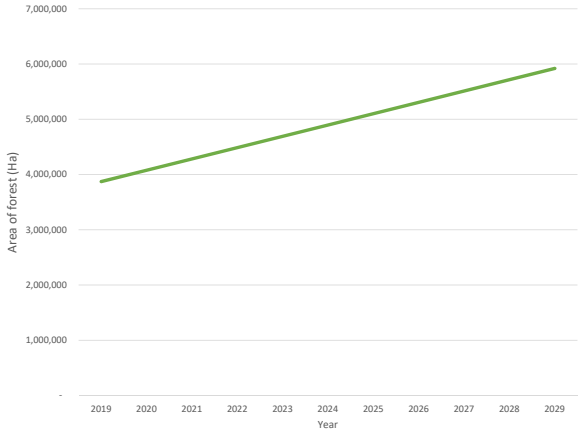
Forest strata	CO_2 Emissions (Tonnes)
	Average for 2002-2018
Montane & Western rain forests	11,990,766
Coastal & Mangrove forests	220,938
Dryland forests	2,080,496
Plantation forests	1,017,881
Total (Emission estimates (Net))	15,310,080

What is the future of Forest Cover in Kenya?

Increase with forest conservation?

Implementation of forest Policies
Conservation policies
Climate change policies
Land conservation policies
More tree planting in farms
More trees in dryland areas
Devolved management systems

Illustration of Vision 2030 targets based on current forest maps

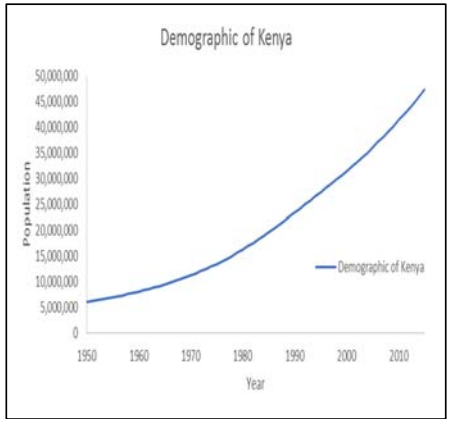


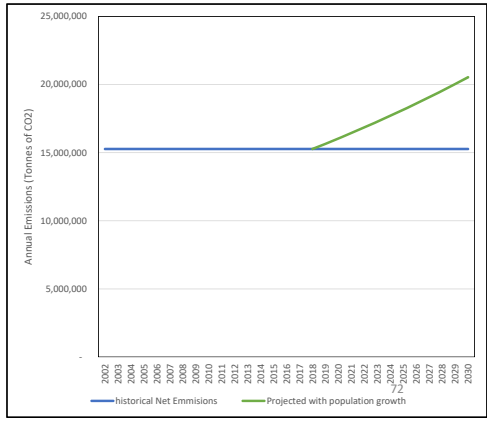
If we increase forest cover today by 204,727 ha per year without losing any forest to other non forest uses, we will attain the vision 2030 goal of 10% forest

Hindrances/Barriers to forest increase

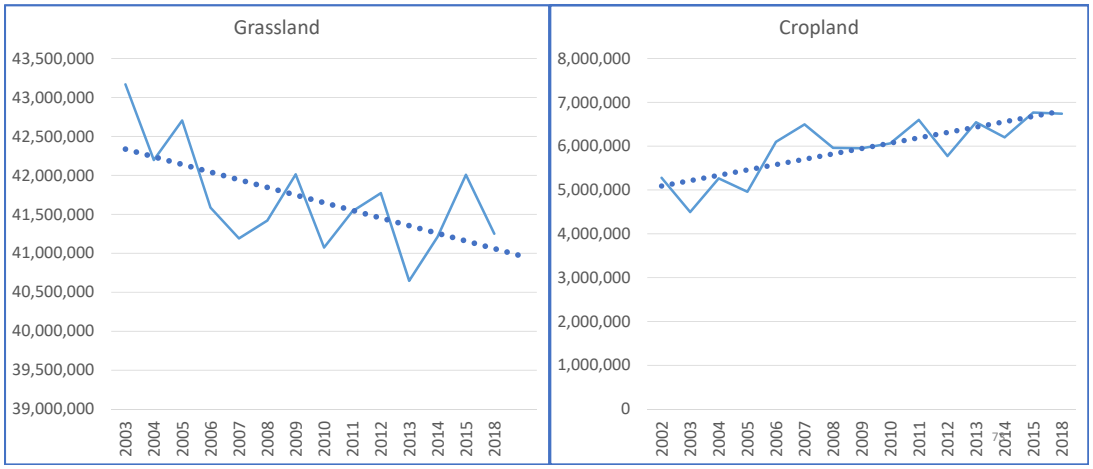
- Increasing population and their associated developmental needs
- Agricultural expansion
- Urban expansion including infrastructure
- Improved access to formerly pristine forests
- Conflicts of natural resource use
- Weak Enforcement

An illustration of Kenya's population growth and how it may increase forest related emissions





Trends of Areas (ha) based on SLEEK mapping



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What will be the emissions in future?

We propose a projection that is based on average historical emissions - 15,310,080 Tonnes of CO_2 Per year

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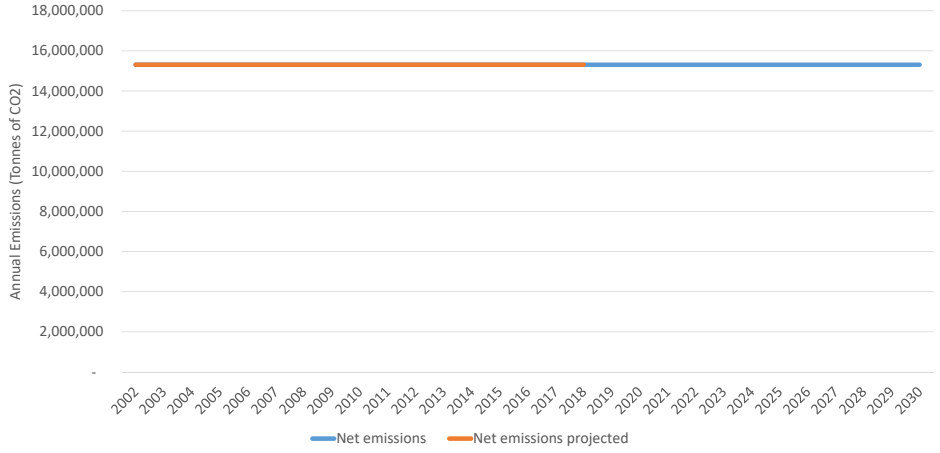
Projection of Net emissions



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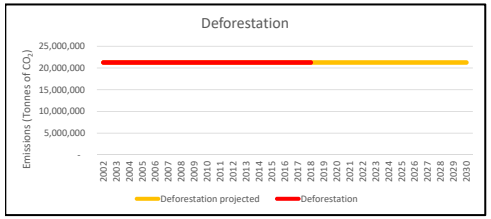
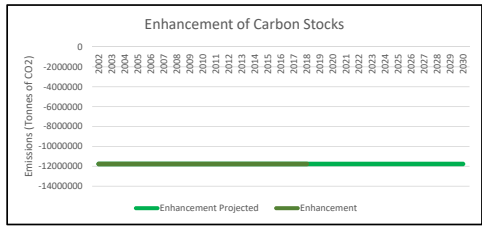
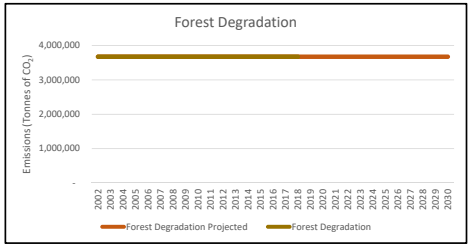
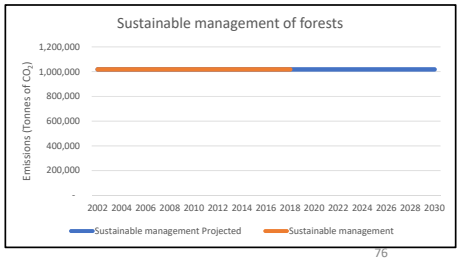
Projected emissions for REDD+ Activities









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Uncertainty of the FRL

By Faith Mutwiri and Mwangi Kinyanjui

Error matrix - 2002 map

Class	Forest (D)		Forest (M)		Forest (O)		Annual Crops		Perennial Crops		Open Grasses		Wooded grass		Water body	
	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions
Forest (D)	71	0.0290309	3	0.0012267	2	0.0008178	0	0.0000000	0	0.0000000	1	0.0004089	8	0.0032711	0	0.0000000
Forest (M)	6	0.0024638	31	0.0127299	2	0.0008213	1	0.0004106	0	0.0000000	0	0.0000000	1	0.0004106	0	0.0000000
Forest (O)	0	0.0000000	2	0.0010508	10	0.0052542	0	0.0000000	0	0.0000000	1	0.0005254	6	0.0031525	0	0.0000000
Annual Crops	0	0.0000000	1	0.0006205	0	0.0000000	100	0.0620459	1	0.0006205	21	0.0130296	10	0.0062046	0	0.0000000
Perennial Crops	1	0.0002799	0	0.0000000	0	0.0000000	4	0.0011198	11	0.0030794	1	0.0002799	0	0.0000000	0	0.0000000
Open Grasses	0	0.0000000	0	0.0000000	0	0.0000000	14	0.0067239	0	0.0000000	265	0.1272742	21	0.0100859	0	0.0000000
Wooded grass	3	0.0018832	3	0.0018832	6	0.0037664	13	0.0081605	1	0.0006277	44	0.0276200	810	0.5084589	0	0.0000000
Water body	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	41	0.0204836
Vegetated Wetland	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000
Other	0	0.0000000	0	0.0000000	0	0.0000000	2	0.0008823	0	0.0000000	14	0.0061762	2	0.0008823	0	0.0000000
Total	**81**	**0.03365792**	**40**	**0.017511022**	**20**	**0.010659664**	**134**	**0.079343032**	**13**	**0.004327587**	**347**	**0.175314283**	**858**	**0.53246598**	**41**	**0.020483601**

Error matrix - 2018 map

Class	Forest (D)		Forest (M)		Forest (O)		Annual Crops		Perennial Crops		Open Grasses		Wooded grass		Water body	
	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions	Count	P_i Area Proportions
Forest (D)	171	0.0274539	35	0.0056192	8	0.0012844	4	0.0006422	4	0.0006422	2	0.0003211	5	0.0008027	0	0.0000000
Forest (M)	36	0.0028522	87	0.0068929	34	0.0026938	6	0.0004754	3	0.0002377	1	0.0000792	7	0.0005546	0	0.0000000
Forest (O)	7	0.0004421	33	0.0020840	51	0.0032207	6	0.0003789	0	0.0000000	0	0.0000000	21	0.0013262	0	0.0000000
Annual Crops	9	0.0011600	8	0.0010311	13	0.0016756	696	0.0897099	16	0.0020623	30	0.0038668	50	0.0064447	1	0.0001289
Perennial Crops	17	0.0003550	12	0.0002506	9	0.0001879	15	0.0003132	169	0.0035292	0	0.0000000	6	0.0001253	1	0.0000209
Open Grasses	3	0.0007597	1	0.0002532	0	0.0000000	86	0.0217786	13	0.0032921	413	0.1045880	44	0.0111425	0	0.0000000
Wooded grass	27	0.0127204	35	0.0164894	34	0.0160182	38	0.0179027	11	0.0051824	50	0.0235562	945	0.4452126	1	0.0004711
Water body	0	0.0000000	2	0.0011517	0	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	1	0.0005758	30	0.0172754
Vegetated Wetland	0	0.0000000	0	0.0000000	0	0.0000000	6	0.0000668	0	0.0000000	0	0.0000000	0	0.0000000	5	0.0000557
Other	0	0.0000000	0	0.0000000	3	0.0016843	18	0.0101055	0	0.0000000	3	0.0016843	5	0.0028071	3	0.0016843
Total	**270**	**0.045743353**	**213**	**0.033772143**	**152**	**0.026764907**	**875**	**0.141373338**	**216**	**0.014945846**	**499**	**0.134095606**	**1084**	**0.468991592**	**41**	**0.019636193**

Summary of Map Accuracy

2002

Class	Forest (D)	Forest (M)	Forest (O)	Annual Crops	Perennial Crops	Open Grasses	Wooded grass	Water body
Uncertainty	11.83%	22.32%	38.53%	10.83%	47.55%	6.74%	2.42%	0.00%
User Accuracy	83.53%	73.81%	52.63%	73.53%	64.71%	83.86%	90.00%	100.00%
Producer Accuracy	87.65%	77.50%	50.00%	74.63%	84.62%	76.37%	94.41%	100.00%
Overall Accuracy	**87.02%**	**87.02%±2.22%**						
Overall Uncertainty	**2.22%**							

2018

Class	Forest (D)	Forest (M)	Forest (O)	Annual Crops	Perennial Crops	Open Grasses	Wooded grass	Water body
Uncertainty	11.79%	17.91%	21.94%	6.25%	25.01%	6.59%	2.77%	16.94%
User Accuracy	73.71%	50.00%	43.22%	82.27%	73.48%	68.95%	81.68%	83.33%
Producer Accuracy	63.33%	40.85%	33.55%	79.54%	78.24%	82.77%	87.18%	73.17%
Overall Accuracy	**76.04%**	**76.04%±2.26%**						
Overall Uncertainty	**2.26%**							

Correctness of the 2018 map

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Dense Forest	270	232	171	63.33%	73.71%
Moderate Forest	213	174	87	40.85%	50.00%
Open Forest	152	118	51	33.55%	43.22%
Wooded Grassland	1084	1157	945	87.18%	81.68%
Open Grassland	499	599	413	82.77%	68.95%
Perennial Cropland	216	230	169	78.24%	73.48%
Annual Cropland	875	846	696	79.54%	82.27%
Vegetated Wetland	86	61	50	58.14%	81.97%
Open Water	41	36	30	73.17%	83.33%
Otherland	212	195	162	76.42%	83.08%
Totals	3648	3648	2774		
Overall Classification Accuracy =		76.04%			

Uncertainty of Emission Factors

With limited data, like in the case of Kenya, The IPCC proposes use of Bootstrap simulation - 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1: General Guidance and Reporting. Chapter 2- Uncertainties

- The results of uncertainty analysis of EF are shown as follows. The estimation describes the ranges of 95 % Probability of the confidence interval.
- The mean is 194.0996.
- Then 2.5 Percentile and the 97.5 Percentile are 149.8854 and 241.9887, respectively. Lower and Upper limit calculated are -22.8 % and 24.7 %, respectively.

Statistics of accuracy

Statistics of accuracy	Montane & Western Rain Forests			Coastal & Mangrove Forests			Dryland Forest			Plantation Forest
	Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open	
No of Plots	9	7	6	18	12	16	8	8	7	36
Mean	344.97	58.43	23.26	94.63	60.45	35.47	80.32	34.52	14.26	324.79
Standard Deviation (SD)	334.88	34.64	13.64	45.03	31.90	34.03	111.22	15.01	6.89	249.38
Coefficient of Variation (CV) [%]	97.08	59.28	58.64	47.59	52.76	95.93	138.47	43.47	48.28	76.78
Standard error of the mean	114.99	22.09	9.50	22.30	17.45	8.87	28.40	12.21	5.39	54.13

Uncertainty of FRL

Calculated as

Uncertainty (%)=√(〖Uncertainty of AD (%)〗 ^2 〖+ Uncertainty of EF (%)〗 ^2)

FUTURE IMPROVEMENTS/CAPACITY BUILDING NEEDS

By Alfred Gichu

Identified issues for improvement

- There is need for a National Forest inventory to improve on EF. This includes establishment of growth models
- An improvement of the Land cover Mapping programme would make the maps more accurate
- Research should be targeted on emissions from
  - Non CO2 emissions like CH4 and N2O
  - Other Carbon Pools – HWP, Soil OM, Dead wood, Litter
- Improvement of data collection methods may justify the use of Gain Loss method against the currently used Stock Change method

REDD+ Technical Working Group Meeting on 1st and 2nd July 2021

Participants : TWG members and Stakeholders

Date : From 1st to 2nd July 2021

Place : Masada Hotel in Naivasha

Day 1:

Time	Activity	Lecturer/Instructor
8:30 - 9:00	Registration	Ms. Veronica Syombua
9:00 – 9:15	Introduction	Mr. Peter Nduati
9:15 - 9:30	Opening Remarks	Mr. Alfred Gichu
9:30 – 10:00	MRV for NDC Forest Sector	Ms. Yvonne Nyokabi
10:00 - 10:30	Ch.1 Background and Purpose of NFMS document and Ch.2 UNFCCC requirements	Mr. Peter Nduati
10:30 - 11:00	Ch.3 Basic Conditions of Kenya's NFMS and Ch.4 Conceptual design of NFMS in Kenya	Mr. George Tarus
11:00 - 11:30	Health Break / Tea Break	
11:30 - 12:30	Ch.5 Monitoring Function of NFMS ➢ Forest Cover and Forest Cover Change for AD	Ms. Faith Mutwiri
12:30 - 13:30	Ch.5 Monitoring Function of NFMS ➢ Forest Carbon Stock for Emission Factor	Mr. Peter Sirayo
13:30 - 14:30	Lunch Break	
14:30 - 15:30	Ch.5 Monitoring Function of NFMS ➢ Forest Cover Change Monitoring	Ms. Faith Mutwiri
15:30 - 16:30	Ch.5 Monitoring Function of NFMS ➢ Policies and Measures (PaMs) ➢ Biodiversity ➢ REDD+ and AR-CDM projects	Dr. Mwangi Kinyanjui
16:30 - 17:00	Health Break / Tea Break	

Day 2

Time	Activity	Lecturer/Instructor
8:30 - 10:30	Ch.6 Data Management Function of NFMS	Mr. Richard Ngugi
10:30 - 11:00	Ch.7 Institutional Arrangements for NFMS Ch.8 Calender of NFMS	Mr. Peter Nduati
11:00 - 11:30	Health Break / Tea Break	
11:30 - 12:30	➢ FRL future improvement based on the Technical Assessment of UNFCCC ➢ Cooperation between NRS and NFMS	Dr. Mwangi Kinyanjui
12:30 – 12:45	Way forward	Mr. Peter Nduati
12:45 - 13:00	Official Closing	Mr. Alfred Gichu
13:00 - 14:00	Lunch Break	

*Question and Answerer time will be set in each session

MINUTES OF THE 7TH REDD+ TWG AND STAKEHOLDERS MEETING
Participants: TWG members and Stakeholders
Date: 1st -2nd July 2021
Venue: Masada Hotel, Naivasha

1 PARTICIPANTS

The meeting was attended by 33 participants. The list of names is availed under appendix 1.

2 AGENDA

1. Registration / Introduction
2. 0pening Remarks
3. Implementation of an Integrated MRV Framework- Kenya Experience
4. NFMS Presentation / Discussions
5. FRL Future Improvement based on technical assessment of UNFCCC
6. Way Forward
7. Cooperation between NRS and NFMS
8. Adjournment

2.1 REGISTRATION AND INTRODUCTION

The meeting started with a word of prayer at 9:00am. An introduction session followed in which all the participants introduced themselves, mentioning names and the organizations they represented.
A list bearing the names of participants was circulated for signing off/registration.

2.2 OPENING REMARKS

Mr. Nduati introduced the main agenda of the day, which was to review and improve the NFMS document. He presented a brief explanation on NFMS, its purpose, scope and progress made since last TWG meeting.
His key highlight was that NFMS is a system for monitoring performance in the forestry sector in the whole country. It is one of the requirements for Kenya to participate in REDD+ activities
He reiterated that the current NFMS document (Version 1) will be constantly revised on the basis of new technologies, information, and/or methodologies.

2.3 IMPLEMENTATION OF AN INTERGRATED MRV FRAMEWORK- KENYA EXPERIENCE

Ms. Nyokabi made a presentation on Integrated Monitoring Reporting and Verification (IMRV under the following:

- Kenya's Climate Change Journey including legal frameworks
- Climate change governance in Kenya
- Kenya's NDC and implications for the forestry sector
- Integrated Monitoring Reporting and Verification (IMRV) Kenya: basis, challenges, elements, operational structure and tool.

Reactions

The presenter took the audience through climate change governance in Kenya that showed the relationship among several agencies/bodies such as the National Climate Change Council, the Parliament, the Ministry of Environment and Forestry, NEMA and the Climate Change Directorate. In reaction, a member sought to know where IMRV framework is domiciled. In response, the presenter said that the IMRV system is currently hosted under the Ministry of Environment and Forestry.

One of the participants wanted to know who the targets groups are and how they should report to the system. The presenter reiterated that they will find a way to bring other sectors on board through a convener with CCD

Another member also sought to know how data would be standardized throughout the system. There are standard templates for collecting and reporting data and that are much easier for the community to interact with.

2.4 NFMS PRESENTATIONS / DISCUSSIONS

2.4.1 Ch.1 Background and Purpose of NFMS document and Ch.2 UNFCCC requirements

Mr. Nduati led the NFMS document presentations by covering chapter 1 and part of chapter 2. The following objectives of the document were covered

- To develop the methodology of how forest is monitored.
- To develop the data management system for REDD+ and sustainable forest management
- To clarify the institutional arrangement for implementation of NFMS
- To clarify the mid/long time calendar for implementation of the national forest monitoring system

He also made a presentation on UNFCCC requirements for Kenya to participate in REDD+ as listed below

(a) REDD+ National Strategy or Action Plan
(b) Forest Reference Emission Level/Forest Reference Level (FREL/FRL)
(c) A robust and transparent National Forest Monitoring System
(d) Safeguards Information System

Reactions

- The NFMS system should go beyond reporting on forest data to include tree cover.
- The system should be able to deliver on the drivers mentioned otherwise it would be lacking its capacity
- There is need to reevaluate whether NFMS covers everything it is required to.

2.4.2 Ch.3/4 Basic Conditions of Kenya's NFMS and Conceptual design of NFMS in Kenya

Mr. George Tarus made a presentation on these section under the following subheadings:

- Land Use Categorization,
- Forest Definition Adopted by the NFMS
- Forest Stratification
- Carbon Pools
- REDD+ in Kenya

- Conceptual Design of NFMS in Kenya

Reactions

A participant pointed out that there was need to broaden the scope of the system to go beyond the definition of forest and provide information on other activities including tree cover. In addition, leaving out vegetation that is ≤2M high out of the definition may cause areas with this vegetation to be exploited

The participant added that this chapter should establish the principles of NFMS by stating clearly what it will achieve.

He also pointed out that the current system being implemented has not covered well the aspect of forest degradation under the 3 substrata of natural forests: Dense Forest (above 65% Canopy); Moderate Forest (40% < 65%) and Open Forest (15% ≤ 40%)

In addition, it was pointed out that there is need: to invest in accuracy assessment to ensure the data provided on this system is reliable and accurate; to strengthen and involve the community to report to the system and to accommodate permanent forest sector changes;

More attention would be required in the area of capacity building to the rangers and other forest officers to provide credible data.

It was observed that NFMS does not mention national interests or its benefits to the communities. There was a suggestion to add a chapter to address how the communities will benefit from the system.

The following suggestion and remarks were also put forward

- A section on definition of terms to be added in the document to ensure standardization throughout the document
- The definition of deforestation was not clear in the document; it lacked a time frame.
- The editorial quotation of the map done in 1981 is very old, recent versions of the same map should be quoted instead.
- Information on safeguards of biodiversity should be captured in chapter 4

Questions

The following questions were asked in reference to the presentation

- how to incorporate forest conservation while addressing the four REDD+ activities in Kenya.
- How NFMS is going to be established in Kenya.
- Other ways in which forest degradation can be monitored apart from using canopy cover as an indicator to which Mr. Nduati responded that the team was still looking at other ways and methods for assessing forest degradation.
- The role of other sectors within the framework.

In this regard, Mr. Kato proposed that we should add another chapter on improvement of NFMS to include e.g. conservation of forest carbon stock as REDD+ activity and participatory/community forest monitoring.

Mr. Nduati reiterated that the suggestions for improvement of this document are welcome. Participants were urged to do a write up or submission to the group.

2.4.3 Ch.5 Monitoring Function of the NFMS- Forest cover and forest cover change for AD

Ms. Faith Mutwiri covered Forest cover and forest cover change for AD under the following:

a) Forest cover area based on SLEEK programme
b) Forest cover change area based on Land cover / Land use change maps

Reactions

Introduction section for each chapter should be added to give an overview of what the chapter is all about.

There needs to be a mention to indicate that the definition of forest as adopted by this document is different from other definitions

Question

A member sought to know how the other documents connected to NFMS can be structured such that definitions remain the same across the documents with regard to FRL/NFMS. In response, Mr. Nduati reiterated that FRL is meant to aid in the implementation of REDD+ whereas NFMS answers to bigger issues. Therefore, definitions that are not allowed in FRL should be included in NFMS.

2.4.4 Ch.5 Monitoring Function of NFMS- Forest Carbon Stock for Emission Factor

This part of chapter 5 was presented by Mr. Peter Sirayo. Under this, he covered National Forest Inventory where he explained the methodology used in sampling data from the field and how to calculate the emission factors.

He also mentioned that sampling is done at intervals of every 10 years

As part of reactions/questions, the audience sought to understand how data was analyzed across the 121 plots (121 plots in NFMS document) and the reason why the forest 2020 data was not used.

According to the document, a third of the proposed Temporary Sample Plots (TSPs) should be marked as Permanent Sample Plots (PSPs) to allow continuous monitoring of the different forest units (p.29). In response, a participant sought to know why a third as opposed to a quarter of the TSP was picked to represent permanent sample plots.

2.4.5 Ch.5 Monitoring Function of NFMS Forest Cover Change Monitoring

This section was presented by Ms. Faith Mutwiri and she covered the following areas

- Detection of deforestation area using radar image using the JJ-FAST
- Display of deforestation area by JJ-FAST on the FIP portal
- Detection of deforestation area using optical image by NRTFAS
- Field report by ground truth using survey 123

Reactions

Mr. Balozi expressed his dissatisfaction with the use of the word ‘deforestation’ in this chapter. He pointed out that an attack from locusts can be classified under degradation and therefore it may give the wrong interpretation of what is happening. Additionally, if logging is classified as deforestation, this would be misleading as it’s considered a normal activity.

Questions

Given that it takes one week for the alerts to be sent, a participant sought to know how this time can be shortened to ensure necessary steps are taken in preventing destruction of huge forest

areas. In response, the presenter pointed out that the system relies on satellite images which takes about a week to capture and send data.
A participant sought to find out how the other counties in Kenya can be brought on board to participate in provision of data to the system considering, the work done was covered under a pilot study
There was also the need to identify how information in the system will be verified in areas where there are no rangers or employees to go to the ground and record the actual happenings.

2.4.6 Ch.5 Monitoring Function of NFMS - Policies and Measures (PaMs); Biodiversity; REDD+ and AR-CDM projects

These sections of chapter 5 were presented by Dr. Mwangi Kinyanjui who took the participants through the policies and measures, biodiversity concepts. He also covered the REDD+ and AR-CDM projects, highlighting the process of updating and publishing each projects data on the forest information Platform.
Reactions

- It was suggested that fauna be included in the biodiversity. In response to this, Mr. George suggested that NFMS can borrow from the works of voluntary agencies e.g., VCS who have listed the parameters to be considered under biodiversity.
- The Table on composition of NFP on page 48 was too bulky and needed to be modified according to National REDD+ strategy.
- One participant sought to know how communities and CFA's can be recognized and appreciated to contribute to the system
- There was also the need to have a national registry to validate some of the projects

2.4.7 Ch.6 Data Management Function of NFMS

Data management function was remotely presented by Mr. Richard via webinar. He reiterated that the FIP is not yet complete but work in progress. He took the participants through components and functions of FIP, access rights, operational structure, data update and management of system infrastructure.

Reactions

- Alfred expressed that FIP being a system for the whole forestry sector in the country, there was need to bring all stakeholders on board so that they can be aware of its existence and operation. He suggested that KFS could be assigned custodianship, i.e., responsibility for housing and continuous improvement of the system. He also added that the system needed to broaden its scope to include forests that are not covered within KFS jurisdiction.
- It was observed that there were gaps in data and there was need to find out how the data can be acquired.
- How the platform can be accessed, how data can be accessed and downloaded and how people can interact with the available data.
- Whether data from JJ FAST has been validated prior to uploading into the platform.
- If there a mechanism in place to ensure no data duplication.

- How the system can be made sustainable for the country.
- On whose responsibility will the data on the platform be placed and whether there is an agreed format of engaging institutions in provision and promotion of the data.
- There was a suggestion that a section to capture human rights concern be added in the system.
- It was noted that the naming of files in the FIP was not clear and needed improvement.
- It was suggested also that system should automatically be able to capture the location of the user feeding data into it using JJ-FAST.
- It was felt that there should be a linkage between FIP and NFP.
- The need to monitor tree planting activities and the progress of planted tree seedlings.
- There is need to establish the vertical power in the forestry sector which will increase cooperation from other institutions and make it easy to collect data from these institutions.
- There is need to include the green belt movement projects and NEMAS CDN projects.
- Since data is mostly collected from the community, it was suggested that a feedback mechanism should be put in place to inform the communities on the action/measures taken on the collected data.

2.4.8 Ch.7 Institutional Arrangements for NFMS

This section Was presented by Mr. Peter Nduati. He took the participants through the tasks and responsibilities of the various stakeholder institutions involved in the monitoring and Data management functions of NFMS for its accountability and sustainability.

Reactions
It was felt that the Institutional Arrangement section in the document was very brief and there was need to add more explanation on the role of the community. It was noted that the role of communities was not mentioned in this chapter even though some of the forest areas are managed under CFAs.
A member also pointed out that the system should be attached to a particular institution to ensure that it continues to function even after the project is completed.

2.4.9 Ch.8 Calendar of NFMS Mr. Peter Nduati

Peter Nduati took the members through the NFMS calendar detailing the milestones covered and those in progress.
Peter advised that the 2020 land cover map was work in progress.
There was no reaction from the team.

2.5 FRL future improvement based on the Technical Assessment of UNFCCC

A presentation was made on recommendations proposed on the technical assessment of FRL by UNFCCC. There were a number of recommendations that would be used for the future improvement of FRL. The presenter also covered the linkage between the three documents i.e. FRL, NFMS and NRS

2.6 Way forward on NFMS by Mr. Nduati

There would be a meeting with the document review team the following Monday to refine the document by incorporating the suggestions made.
The revised document would be shared with TWG to go through and check whether appropriate changes have been made.
Another TWG meeting was proposed to take place in September to review the work done, validate and possibly adopt the document.
TWG members with special skills and expertise may be called upon to offer their input and advice on improving the NFMS.
There will be an additional chapter to focus on future improvement of NFMS.
Participants with additional recommendations for improvement of NFMS were encouraged to do a submission to CADEP-SFM component 3 and KFS.

2.7 Cooperation between NRS and NFMS by Dr. Mwangi Kinyanjui

The presenter took the participants through the REDD+ strategy document. He added that the document was not ready for sharing yet as it is still under development. It would however be availed later for review.

Reactions

- There is need to address underlying issues e.g., corruption which is the root cause of deforestation.
- The document was said to be still very raw (version 0) and it would undergo some modification before it's shared to the group for review.
- It was felt that the institutional arrangement was proposed without context and one participant sought to find out how it was arrived at.
- Another participant sought to know under which phase of the 3 phases of REDD+ will management development fall.
- It was noted that the NRS did not address the issues of land ownership in Kenya which is a critical matter. It was suggested that a section to address this matter be included in NRS and explain clearly how county governments can allocate land to forestry and protect it.

2.8 Adjournment

The meeting was closed with a vote of thanks by Mr. Alfred Gichu followed by a word of prayer by one of the participants. There being no other agenda, the meeting ended at 4 pm on 2nd July.

Minutes prepared by:
Name: Veronica Syombua Signature: ……
Date: 9.07.2021.

3 Appendices

3.1 Appendix 1: list of participants

S/No	NAME	ORGANIZATION
1	MWANGI KINYANJUI	KARATINA UNIVERSITY
2	MERCELINE OJWALA	DRSRS
3	GEORGE TARUS	KFS
4	FAITH MUTWIRI	KFS
5	JANE WAMBOI	KWS
6	JAMES KIMONDO	KEFRI
7	DAVID ADEGU	CCD
8	DAVID CHEGE	KFS
9	JOHN KIGOMO	KEFRI
10	PHOEBE ODUOR	RCMRD
11	BALOZI BEKUTA	UNIVERSITY OF ELDORET
12	MWANGI GITHURU	WILDLIFE WORKS
13	ALI MWANZEI	NEMA
14	PETER SIRAYO	KFS
15	ANNE OMAMBIA	NEMA
16	KAZUHISA KATO	AAS
17	YOSHIHIKO SATO	AAS
18	SATO KEI	PASCO
19	PETER NDUATI	KFS
20	SEMBO AKINOMBU	PASCO
21	ALFRED GICHU	ME&F
22	VERONICA SYOMBUA	AAS
23	KEVIN KIPTOO	GATSBY AFRICA
24	YVONNE NYOKABI	ME&F
25	MANKI TWALA	ILEPA
26	BILDAD MULANDA	KNCHR
27	DIANA KISHIKI	KFS
28	FELIX MUTUA	JKUAT
39	PATRICK TWALA	UNDP
30	BERNARD ABINGO	UNDP
31	BERTRAND TESSA	UNDP
32	AGNES NDEGWA	UNDP
33	HARUN WARUI	UNDP

Ch.1 Background and Purpose of NFMS
Ch.2 UNFCCC requirements

REDD+ TWG AND STAKEHOLDERS MEETING ON 1ST AND 2ND JULY 2021

COMPONENT MANAGER OF COM.3 IN CADEP-SFM

MR. PETER NDUATI

Contents

Introduction (From Work Plan Com3.)

- ✓Providing consistent data in time-series
- ✓Providing data and information suitable for MRV
- ✓Assessing various forest types including natural forests
- ✓Flexible and allow for system improvement
- ✓Providing information about safeguards

✓guided by the most recent IPCC guidance
✓built upon existing systems
✓The phased approach is applied as appropriate

Sovereignty of a country

Protecting safeguards

Consistency with policies

Goal

Maintaining Robustness and transparency

NFMS: National Forest Monitoring System

Work Plan (Com.3 CADEP-SFM)

Ch.1 Background and Purpose of NFMS document

1.1 Background

In reference to the National Forest draft Policy 2020 Kenya is endowed with a wide range of forest ecosystems ranging from montane rainforests; savannah woodlands; dryland forests; plantation forests and coastal forests, which include mangroves and Kayas. The current forest cover of 6.0% of the land area of the country is still below the constitutional requirement of 10%. Kenyan forests have high species richness and endemism, which has made the country be classified as mega diverse. They rank high as the country's natural capital due to their environmental, life supporting functions, and the provision of diverse ecological and economic goods and services.

Ch.1 Background and Purpose of NFMS document

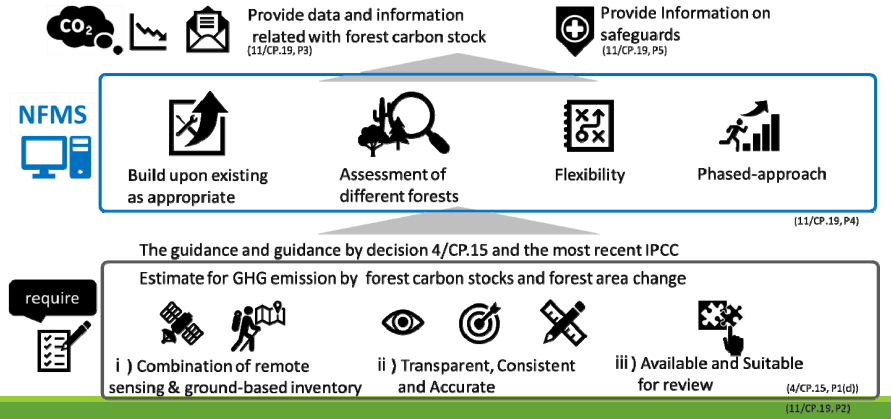
1.3 The Purpose of the NFMS Document

The main objectives of this document are presented below.

- ✓To develop the methodology of how forest is monitored.
- ✓To develop the data management system for REDD+ and sustainable forest management
- ✓To clarify the institutional arrangement for implementation of NFMS
- ✓To clarify the mid/long time calendar for implementation of the national forest monitoring system

The NFMS document has to be constantly revised on the basis of new technologies, information/data, and/or methodologies. This is indispensable for the forest monitoring of Kenya.

Ch.2 UNFCCC requirement



Ch.2 UNFCCC requirement

Kenya intends to take a step-wise approach to develop its NFMS based on National circumstances and technological capacities available at the time. As such, the current NFMS reflects the latest available information at present and its scope and methodologies will be modified with improvement in technical capacities.

Ch.2 UNFCCC requirement

Decision 4 of COP 15 in 2009 in Copenhagen, Denmark

In Paragraph 1, The Conference of the Parties requests developing country Parties to establish, according to national circumstances and capabilities, a robust and transparent national forest monitoring systems and, if appropriate, sub-national systems as part of national monitoring systems 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

Ch.2 UNFCCC requirement
Decision 1 of COP 16 in 2010 in Cancun, Mexico

In paragraph 70, developing countries are encouraged to contribute to mitigation actions in the forest sector, in accordance with their respective capabilities and national circumstances, by undertaking 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

Ch.2 UNFCCC requirement
Decision 1 of COP 16 in 2010 in Cancun, Mexico

Also in paragraph 71, developing countries aiming to undertake REDD+ activities under the convention are requested, in the context of the provision of adequate and predictable support, including financial resources and technical and technological support, to develop a number of elements as follows:

(a) REDD+ National Strategy or Action Plan

(b) Forest Reference Emission Level/Forest Reference Level (FREL/FRL)

(c) A robust and transparent National Forest Monitoring System

(d) Safeguards Information System

Ch.2 UNFCCC requirement
Decision 11 of COP 19 in 2013 in Warsaw, Poland

The conference of the Parties decides that national forest monitoring systems should

(a) Build upon existing systems, as appropriate;

(b) Enable the assessment of different types of forest in the country, including; natural forest, as defined by the Party;

(c) Be flexible and allow for improvement;

(d) Reflect, as appropriate, the phased approach as referred to in Decision 1 of COP 16.

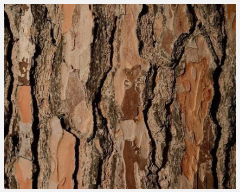
Basic Conditions of Kenya's NFMS

GEORGE TARUS

Topics

- Land use categorization
- Forest Definition
- Forest Stratification
- Carbon pool
- Scope gas
- REDD+ in Kenya
- NFMS Design






Land use categorization

The 2006 IPCC Guidelines provided the categorization

- **Forest Land**:
- **Cropland**:
- **Grassland**:
- **Wetlands**:
- **Settlements** and **Other Land**:

Forest Definition

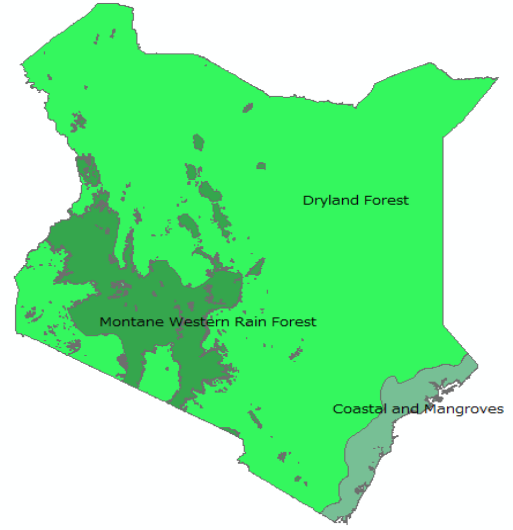
An area cover a minimum of 0.5 ha, minimum 15% canopy cover, and potential to reach a minimum height of 2 meters at maturity.

Perennial tree crops like coffee and tea are not considered as forests under this definition irrespective of whether they meet the definition of forests.

This definition was informed by five basic considerations;

- Provision of opportunity to many stakeholders within the country to participate in incentivized forestry
- Inclusion of the variety of forest types
- Possibility of providing consistent data for establishing the reference level and for monitoring of performance based on available technology;
- Need to balance the costs of implementation and monitoring and the result-based incentives
- Consistency with the national forest agenda to optimize, manage and conserve Kenya's forests.

Forest stratification



(The National Forest Reference Level for REDD+ Implementation, 2020)

Stratum	Area(ha)
Montane and western Rain forests	1,356,317
Coastal and Mangrove forests	499,658
Dryland forest	1,541,323
Plantation forest	90,246

First level stratification	Second level stratification
Montane and western rain forests and bamboo	Dense (canopy cover ≥65%)
	Moderate (Canopy cover 40-65%)
	Open (Canopy cover 15-40%)
Mangrovesand coastal forests	Dense (canopy cover ≥65%)
	Moderate (Canopy cover 40-65%)
	Open (Canopy cover 15-40%)
Dryland forests	Dense (canopy cover ≥65%)
	Moderate (Canopy cover 40-65%)
	Open (Canopy cover 15-40%)
Plantation forest land	Plantation forest managed by KFS

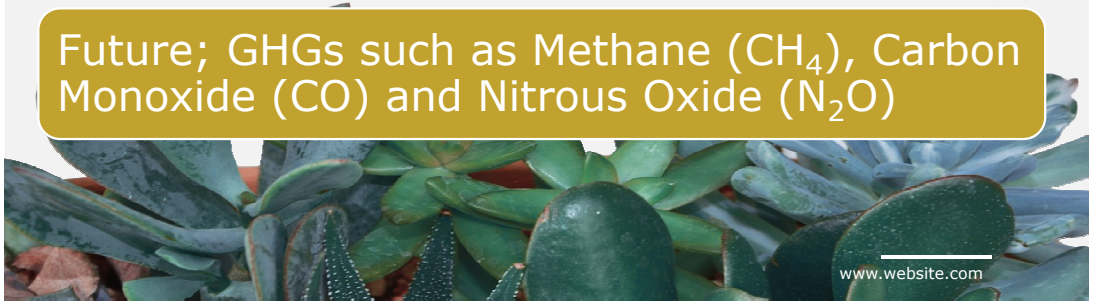
Carbon pool

Carbon pools	Included
Above ground biomass (AGB)	Yes
Below ground biomass(BGB)	Yes
Soil organic carbon	No
Dead wood	No
Litter	No

Scope gas

The currently focus on carbon dioxide (CO_2).

Future; GHGs such as Methane (CH_4), Carbon Monoxide (CO) and Nitrous Oxide (N_2O)



REDD+ in Kenya

Scale

- National
- Nesting/Jurisdictional?
- Project Level??

REDD+ Activities

REDD+ activity	Included
Reducing Emissions from Deforestation	Yes
Reducing Emissions from Forest Degradation	Yes
Conservation of Forest	No
Sustainable Management of Forest	Yes
Enhancement of forest carbon stocks	Yes

Definition of REDD+ activities

Forest strata			Area in 20XX+(X)													
			Forest										Non Forest			
			Montane & Western Rain Forest			Costal and Mangrove forest			Dryland Forest			Public Plantation Forest	Cropland	Grassland	Wetland	Settlement & Otherland
			D	M	O	D	M	O	D	M	O					
Area in 20XX	Forest	Montane & Western Rain Forest D	n	dg	dg								df	df	df	df
		Montane & Western Rain Forest M	e	n	dg								df	df	df	df
		Montane & Western Rain Forest O	e	e	n								df	df	df	df
		Costal and Mangrove forest D				n	dg	dg					df	df	df	df
		Costal and Mangrove forest M				e	n	dg					df	df	df	df
		Costal and Mangrove forest O				e	e	n					df	df	df	df
		Dryland Forest D							n	dg	dg		df	df	df	df
		Dryland Forest M							e	n	dg		df	df	df	df
		Dryland Forest O							e	e	n		df	df	df	df
		Public Plantation Forest										n	s	s	s	s
	Non Forest	Cropland	e	e	e	e	e	e	e	e	e	s	NA	NA	NA	NA
		Grass land	e	e	e	e	e	e	e	e	e	s	NA	NA	NA	NA
		Wetland	e	e	e	e	e	e	e	e	e	s	NA	NA	NA	NA
		Settlement & Otherland	e	e	e	e	e	e	e	e	e	s	NA	NA	NA	NA

df Deforestation (F→NF) | dg Forest Degradation (F→F(Degraded)) | e Enhancement (F→F(Improved) ,NF→F)
n No Change (F→F) | s Sustainable Management of Forest (F→NF, NF→F) | NA Not Available

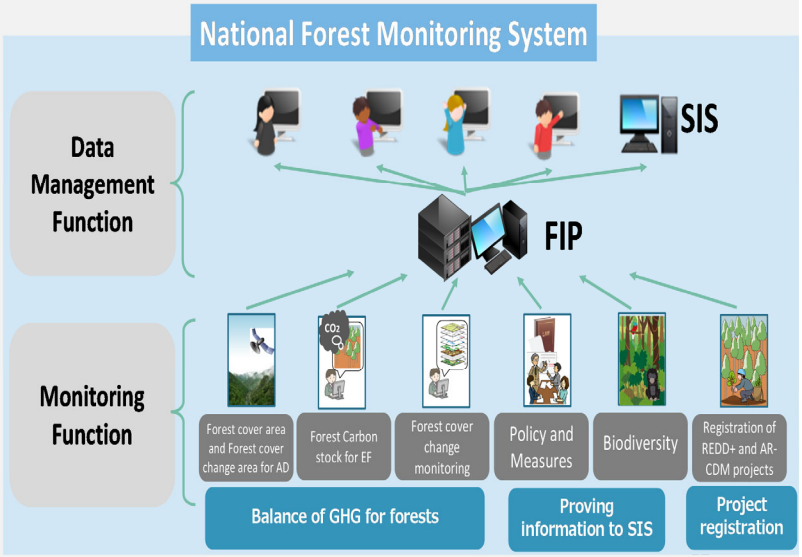
9

CONCEPTUAL DESIGN OF NFMS IN KENYA

Objectives

- Gather accurate and transparent data and information related with Kenya forest management
- Providing it to inform interested stakeholders on the forest status,
- Report to international conventions,
- Use information for sustainable forest management in Kenya.

Layout of NFMS



Monitoring items in Kenya

Item	Information resource
Forest cover area and forest cover change area (AD)	Land cover/Land use map,Land cover/Land usechange map
Forest carbon stock (EF)	National Forest inventory, Biomass survey
Forest cover change Monitoring	JJ-FAST, Extraction of deforestation area using optical image (Sentinel 2) developed by Forest 2020, and ground truth using Survey 123
Policy and Measures	National REDD+ strategy and National Forest Program, etc.
Biodiversity	Protected area management plan, biodiversity assessment etc.
Project registration	Registration form of REDD+, A/R CDM project based on the information and data to be gained through REDD+ and A/R CDM projects in Kenya

Data management function

To ensure transparency and accessibility of information related to the forest sector in Kenya

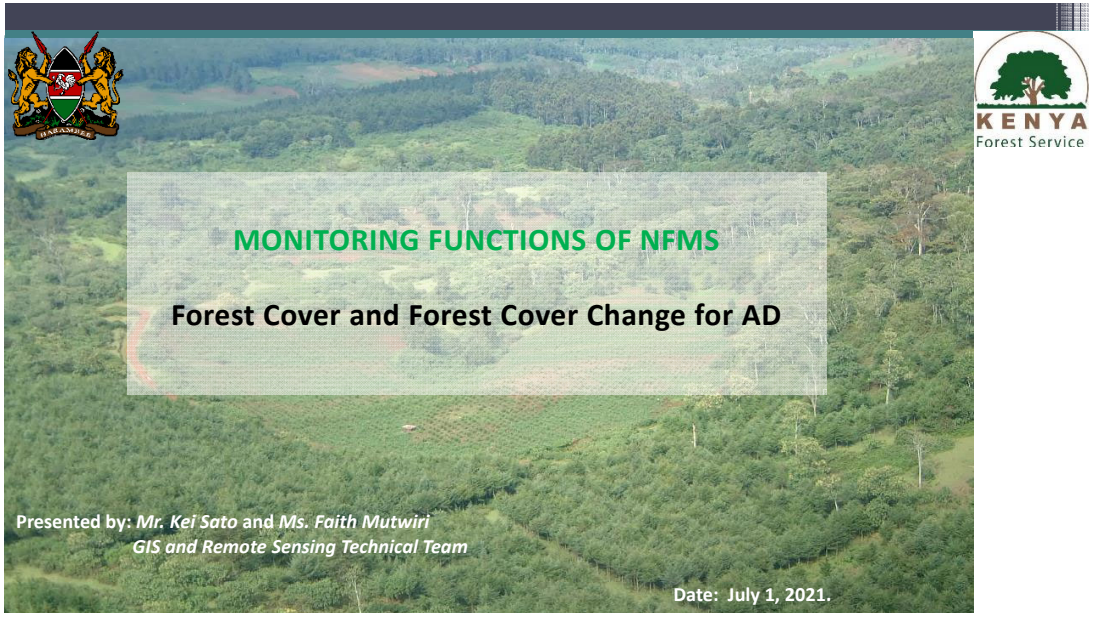
To store and provide the forest data gathered according to the methodologies indicated in the guideline

To store and provide data and information on policy and measures of the forest sector.

To provide useful information to the SIS

To register the project level activities of forest sector.

Thank you



ntroduction

- **Monitoring functions of National Forest Monitoring System (NFMS);**
  - Forest Cover and Forest Cover Change for Activity Data (AD);
  - Forest Carbon Stock for Emission Factor (EF);
  - Forest Cover Change Monitoring;
  - Policies and measures (PaMs);
  - Biodiversity and;
  - REDD+ and AR-CDM projects.

Forest Cover and Forest Cover Change for Activity Data (AD);

- **What is AD?**
  - It refers to the spatial extent of each forest cover and land cover/ land use type at a certain time point, and associated change over time, and is expressed in hectare.
  - For REDD+ activities it's the change in spatial extent for;
    - Deforestation,
    - Forest degradation,
    - Sustainable management of forest, and
    - Forest carbon stock enhancements

Forest cover area

1. **Purpose**

   - To prepare of AD for the NFMS;
   - To provide information about the areas of each forest cover and land cover / land use class and their changes;
   - To understand drivers of deforestation and forest degradation; and
   - To plan of appropriate mitigation activities.

Forest cover area

2. Approach

Three different approach options were used to prepare AD for the forest cover change monitoring in Kenya:

- Measuring the total area of each land cover/land use category without information on conversions.
- Tracking area conversions between land cover/land use categories (non-spatially explicit land-use conversion matrix between two time points).
- Tracking of spatially explicit cover/land use conversions over time. This method shows the specific areas of change over time and follows the IPCC 2006 guidelines on consistent representation of lands (Chapter 3 of volume 4 of the 2006 IPCC guidelines). This method allows better understanding of the drivers of change because it specifies the change areas over each time series mapping.

Forest cover area

3. Classification System

Categorized classes were considered based on **international guidelines**, **local definitions** of land uses, ability to capture variations of carbon stocks among land uses and simplicity of land cover mapping system.

Broad class	1st level sub category	2 level sub category (based on ancillary data)
Forestland	➢ Natural • Dense Forest (above 65% Canopy) • Moderate Forest (40% < 65%) • Open Forest (15% ≤ 40%)	Montane and Western rain forests and bamboo Mangroves and Coastal forests Dryland forests
	➢ Plantation	-
Grassland	➢ Wooded Grassland ➢ Open Grassland	-
Cropland	➢ Perennial Cropland ➢ Annual Cropland	-
Wetland	➢ Vegetated Wetland ➢ Open Water	-
Other Land	➢ Settlement	-

Forest cover area

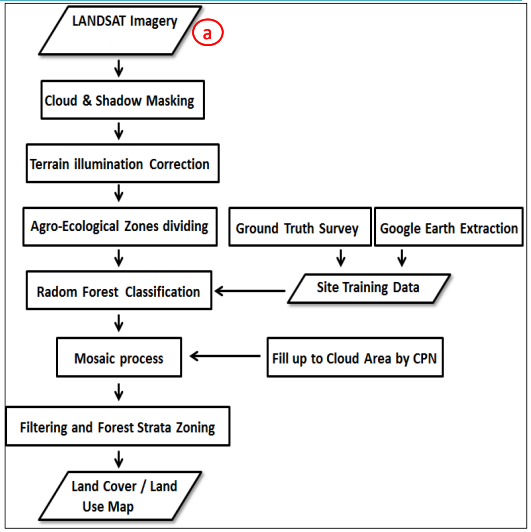
4. Methodology

a) Landsat Imagery

Land Sat data from the USGS website was selected following the technical manual guidance

- Availability at the USGS archive
- Date of acquisition (Season)
- Cloud cover percentage

Landsat was selected because it is freely available, historical images are available, has medium resolution and it is already pre- processed

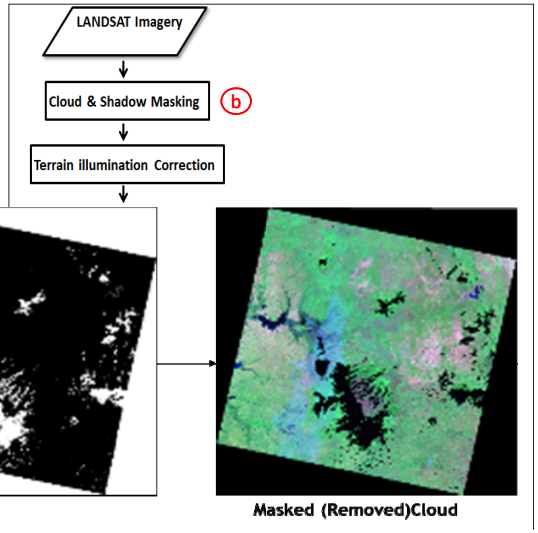


Forest cover area

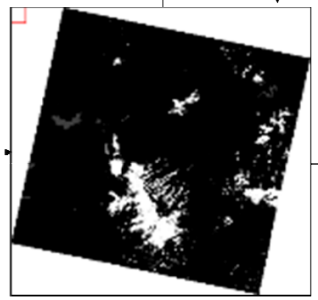
4. Methodology

b) Cloud and shadow masking

- Masking (Removing) all clouds and their shadow
- Used "cfmask" band from USGS



Raw Image



cfmask Band

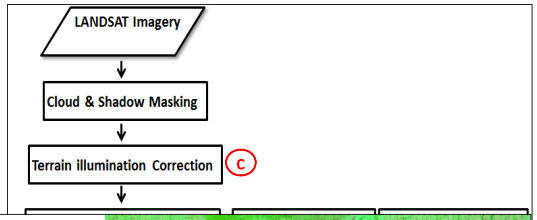
Masked (Removed)Cloud

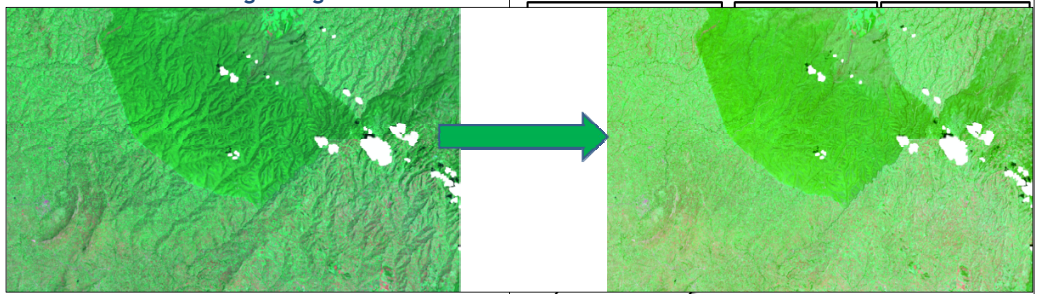
Forest cover area

4. Methodology

c) Terrain Illumination Correction (TIC)

- Affected by variations in slope and aspect
- The process corrects terrain illumination effects so that the same land cover will have a consistent digital signal





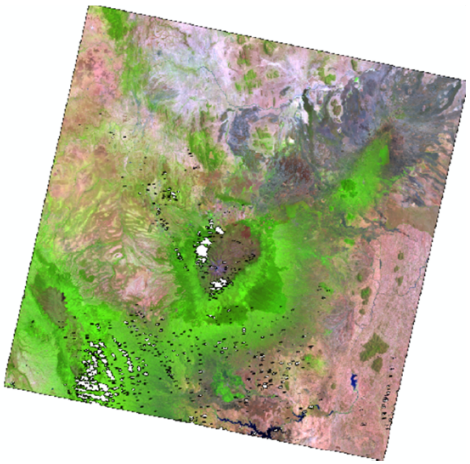
Before TIC

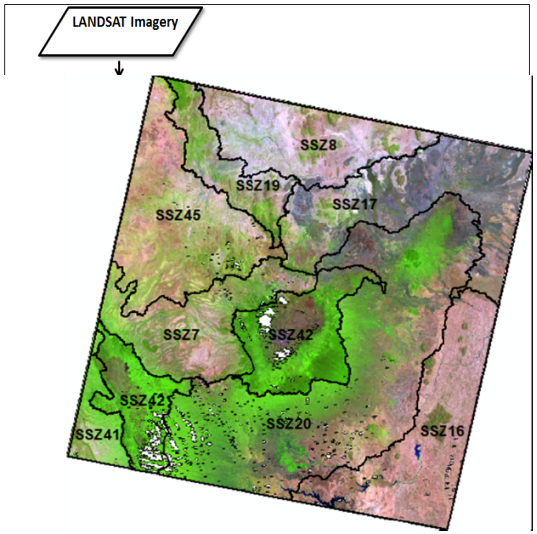
After TIC

Forest cover area

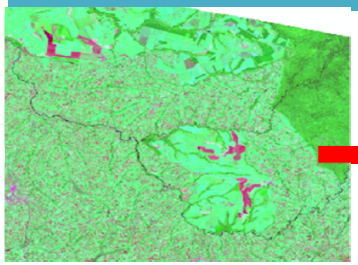
4. Methodology

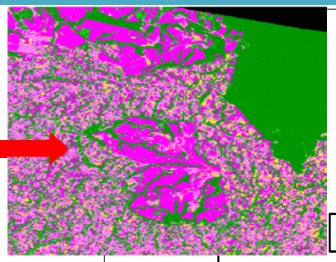
d) Agro-Ecological zones dividing





Forest cover area

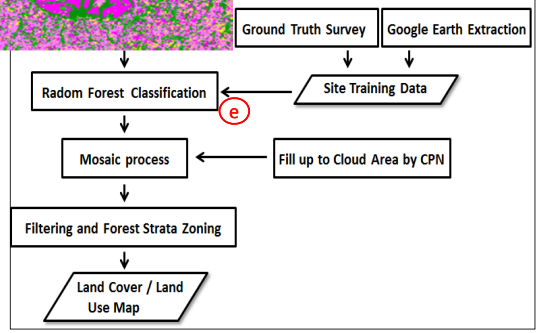




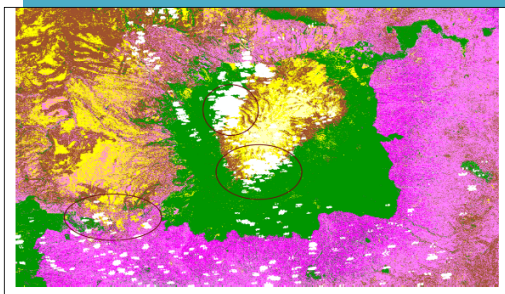
4. Methodology

e) Random Forest Classification

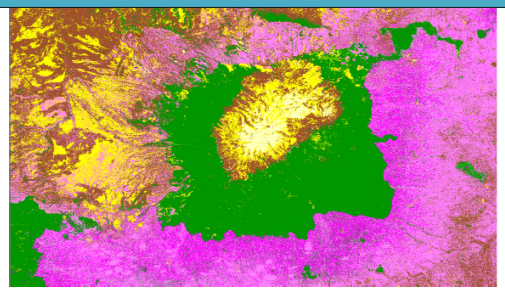
- Training sites are extracted from ground truth survey and Google Earth in cases of inaccessible areas
- Running R-Scripts - Random forest was selected as it is open source, has higher accuracy, stores uncertainty
- QAQC - Both internal and external



Forest cover area



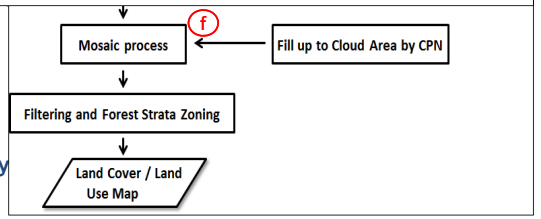
Before gap filling



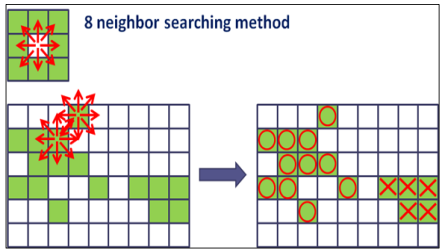
After filling with CPN

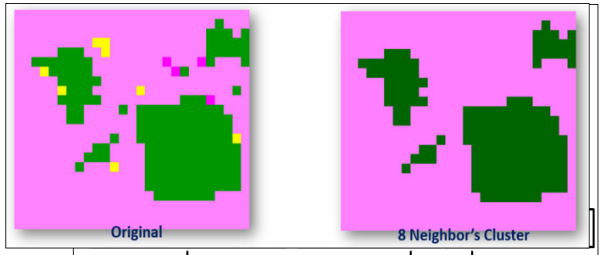
CPN

- Due to data gaps a mathematical model known as a conditional probability network (CPN) is used to fill.
- It uses the time series maps and the probability bands developed during classification



Forest cover area

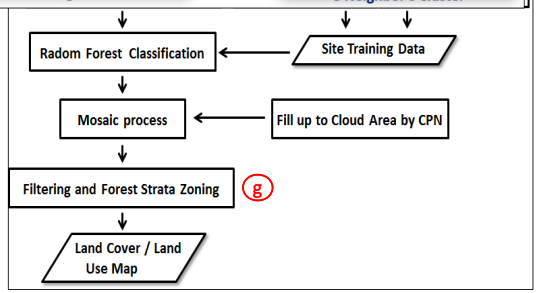


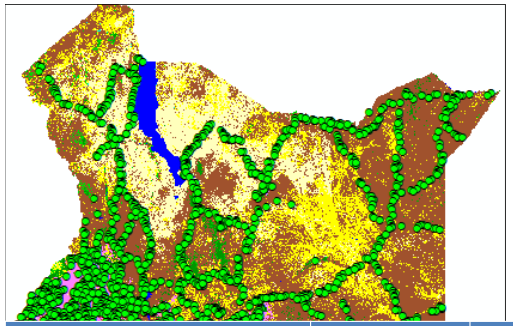


4. Methodology

g) Filtering and Forest Strata Zoning

- Image filtering is done to correspond with a country's forest definition
- In Kenya, a forest is defined with a minimum **0.5ha ,2m height and 15% canopy**



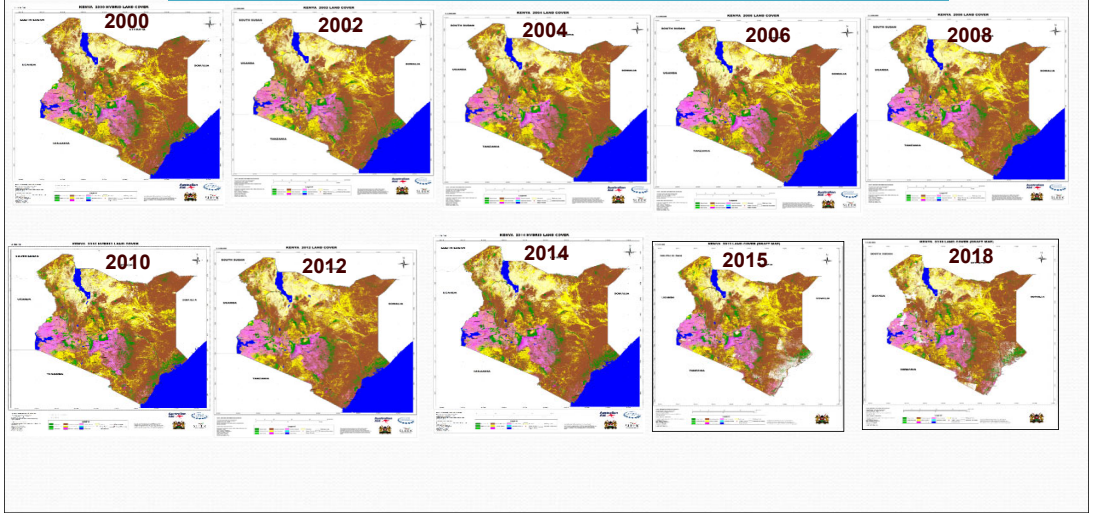


h) Accuracy Assessment

- Checking the correctness of the map
- Sampling Procedure - *Proportionate stratified random*
- *Use of High resolution images and Aerial photography*

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy
Dense Forest	270	232	171	63.33%	73.71%
Moderate Forest	213	174	87	40.85%	50.00%
Open Forest	152	118	51	33.55%	43.22%
Wooded Grassland	1084	1157	945	87.18%	81.68%
Open Grassland	499	599	413	82.77%	68.95%
Perennial Cropland	216	230	169	78.24%	73.48%
Annual Cropland	875	846	696	79.54%	82.27%
Vegetated Wetland	86	61	50	58.14%	81.97%
Open Water	41	36	30	73.17%	83.33%
Otherland	212	195	162	76.42%	83.08%
Totals	3648	3648	2774		
Overall Classification Accuracy =		76.04%			

Land cover Time Series (2000 – 2018)



Forest cover Change for AD

Calculation of area of change

- The measuring of area of change in forest cover to estimate the AD
- Done by comparing two subsequent Land Cover/Land Use maps, extracts of land cover change areas can be made and their specific areas calculated

  - Deforestation,
  - Forest degradation,
  - Sustainable management of forest, and
  - Forest carbon stock enhancements

Forest cover Change for AD

Forest strata			2018												
			Montane and western rain Forests and bamboo			Mangroves and coastal Forests			Dryland Forests			Plantation Forest land	Crop land	Grass land	Wet land	Settlement & Otherland
			Dense	Moderate	Open	Dense	Moderate	Open	Dense	Moderate	Open					
2014	Montane and western rain forest and bamboo	Dense	834,862	49,209	19,734								88,835	91,840	416	821
		Moderate	40,248	83,235	12,899								11,406	53,825	78	33
		Open	9,843	10,324	26,260								6,435	51,566	10	25
	Mangroves and coastal forests	Dense				164,282	87,918	1,363					6,422	160,174	1,632	825
		Moderate				22,023	40,366	2,040					3,565	50,419	458	233
		Open				1,116	989	452					110	2,797	9	12
	Dryland Forests	Dense							344,985	97,928	42,170		24,559	455,918	3,874	2,307
		Moderate							57,877	60,223	33,164		4,763	127,932	1,229	1,018
		Open							21,221	20,412	66,984		4,012	185,783	1,445	4,274
	Plantation forest land											56,315	17,880	7,263	26	23
	Cropland		78,641	8,156	6,568	1,689	2,567	438	21,204	9,163	10,163	3,886				
	Grassland		85,367	48,885	38,956	76,856	82,563	13,417	377,850	207,559	158,441	4,834				
	Wetland		267	176	12	343	316	38	1,648	1,083	1,877	14				
	Settlement & Other land		866	107	1,702	398	470	15	1,667	2,424	3,279	6				

Forest cover Change for AD

Uncertainty Assessment for AD

- **"Activity Data" (AD)** - area of land undergoing the transmission e.g., the area deforested per hectare.
- **The accuracy assessment** - checking the correctness of the land cover and forest cover change maps.
- The accuracy information - crucial in estimating area and **uncertainty.**
  - To reduce uncertainties as far as practicable to have neither **over nor underestimates**.
  - To allow for calculation of error propagation due to AD and EF

$$S(\hat{P}_j) = \sqrt{\sum_{i=1}^{q} W_i^2 \frac{\frac{n_{ij}}{n_i}\left(1 - \frac{n_{ij}}{n_i}\right)}{n_i - 1}}$$

"Error-adjusted" estimator of area formula (Olofsson, et al, 2013) used to calculate the uncertainty

MONITORING FUNCTION OF NFMS: FOREST CARBON STOCKS FOR EMISSION FACTORS' ESTIMATION

BY

SIRAYO P.L., KENYA FOREST SERVICE

A PRESENTATION MADE DURING THE TWG WORKSHOP IN MASADA HOTEL, NAIVASHA ON 1ST AND 2ND JULY 2021

Background Information

- **Emission Factor (EF):** amount of emissions/removals of greenhouse gases per unit area, e.g. amount of carbon dioxide emitted per hectare of deforestation activities
- Generally, EF is obtained from national forest inventory data
- However, NFI has **not been undertaken** in Kenya; thus forest stock data collected in a Pilot Forest Inventory by IC-FRA (KFS, 2016) and CADEP-SFM (JICA, 2017) together with default IPCC values were used in estimating EF

National Forest Inventory

- **Purpose:-** to estimate the amount of biomass and carbon stock in the forest
- NFI is necessary to periodically assess the forest resources of a country
- Methodology for national forest inventory was developed by IC-FRA (KFS, 2016a)
- IC-FRA methodology adopted a slightly **different forest stratification** with SLEEK methodology which develops AD based on the time series land cover/land use maps
- Part of IC-FRA inventory methodology related to the forest stratification such as **sample plot setting; sampling design, calculation of the required number of samples, and selection of place of samples**, was revised to be consistent with forest stratification for the AD

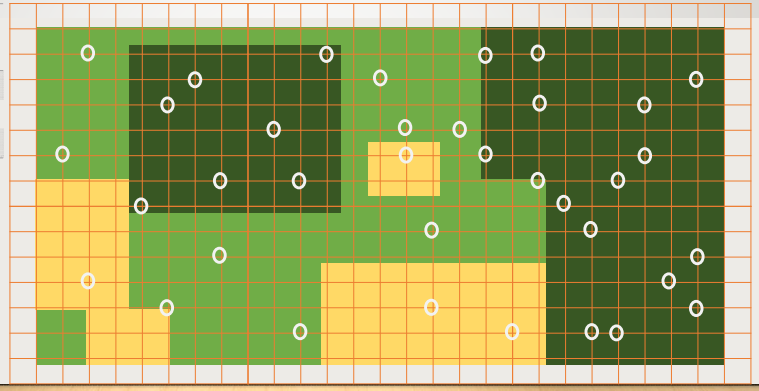
NFI Cont'd

Sampling design

- For NFI, generally a statistical sample method is used where sample plots are statistically calculated to give an overall picture of the entire forest
- Kenya has adopted a **stratified random sampling** method
- The strata are the four main forest strata with their sub categorizations
- Based on results of the pilot inventory the statistically significant number of sample plots was generated and the pre-determined number of plots placed randomly within each stratum

Sampling design Cont'd

Forest strata	Necessary sample number
Stratum A	22
Stratum B	10
Stratum C	4

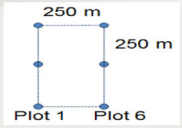


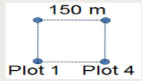
Stratified random sampling

Sampling design cont'd

- To reduce heterogeneity in the forest at the sample point, cluster sampling has been adopted
- The cluster sampling method establishes a group of plots(cluster) based on the predetermined position of a sample plot based on stratified random sampling
- For Montane and western rain forests, and Dryland forests where the forests have great variations at short distances, the cluster comprises of six sample plots in a rectangular shape. The plots are placed at distances **250 meters** distance from each other.
- For Coastal and mangrove forests, and Plantation forest land, a cluster comprising four sample plots in a square shape with a distance of **150 meters** between the plots.
- The plots are located in a **N-S** and **W-E** direction in the field; making it easy to trace

Sampling design Cont'd





Cluster design of 6 sample plots in rectangular shape and 4 sample plots in a square shape

Stratum	Plot number in a cluster	Plot size (radius meter)	Total plots area in a cluster(m^2)
Montane forests and western rain forests and bamboo	6	15	4,239
Coastal and mangrove forests	4	15	2,826
Dryland forests	6	20	7,536
Plantation forest land	4	15	2,826

Plot number and size per cluster in each forest stratum

The plots may represent the **variety** of forest canopy classes at local level, the data collected from each cluster, however, represent the forest class or strata for **which it was allocated** during stratified random sampling

Sampling design cont'd

- The required **number of samples** for the proposed NFI was calculated using the results of pilot forest inventory data from IC-FRA and CADEP-SFM for **standard deviation** and **mean biomass value per hectare** in each stratum, which were used in Kenya's FRL (GOK, 2020)
- The calculation of the sample size also requires the establishment of the required **accuracy and confidence intervals** for the NFI survey results.
- For the NFI survey in Kenya, the target error rate is **10%** and the confidence interval is **95%**
- The equation, Hirata at el, 2012, is used for the calculation of the required number of samples

Sampling design cont'd

$$n = \left(\frac{t_{0.05} * C_v}{e}\right)^2$$ Equation 1

n = the minimum required number of clusters for a stratum
$t_{0.05}$ = Critical value from a two tail-test with n-1 degrees of freedom, based on confidence interval of 95%
C_v = Coefficient of variation which is the standard deviation divided by the mean biomass value per hectare in a stratum.
e= Target error rate

- The **required number of samples** is regarded as the **required number of clusters** in the Kenyan NFI
- The minimum number of clusters per forest class was set at **30 clusters**. Therefore, if the calculated clusters of a given forest stratum is less than 30, the number of clusters in the actual NFI plan is set to be 30 clusters for the forest stratum.

Sampling design cont'd

Stratum		Pilot Inventory Data			Cv	t0.05	e	n
		Sampling No.	Mean Biomass (t/ha)	Standard Deviation (t/ha)				
Montane and western rain forests and bamboo	Dense	8	335.37	216.38	0.65	1.96	0.10	160
	Moderate	7	80.05	47.46	0.59	1.96	0.10	135
	Open	5	25.08	9.55	0.38	1.96	0.10	56
Costal &mangrove Forest	Dense	18	113.55	54.04	0.48	1.96	0.10	87
	Moderate	11	63.30	22.00	0.35	1.96	0.10	46
	Open	14	28.81	17.01	0.59	1.96	0.10	134
Dryland forests	Dense	7	54.31	41.10	0.76	1.96	0.10	220
	Moderate	8	44.19	19.21	0.43	1.96	0.10	73
	Open	7	18.26	8.82	0.48	1.96	0.10	90
Plantation forests land	-	36	412.48	316.71	0.77	1.96	0.10	226
Total		121						1227

Number of sampling clusters calculated for each forest class

Sampling design cont'd

- The NFMS proposes supplementary clusters set at **20%** of the calculated number of clusters for each forest stratum/class as a safeguard that allows **representation** of all stratum/class in the data collected from the NFI;

- **land use change** has occurred since the last mapping that was used to generate sampling clusters

- some identified clusters may be quite difficult to access due to **terrain**, **barriers**, **water bodies** or any other causes

Note: Sampling design described above is for Temporary Sampling Plots (TSPs) and as indicated, the design will be generated every time before an NFI is carried out based on the distribution and size of forest classes in the previous mapping programme.

Sampling design cont'd

- The FRL has specifically identified the purpose of PSP as provision of data for;

-Carbon and volume accumulation in areas under enhancement of carbon stocks due to afforested and reforested sites

-Carbon and volume increments in areas with under enhancement of carbon stocks where canopy improves from a lower canopy class to a higher canopy class e.g. from open forest to dense forest

-Carbon dynamics in areas of forestland remaining forestland

-Carbon stocks in deforestation affecting different types of forests such as the national strata, ecological zones, site indices, species etc.

-Carbon stock removals in areas under various drivers of forest degradation

-Monitoring biodiversity indicators

Sampling design cont'd

The NFMS identifies that, for management purposes, **a third** of the proposed TSPs should be marked as PSPs to allow **continuous monitoring** of the different forest units

Strata		Total No of TSPs	Total No of PSPs
Montane and western rain forests	Dense	160	54
	Moderate	135	45
	Open	56	19
Coastal & Mangrove Forest	Dense	87	29
	Moderate	46	16
	Open	134	45
Dryland forests	Dense	220	74
	Moderate	73	25
	Open	90	30
Plantation forests land		226	76
Total		1,227	413

Required number of clusters for PSPs

Sampling design cont'd

Selection of location of sample clusters

- Location of the clusters is extracted adopting **stratified-random sampling** using the following procedure:

-A1 km x 1 km grid on the latest Land Cover/Land Use Map is generated on a GIS platform. Intersections of the grid are candidate for the sampling cluster.

-The intersection points are assigned cluster IDs.

-All potential clusters (intersection points) for each stratum, in which four (4) or six (6) plots has same forest type on the land cover/land use map, are identified.

Sampling design cont'd

-Based on the calculated number of clusters per stratum/forest class, the random sampling tool on GIS is used to select priority clusters and supplementary clusters (based on the 20% safeguard described already).

-The list of randomly selected clusters, their forest stratum, cluster ID, administrative units and coordinate are recorded.

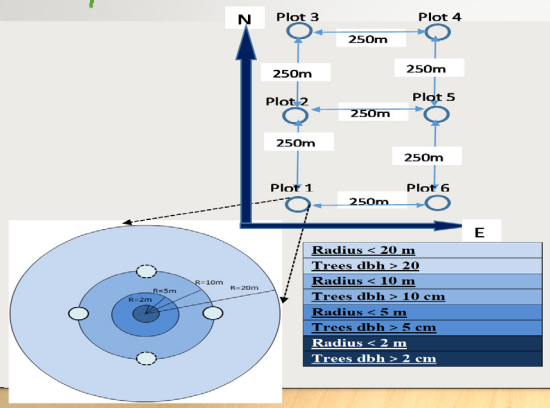
-**Plot 1** of the cluster is located at the **intersection point** which is the **southwestern** part of the cluster. The six (6) or four (4) plots in a cluster are set clockwise from the intersection and their plot numbers follow the order in the clockwise direction

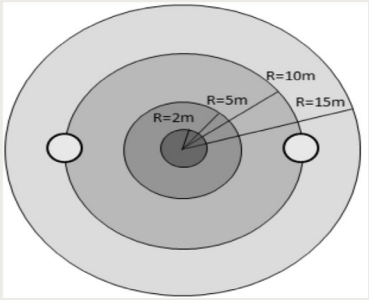
Sampling design cont'd

Plot shape

- Kenya has adopted **circular shape** for NFI.
- Philip (1994) described a circular shape as having **fewer border line trees** due to its **minimum perimeter** compared to other shapes with its equivalent area. This reduces **uncertainty** of measuring borderline trees.
- Secondly for PSPs, circular plots are **easy to measure** because only coordinates of the centre point are needed to perfectly re-establish the plot.
- Two plot sizes were adopted depending on the forest stratum. One (**20m**) is the size adopted for Dry land forests and the other one (**15m**) is the size adopted for Montane and western rainforests, Mangroves and coastal forests and Plantation forest land

Sampling design cont'd





Sampling design cont'd

- Data items to be collected and recorded are:

Measuring item	Size or location from centre of Sample plot	Data to record
Shrubs	Within 15m radius	-
Tree regeneration	Two circular (1.5 m radius subplots) locating 10 meters from the sample plot centre.	Height ≥10cm, DBH ≤2cm
Tree	Within 2m radius	DBH ≥2cm (seedlings)
	Within 5m radius	DBH ≥5cm (Saplings)
	Within 10m radius	DBH ≥10cm (poles)
	Within 20m radius (Dryland Forests Stratum)	
	Within 15m radius (other than Dryland Forests Stratum)	DBH ≥20cm
Dead wood	Within 15m radius	Diameter ≥10cm
Stumps	Within 15m radius	Diameter ≥10cm
Bamboo	Within 10m radius	All bamboo shoots ≥1.3m
Climbers	Within 2m radius	DBH ≥2cm
	Within 5m radius	DBH ≥5cm

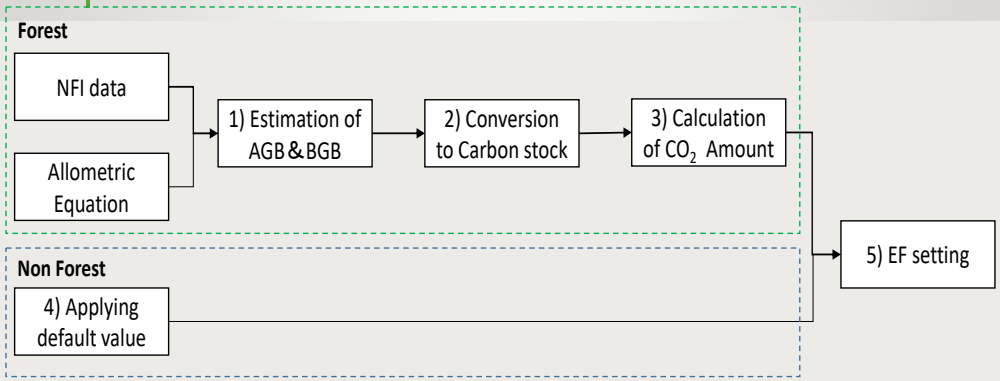
QA/QC of NFI

- Quality Assurance of the NFI is done through use of **conventional methods, proper training of inventory teams, use of qualified technicians** and ensuring that tools used are **properly calibrated**
- For all the sampled plots, a **10% sample** will be premeasured by an independent team to provide quality control of the data
- Quality Control is proposed to be done by **research institutes** such as KEFRI or the University staff
- The QC process identifies weaknesses of the NFI process, allows calculation of the uncertainty of the NFI data and forms a basis for future improvement

Conversion of inventory data to carbon stocks

- To determine forest carbon stocks, the forest biomass is first estimated, by using allometric equations (Hirata at el, 2012)
- Generally, an allometric equation is developed by biomass survey
- The IC-FRA project developed a **Field Manual for Tree Volume and Biomass Modelling** (KFS, 2016b). This manual gives guidelines on how allometric equations may be developed and is based on scientific guidance
- Currently, Kenya has **limited** generic and species specific allometric equations. Examples of such equations are found in Kuyah et al (2012) and Owate et al (2018) but these are for agroforestry species and were developed in small geographical extents.
- It is proposed that **international equations** such as those of Chave et al (2014) may be used until when locally developed allometric equations are available and verified for use in the country.

Conversions to carbon stocks cont'd



AGB estimation

- When the data of the forest inventories is obtained, the amount of above ground biomass (AGB) (t/ha) can be estimated from allometric equations

Type	Volume (m^3)	Reference	Equation for AGB (kg)	Reference
Common for natural forests and plantations	$\pi \times (DBH/200)^2 \times H \times 0.5$	Henry et al. 2011	$0.0673*(0.598*D^2H)^{0.976}$	Chave et al. 2009, 2014
Rhizophora sp. in mangroves	$\pi \times (DBH/200)^2 \times H \times 0.5$	Henry et al. 2011	$0.128 \times DBH^{2.60}$	Fromard et al. 1998, Komiyama et al. 2008
Bamboo in montane forests	d^2-$(d*0.7)^2/4*\pi*h*0.8$	Dan et al. 2007	$1.04+0.06*d*GW_{bamboo}$ $GW_{bamboo} = 1.11+0.36*d^2$ (bamboo diameter > 3 cm) $GW_{bamboo} = 1.11+0.36*3.1^2$ (bamboo diameter ≤ 3 cm)	Muchiri and Muga. 2013
Climbers in natural forests	-	-	$e^{(-1.484+2.657*\ln(DBH))}$	Schnitzer et al. 2006

BGB estimation

- Root shoot ratios may be applied when the allometric equation used only related to the AGB

Forest strata	Root shoot ratio	Source in table 4.4 of IPCC 2006 guidelines V4.4
Montane	0.37	For Tropical rainforest
Dryland	0.28	Above-ground biomass >20 tonnes ha^{-1} for Tropical Dryland forests
Coastal and Mangrove	0.20	Above-ground biomass <125 tonnes ha^{-1} for Tropical moist deciduous forest
Plantation	0.27	For Tropical Mountain systems

Conversion of AGB and BGB to Carbon Stocks to CO_2

- Carbon fraction obtained from IPCC 2006 guidelines used
- **Carbon stock (tC/ha)=(AGB (t/ha) +BGB (t/ha))× CF**

Part of biomass	Carbon Fraction	Reference
Above ground biomass (ABG) Below ground biomass (BGB)	0.47	IPCC, 2006

- From the amount of carbon stock calculated, the amount of CO2 can be estimated using the formula shown below which is obtained from IPCC 2006 guidelines.
- **CO_2 amount (tCO_2/ha) = Carbon stock (tC/ha) ×44/12**

Estimation of the CO_2 amount in Non-Forest land class

- Based on lack of conclusive data on carbon stocks of the non-forests, Kenya has used IPCC **default values** of CO_2 amount in Non-Forest land class
- **CO_2 amount (tCO_2/ha) of Non Forest area = Area (ha) × applied default value (t/ha)**

Class	CO_2 Amount(t/ha)	References
Cropland	0	IPCC Guideline 2006
Grassland	14.99	IPCC Guideline 2006
Wetland	0	IPCC Guideline 2006
Settlement and Other land	0	IPCC Guideline 2006

Setting of EF

- The Emission factor for each land use change is the values of CO_2 that changes at two points in time based on the initial carbon stock and the resultant carbon stock
- *Illustration*
- **-EF (Forestland to Forestland) = CO_2 amount (Forestland) - CO_2 amount (Forestland)**
- **-EF (Forestland to Non-forestland) = CO_2 amount (Forestland) - CO_2 amount (Non-forestland)**
- **-EF (Non-forestland to Forestland) = CO_2 amount (Non-forestland) - CO_2 amount (Forestland)**

Thank you for your attention!!!

MONITORING FUNCTIONS OF NFMS

Forest Cover Change Monitoring

Presented by: *Mr. Kei Sato* and *Ms. Faith Mutwiri*
GIS and Remote Sensing Technical Team

Date: July 1, 2021.

.ntroduction

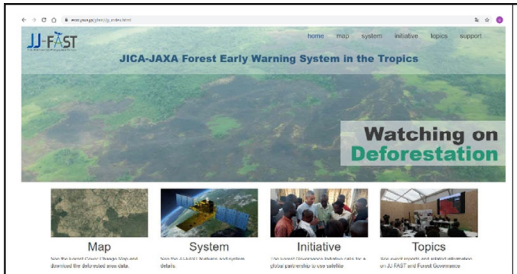
- Kenya has identified near real time processes for forest cover change monitoring - detect deforestation
- These are:
  - JJ-FAST;
  - The Near Real Time Forest Alert System (NRTFAS); and
  - Field report by ground truth using Survey 123

JJ-FAST

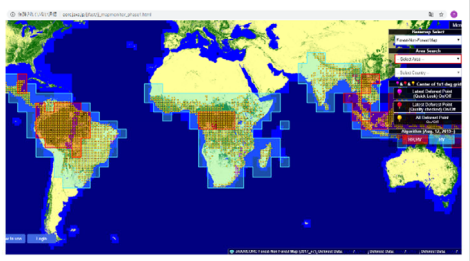
- The system capable of detecting deforestation every 1.5 months
- It Uses L-band Synthetic Aperture Radar (SAR) data acquired by the PALSAR-2 sensor aboard JAXA's Advanced Land Observing Satellite 2 (ALOS-2)
- Data provided is free to users *(https://www.eorc.jaxa.jp/jjfast/jj_index.html).*
- Can be viewed in FIP

JJ-FAST

How to access and use JJ-FAST information

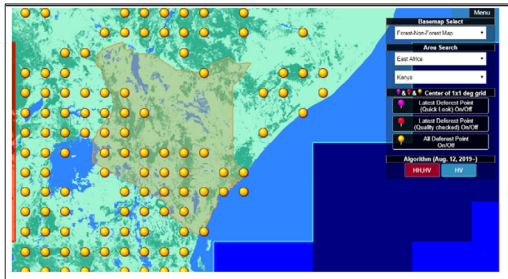


(1) Access to the top page of JJ-FAST web site from FIP. (http://portal.kenyaforestservice.org/portal/apps/MapSeries/index.html?appid=bf97262a51484b0eb4dcddf18c4e570b or https://www.eorc.jaxa.jp/jjfast/jj_index.html)

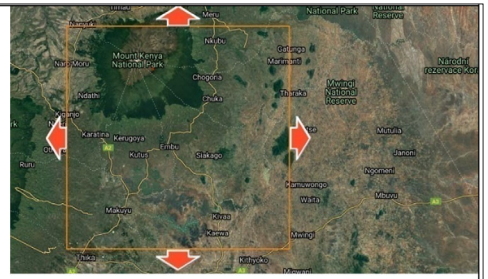


(2) Enter the Map page from top page and select the area and country to survey for deforestation from pull down menu in the upper right of Map page.

JJ-FAST

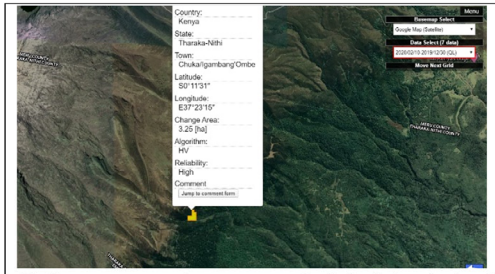


(3)Click a lo cations marked by a red, purple or yellow pin which are indicate the existence of a deforested area within 1° latitude and longitude.

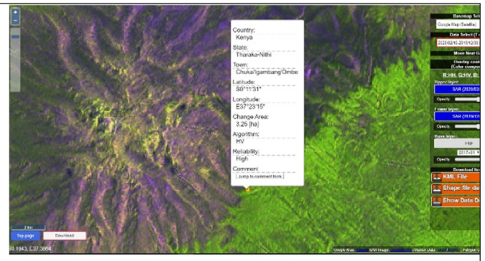


(4) Click on the deforested area polygon which is surrounded by red lines

JJ-FAST



(5) Country, state and town names, the latitude longitude of the centre point of the polygon, the size of the deforested area, and level of reliability are displayed.



(6)Click the "Download" button in the lower left menu then a menu for downloading data on defo rested areas within the "menu" section to the right is displayed.

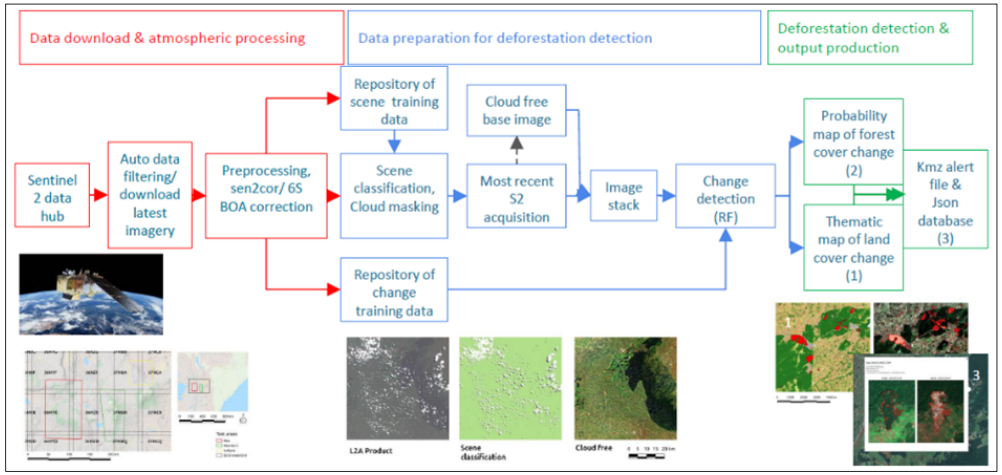
The Near Real Time Forest Alert System (NRTFAS)

1. NRTFAS has been implemented as a pilot project in the UK-sponsored Forest 2020 project
2. NRTFAS for deforestation detection using the optical satellite (Sentinel 2) data – 10m resolution
3. Implemented using PYthon for Earth Observation (Pyeo) developed by the University of LEICESTER
4. NRTFAS is updated every week

5. Can be viewed in FIP

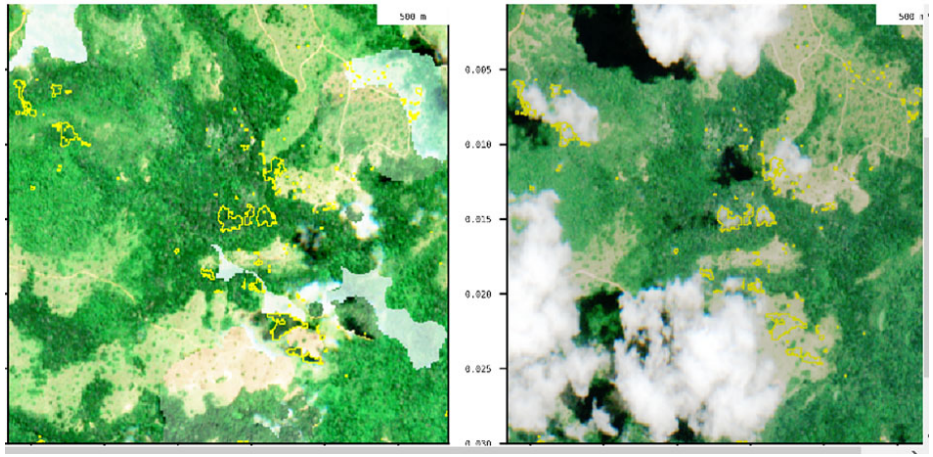
The Near Real Time Forest Alert System (NRTFAS)

1. Flow chart for NRTFAS



The Near Real Time Forest Alert System (NRTFAS)

2. Detection of deforestation (Left: before, Right: after)

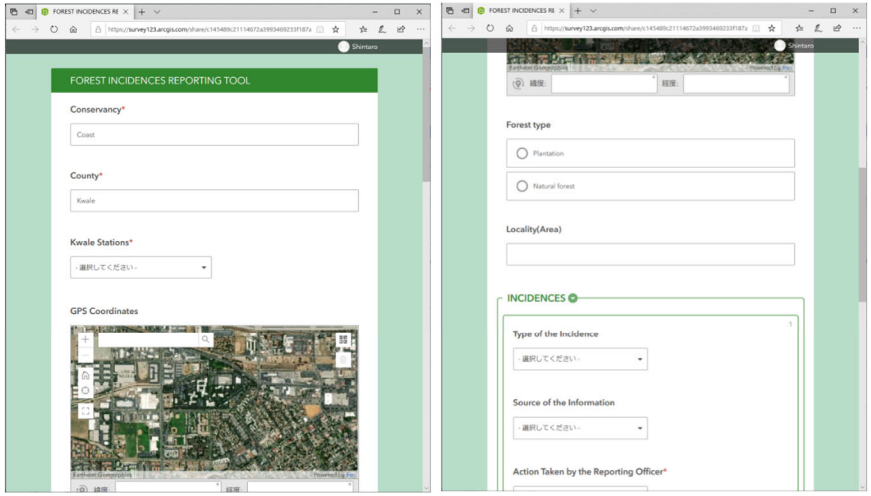


Field report by ground truth using Survey 123

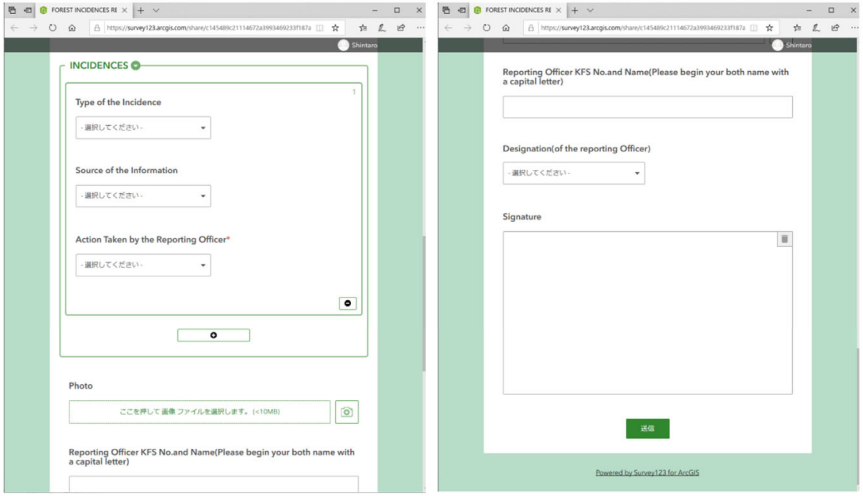
1. The deforestation alert information detected by JJ-FAST and NRTFAS are validated in the field by KFS rangers using mobile smartphone or tablet device equipped with an application that utilizes Survey123.
2. They also report deforestation activities they find in their line of duty
3. The reported data is viewed online, and all reports are displayed as statistical information in dashboard format.
4. This dashboard is one of the function of “Forest cover change monitoring” in FIP.

Field report by ground truth using Survey 123

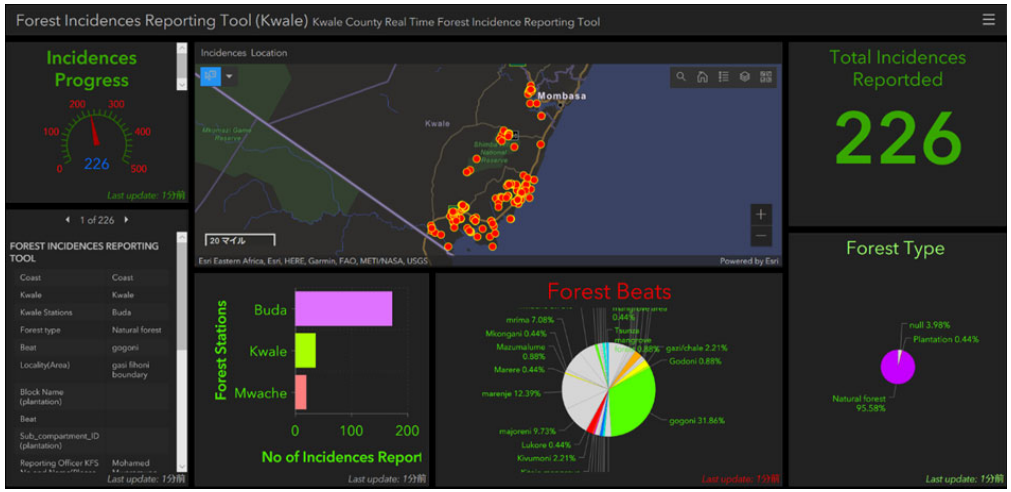
Input Form at Tablet tool



Field report by ground truth using Survey 123



Field report by ground truth using Survey 123



Thank you

NATIONAL FOREST MONITORING SYSTEM

Monitoring Functions Of The NFMS

By
Mwangi Kinyanjui – Karatina University

BIODIVERSITY

INTRODUCTION

- Biodiversity is listed as an Environmental safeguard in REDD+ implementation
- It is therefore important that the NFMS adds value to
  - International commitments on the environment;
  - National biodiversity conservation policies (including National Biodiversity Strategies and Action Plans)
  - Other environmental and natural resource management policy objectives
- Biodiversity can be described in three levels – ecosystems, species and genes
- The NFMS should provide information on progress of REDD+ implementation on these aspects of biodiversity either directly or indirectly

The case of Kenya

- Kenya is rich in biodiversity
- Biodiversity hotspots include the western rain forests, the Eastern Arc forests of the coast
- Diversity in flora has direct implications on the fauna biodiversity and therefore this implies on Kenya's wildlife diversity

Assessing biodiversity in the NFMS

- The NFI through which biodiversity aspects will be collected has clear guidelines
- Refer to the data collection questionnaire
  - Regeneration
  - Saplings
  - Poles
  - Big trees
  - Bamboo

Assessing biodiversity in the NFMS

Measuring Item	Size or location from centre of Sample plot	Data to record
Shrubs	Within 15m radius	-
Tree regeneration	Two circular (1.5 m radius subplots) locating 10 meters from the sample plot centre.	Height ≥10cm, DBH ≤2cm
Tree	Within 2m radius	DBH ≥2cm (seedlings)
	Within 5m radius	DBH ≥5cm (Saplings)
	Within 10m radius	DBH ≥10cm (poles)
	Within 20m radius (Dryland Forests Stratum)	DBH ≥20cm
	Within 15m radius (other than Dryland Forests Stratum)	
Dead wood	Within 15m radius	Diameter ≥10cm
Stumps	Within 15m radius	Diameter ≥10cm
Bamboo	Within 10m radius	All bamboo shoots ≥1.3m
Climbers	Within 2m radius	DBH ≥2cm
	Within 5m radius	DBH ≥5cm

Biodiversity assessment opportunities

- Using PSPS, compare biodiversity changes over time – may illustrate effects of REDD+ implementation
- Using TSPS compare biodiversity among
  - Strata
  - Ecosystems
  - Clusters
  - Plots in a cluster
  - Tree size classes

Biodiversity assessment opportunities

Biodiversity indicator	purpose for monitoring	Methodology for monitoring
Abundance by numbers	Identifies the number of trees identified in a forest. Noting the uneven distribution of trees in forests, a forest with more trees is better stocked compared to one with less trees	Abundance is derived from the total number of individuals recorded in a forest
Species richness	Identifies how many species are found in a forest. A forest with more species is richer and has a wider variety	Species richness is calculated from total number of species in a forest
Relative abundance	Identifies the contribution of a species to the total population of a forest. A species with more numbers in the population has a higher relative abundance. Such a species may not be threatened by overuse in that forest	Calculated from the total number of individuals of each species as a fraction of the total population
Relative frequency	Identifies the distribution of a species among sample sites. A species that is recorded in most sample sites is well distributed and can be described as adaptable to different ecological conditions or different levels of anthropological/natural stress	Calculated from the total number of samples a species is recorded as a proportion of the total number of sample sites

Biodiversity assessment opportunities

Biodiversity indicator	purpose for monitoring	Methodology for monitoring
Relative dominance	Identifies the contribution of a species to the total basal area of a forest. Large trees with more basal area normally form the dominant trees in the forest and may comprise emergent/top canopy trees, mother trees for seed production. They may also influence water catchment and are major hosts of biodiversity.	Calculated from the total basal area of a species as a proportion of the total forest biomass
Importance Value Index	This is a combined index that caters for relative abundance, relative frequency and relative dominance and indicates the overall dominance of a species based on several indicators	Calculated as the sum of relative abundance + relative frequency + relative dominance per species (Kinyanjui, 2009)
Species similarity	Forests exists as associations where certain group of species grow together. A forest with a wide variety of associations deviates from monoculture characteristics and therefore host more biodiversity	Calculated from a variety of similarity indices e.g. Sorenson's or Jacard's indices (Washington, 1984)
Diversity	Diversity of species in a forest explain the variety of roles the forest has. This variety includes the opportunities for hosting flora and fauna as well as microorganisms	The most commonly used index for species diversity is the Shannon- wiener diversity index (Omayio and Mzungu, 2019) it takes into account the number of species present, as well as the relative abundance of each species
Species evenness	Describes how homogenous or evenly distributed the species described in the diversity index occur	Is calculated form the diversity index and the species richness of the forest

REDD+ and AR-CDM projects

Purpose

- To compile greenhouse gas reduction efforts in forests in Kenya and to prevent duplication of credits in emissions trading.
- To keep record of REDD+ projects in Kenya and their contribution to national targets?
- To keep record of climate finance provided to the different REDD+ projects

What kind of information?

- ✓ Name of Project
- ✓ Implementer,
- ✓ Location of the project (County, Sub-County, Location)
- ✓ Area(ha)
- ✓ Start date of the project
- ✓ End date of the project (expected)
- ✓ Target emission reduction amount (CO2t)
- ✓ Actual emission reduction amount (CO2t)
- ✓ Quantities for which payments ware received (CO2t, Year)
- ✓ Entity paying for results
- ✓ Kinds of activities
- ✓ Monitoring method
- ✓ Pools measured

Policies and Measures

Why Monitor PaMs

Katowice Climate Change Conference Delivers Outcomes ..to make the Paris Agreement operational..

…..intended to motivate countries to improve the quality of their adaptation efforts

Reporting of the Effects of PaMs (WM, WoM, WAM) in projecting GHG emissions

1. Therefore for BUR/BTR and NC Kenya may need to illustrate effects of PaMs
2. For REDD+, the PaMS are the strategic actions/investments that will demonstrate value fo effort in terms of Emission reduction

Monitoring indicators

Programme strategies	Method of monitoring PaM
11.1 Forest conservation, restoration and management based on best practice	✓ Area of forest under management ✓ Number of PFMP projects under implementation ✓ Increase in forest area ✓ Increase in forest stocks ✓ Canopy enhancement
11.2 Promote participatory forest management through CFAs	✓ Number of CFAS in PFM ✓ Area under PFMP ✓ Number of PFMPs under implementation ✓ Revenue from PFMP investments
13.1 Development of community forestry through a participatory process	✓ No of community forests ✓ Number of management plans under implementation ✓ No of communities/groups involved
16.6 Develop charcoal value chain and standards	✓ Number of value chains ✓ Volume of charcoal produced ✓ Number of beneficiaries/groups ✓ Revenue from value chains

Monitoring indicators from R+S

Strategic Investments /investment areas	Actions for investment
1. Promote large scale tree planting in private land.	1. Targeted campaigns on the variety of benefits of tree planting in private lands 2. Promote agroforestry for sustainable livelihoods and agricultural landscapes including standards for species compatibility.
1. Promote afforestation in community and private lands for cultural, environmental and biodiversity purposes	1. Targeted campaigns on cultural, environmental and biodiversity benefits of forests 2. Promote PES programmes in community forests including supporting REDD+ programmes
1. Support afforestation and reforestation programmes in dryland and degraded forests	1. Promote action oriented Research on appropriate species for ideal site matching to enhance forest growth/regrowth especially in drylands 2. Develop and implement an integrated system for fire management in montane and dryland forests 3. Provide platforms for corporates to support large scale CSR tree planting and management programmes. 4. Support and incentivize tree planting and management by forest dependent communities in degraded forests

Forest Information Platform for NFMS , REDD+ and SFM

2nd July 2021
Richard Mwangi
Mr Sembo Akinobu

Table of Presentation

- FIP Objectives
- FIP Functional description
- FIP Basic Components
- FIP Main Functions
  - 1. FIP Site Map
  - 2. Management of Inventory Data
- FIP Development Schedule
- FIP Milestones
- FIP Challenges
- FIP live Demo

Implementation Methods of REDD+ Readiness Component

[1] Activities on the NFMS and the Forest Information Platform

[2] Activity on various type of map creation

[3] Activities on FRL

[4] Activity on forest cover change monitoring in the whole of Kenya

[5] Activity on the MRV training

[6] Activities on pilot project for REDD+ (Contribution to Component 2)

Definition of the NFMS in Kenya

Defining the NFMS as methodology and the NFMS as a database (forest information platform)

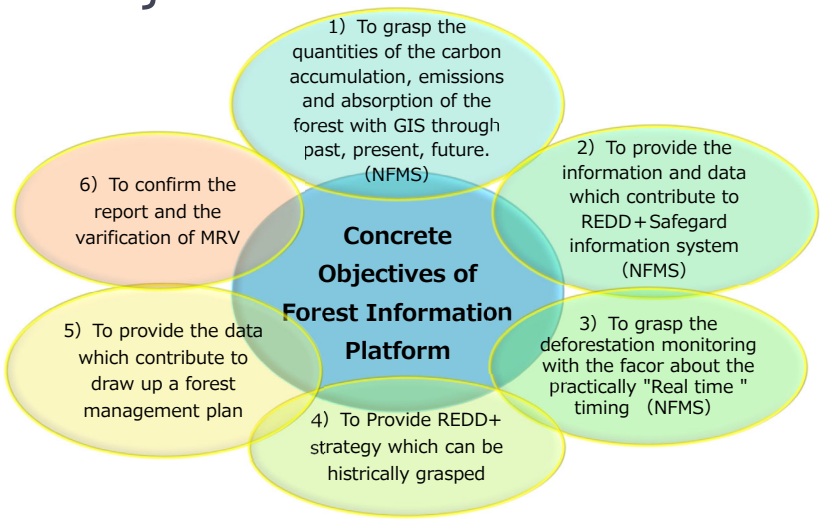
➢ **NFMS**

Methodology of how forests are monitored

➢ **Forest Information Platform**

A database to provide information that does not only include the information identified according to the NFMS but the information necessary for implementing REDD+ and sustainable forest management

FIP Objectives



FIP Functional description

To **replace KFIS's** functionality with the Web Portal Service with ArcGIS Enterprise

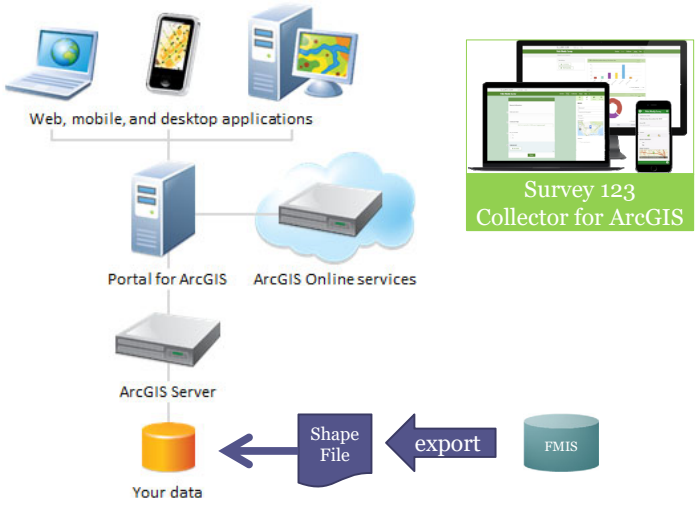
To use the Portal for ArcGIS Server with the limited access to the contents.

To utilize ArcGIS Online as the gateway to the accessible contents .

To support PDA devices for the data collection activities at the field

To support the other external system data with the static link.

FIP Basic Components

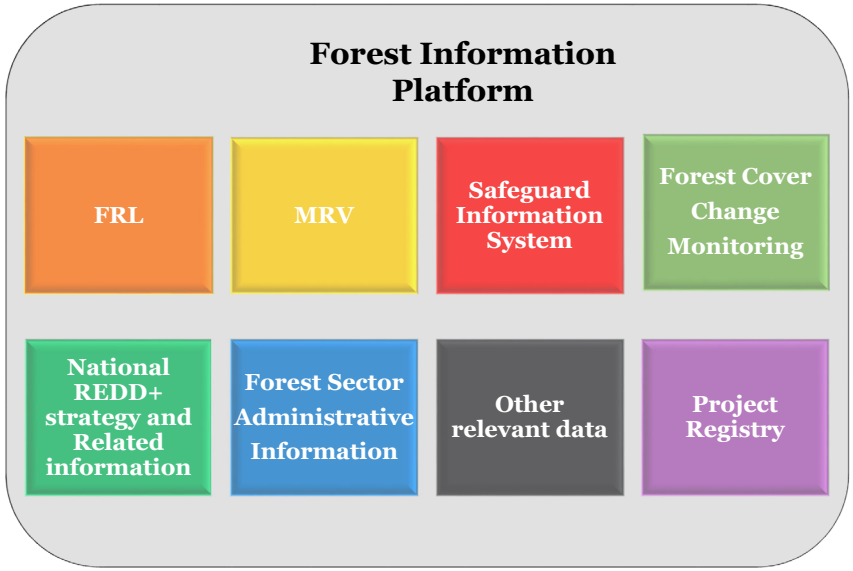


FIP Main Functions

1. FIP Site Map
2. Management of Field Survey Data
3. FMIS Linkage

1． FIP Site Map

FIP Main 8 Components(Draft)

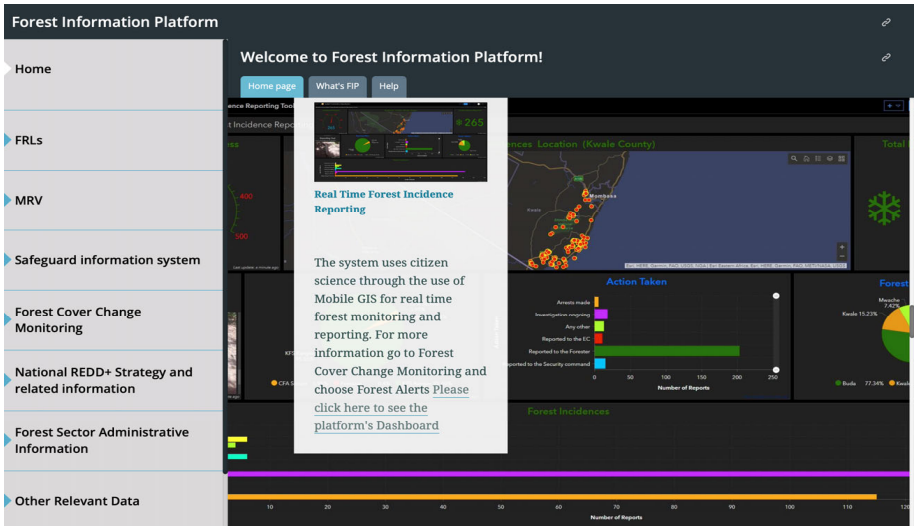


Contents type and persons to access FIP

- 4 type Contents
  ①Description：Explanation of Contents
  ②GIS data
  ③Table：The result of calculation or Inventory
  ④Document
- 4 type persons with access right on FIP
  - FIP Administrator
  - KFS
  - Related Stakeholder
  - General Citizen

Development of FIP

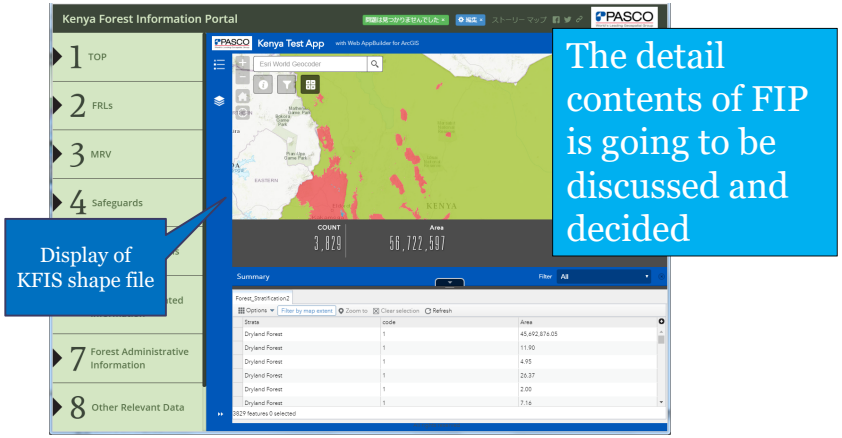
The FIP sample layout as sitemap have been developed



Development of FIP

Updating sample data on FIP including

・Shape file、Document data(word , pdf etc…)、Table data including excel file



2． Management of Field Survey Data

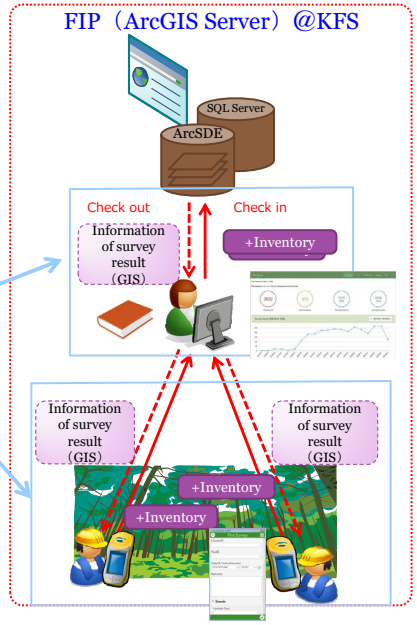
Field Survey Data collection Tool: Survey 123

Survey 123

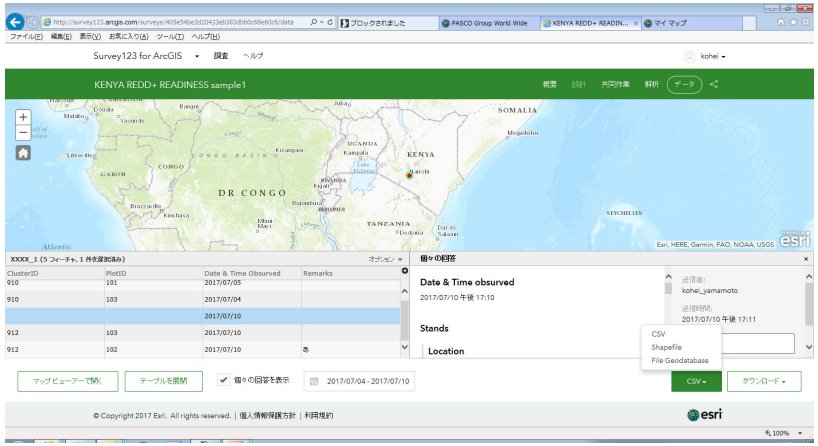
Survey 123 is the software based on ArcGIS Online Solution.

[The merit of Survey 123]
- Centralized management of inventory collect data using administrator's function
- Registration of location information referring Map and Satellite imagery.

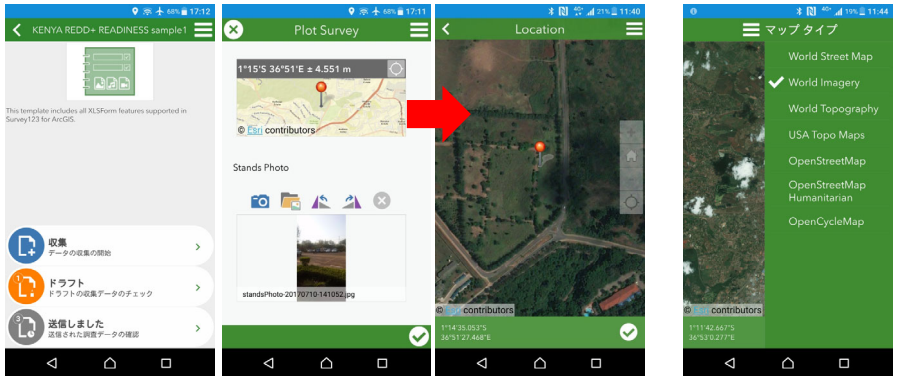
*Interface and function will be developed based on the function of ArcGIS Server



Sample application of survey 123 Administrator's tools



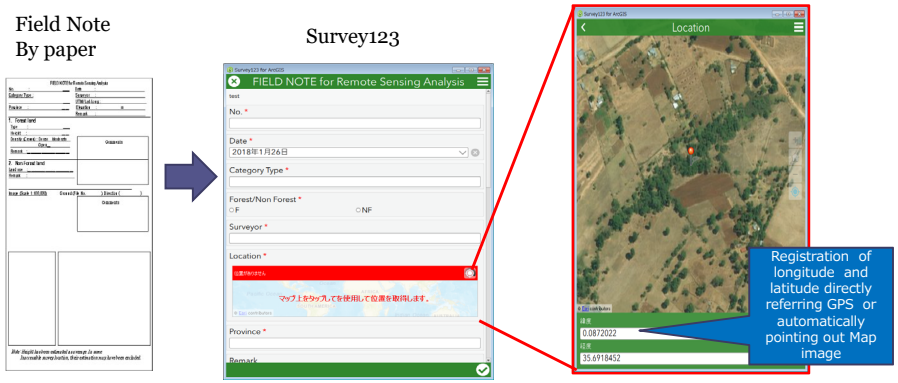
PDA Client



Development of Forest Inventory Collection Tool Based on Remote Sensing Analysis for this year

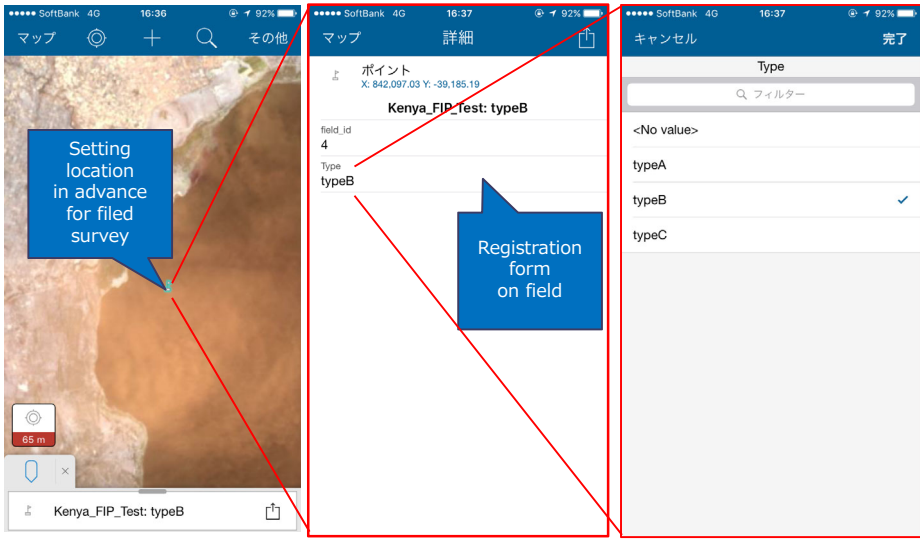
Field Note
By paper

Survey123



Field Survey Data collection Tool: Collector for ArcGIS

Development of basic function of Forest Inventory Collection Tool by Collector for ArcGIS



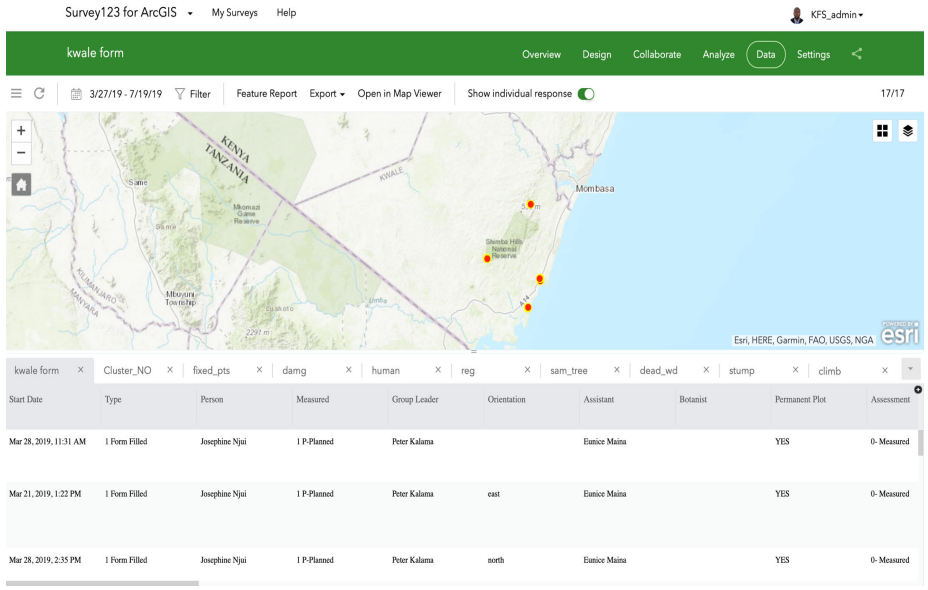
Field Survey Data collection Tool: Summary

- Depending on the intended use of the field survey tool by the Kenya, both Survey123 and Collector for Arc GIS are preferred to utilize together.

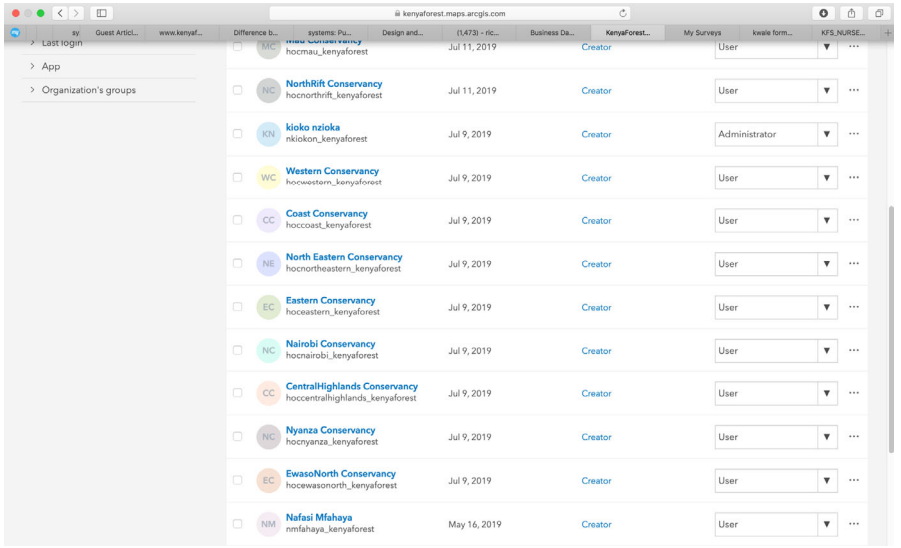
- For the forest inventory research tool, Collector for Arc GIS is preferred because of the function "setting the locations for the research in advance, and register their results.“

- For field survey of remote sensing or Patrol, Survey123 is preferred because of user friendly GUI and easy management of data.

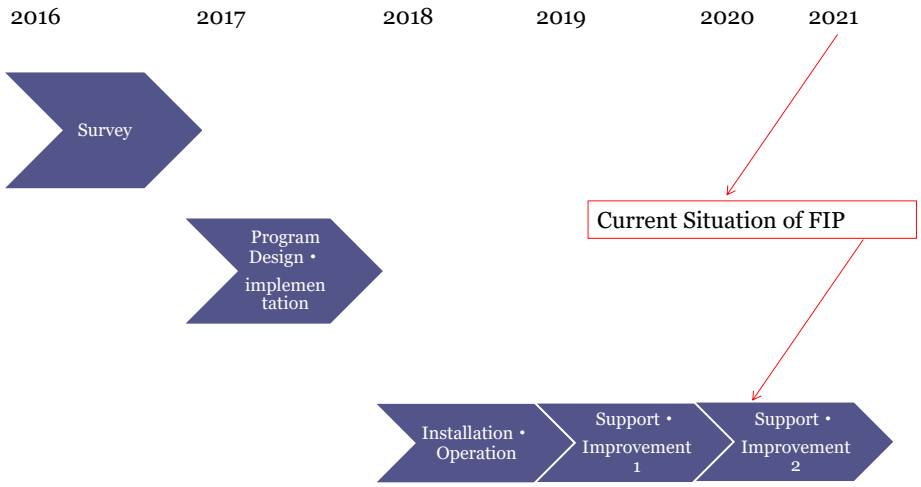
Survey 123



Survey 123



FIP Development Schedule



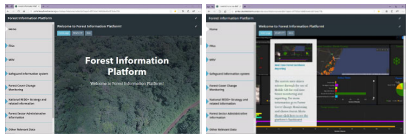
FIP Milestones

- Intergration with JJFast.
- Intergration with forest Alerts.
- Introduction of Forest and Landscape restoration Module.
- Intergration with Mobile GIS(Survey 123) For Citizen science
- Development of Real time Data Dashboards.

1 Progress and achievements with future work plan

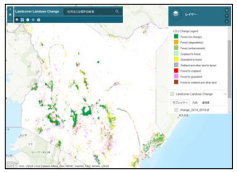
1.3 Activity 3-2: Operationalize the Forest Information Platform (in progress)

Previous top page (just single image)



New top page (slideshow like interface)

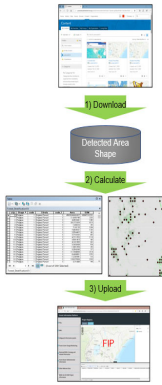
- Regarding the improvement of FIP, updating the documents and maps including the land use/land cover change maps used for FRL were made and top page of FIP was modified. The counterparts learned how to design and upload the GIS data to FIP more easily with latest GIS application.



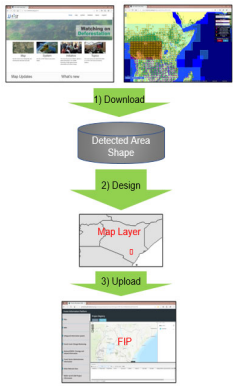
Land use / Land cover change maps

1 Progress and achievements with future work plan

Future work plan for Improvement of FIP as Activity 3-2



Workflow of carbon and biomass calculation tool



Workflow of JJ-FST Data import tool

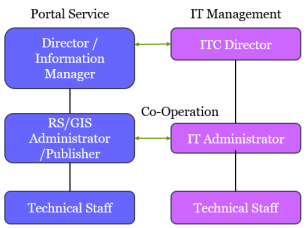
- Development of the arithmetic program for automatically calculating carbon amount using data of plot survey on the assumption of future implementation of NFI as the additional tool.
- Development of deforestation monitoring system by use of JJ-FAST as the additional tool. This will help the users to retrieve the data from JJ-FAST and import them to FIP easily.
- The information/data will be continuously uploaded.

FIP should be opened in public as early as possible.

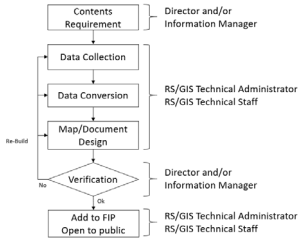
1 Progress and achievements with future work plan

1.3 Activity 3-2: Operationalize the Forest Information Platform (in progress)

- Regarding the operation and maintenance of FIP, the flame work of organization and workflow was developed.



Organization for FIP management



Workflow of FIP contents management

Future work plan

- The operation flame work and workflow will be practiced and improved.

This activity is very important for the sustainable use of FIP.

FIP Challenges

Activity Data (Delays in National Mapping)

Lack of data to populate some modules eg GHG

The citizen science module has not been fully utilized

All stakeholders have not been brought on board(county government, private sector, community)

Biodiversity module not yet implimented in the system.

FIP Live Demo

Questions Comments

- Thank you
- Merci
- Arigatogozaimas
- Gracias

Ch.7 Institutional Arrangements for NFMS Ch.8 Calender of NFMS

REDD+ TWG AND STAKEHOLDERS MEETING ON 1ST AND 2ND JULY 2021

COMPONENT MANAGER OF COM.3 IN CADEP-SFM

MR. PETER NDUATI

Contents

Ch.7 Institutional Arrangements for NFMS

The tasks of each party involved in the monitoring function and data management function of the NFMS, and the procedures for the management, will be formalized through institutional arrangements to ensure the long-term sustainability and accountability of the system. The NFMS secretariat will be established in KFS to oversee implementation and operation of NFMS.

Ch.7 Institutional Arrangements for NFMS

7.1 Institutional Arrangements for the Monitoring Function (1/2)

Item	Activity/Data Type	Lead Institution	Mandated institutions	
			Institutions	Role
Forest cover area based on SLEEK programme	Creation, authorization and publication of the Land cover/Land use (LCLU) map	SLEEK	KFS	Creation of the LCLU map
			KEFRI	
			Survey of Kenya	
			DRSRS	
			JKUAT	Undertaking accuracy assessment on products developed (QA/QC)
			SLLEK	Authorization and publication of LCLU map
Forest cover change area based on LCLU maps (AD)	Creation of the land cover/ land use change maps based on the LCLU maps	KFS	KFS	Creation of LCLU change maps
			SLEEK	Checking accuracy of the change maps (QA/QC)
			JKUAT	
			DRSRS	
			KEFRI	
National forest inventory (NFI)	Implementation of the NFI	KFS	KFS	Carry out NFI
			KEFRI	Support NFI
			Universities	Carry out QA/QC
			County Government	Involvement to Forest Inventory
Conversion of the inventory data into carbon stock data (EF)	Analysis of inventory data & improvement of allometric equations and other related conversion factors	KFS	KFS	Carry out the conversion
			KEFRI	Support analysis of inventory data & improvement of allometric equations and other related conversion factors
			Universities	Carry out QA/QC
JICA-JAXA Forest Early Warning System in the Tropics（JJ-FAST）	Monitoring of deforestation	KFS	KFS	Management of the monitoring

Ch.7 Institutional Arrangements for NFMS

7.1 Institutional Arrangements for the Monitoring Function (2/2)

Item	Activity/Data Type	Lead Institution	Mandated institutions	
			Institutions	Role
The Near Real Time Forest Alert System (NRTFAS)	Receiving and analyzing of forest destruction alerts	KFS	KFS	Management of the monitoring
Field validation for deforestation according to data from JJ-FAST and NRTFAS	Ground truth survey by use of Survey 123	KFS	KFS	Carry out ground truth, and data collection and analysis
Policies and Measures (PaMs)	Monitor Policies and Measures based on indicators for each	MoE&F	MoE&F	Manage the monitoring
			KFS	Support the monitoring of PaMs
			KWS	
			KEFRI	
Biodiversity	Biodiversity Monitoring	KFS	KFS	Data collection through NFI and analysis of data
			NMK	Support monitoring and share data on biodiversity
			KEFRI	
			KWS	
REDD+ and AR-CDM projects	Monitoring of REDD+ & AR-CDM projects in Kenya	MoE&F	MoE&F	Manage the results of monitoring
			KFS	Collect data of the projects
			REDD+ and A/R CDM Projects	Provide data

Ch.7 Institutional Arrangements for NFMS

7.2 Institutional Arrangements for Data Management Function

Item	Activity/Data Type	Lead Institution	Mandated institutions	
			Institutions	Role
Data/Information update	Collection, verification & Uploading of data/Information	KFS	KFS	Manage the updating of data/information including providing access rights
			KEFRI	Provide data/information to be uploaded to FIP
			Survey of Kenya	
			ICRAF	
			DRSRS	
			Universities	
			Other institutions	
Server Management	Maintenance and renewal of hard and soft ware	KFS	KFS	The maintenance and renewal
			ME&F	Support budget for the maintenance and renewal
			Treasury	
	Publish data		DRSRS	
	Store data		Survey of Kenya	
	Receive data		ME&F	

Ch.8 Calender of NFMS

Year	Forest cover area and forest cover change area for AD	Forest Carbon stock for Emission factor	FREL/FRL	Submission of NC and BUR	Remarks
		NFI			
2017	Land cover/Land use map in Year 2000, 2014				
2018	The map in Year 2015				
2019	The map in Year 2018				
2020			○ (Period 2002-2018)		Paris Agreement come into force
2021	The map in Year 2020				
2022		First NFI		BUR	
2023	The map in Year 2022				
2024				NC	
2025	The map in Year 2024				
2026				BUR	
2027	The map in Year 2026				
2028				NC	
2029	The map in Year 2028				
2030				BUR	Finish year of Vision2030

NATIONAL FOREST MONITORING SYSTEM

Way forward and linkage of NFMS to other REDD+ processes

By
Mwangi Kinyanjui – Karatina University

INTRODUCTION

Decision 4 of COP 15 in 2009 in Copenhagen Paragraph 1,
The CoP requests developing country Parties to establish, ***according to national circumstances and capabilities***, a ***robust and transparent national forest monitoring systems*** and***, if appropriate, sub-national systems*** as part of national monitoring systems that:

- ✓ 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;
- ✓ Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities;
- ✓ Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties

Kenya's NFMS and basic MRV principles

- ✓ Demonstrates methodological guidance **(Transparency)** on use of
  - ✓ The SLMS for land cover and land cover change
  - ✓ The Ground data collection
  - ✓ EF and AD generation
- ✓ Demonstrates **Consistency** in methods over the time series, **Completeness** (e.g. Wall-Wall coverage) and demonstrates **Comparability** spatially
- ✓ Explains procedures for uncertainty assessment and Provides opportunities for improving **Accuracy**

Future/stepwise improvements – from TA of FRL

- ✓ Improve the SLEEK mapping programme, making it possible to monitor a single pixel over time preventing the under- or overestimation of emissions and removals – the FLINT vision
- ✓ Implementing the sampling design for an increased number of PSPs, which could capture the carbon stock changes in forest land remaining in the same canopy class and would in turn enhance the accuracy of future removal estimates (Can capture emissions arising from a canopy remining in same canopy class)
- ✓ Estimating carbon stock changes for changes in canopy cover in public plantations using an improved NFI
- ✓ Refining the SLEEK mapping programme and increasing sampling, which would help to enhance the transparency of land-use transitions and the accuracy of emission and removal estimates

Future/stepwise improvements – from TA of FRL

- ✓ Updating the EF used for deforestation to cropland, which could capture carbon stocks in annual cropland more appropriately in the future
- ✓ Resolving the contradiction in the capping manipulation using an improved NFI or appropriate literature references
- ✓ Developing carbon fractions corresponding to each forest type and species
- ✓ Differentiating between tree species in public and private plantations
- ✓ Ensuring consistency in the methods, data sources and time intervals used for the FRL with those used for the GHG inventory included in Kenya's next national communication
- ✓ Improving the uncertainty analysis, for example by analysing not only the overall accuracy of land-cover maps but also individual land classes and by increasing the number of validation points

Emerging issues from REDD+ strategy

- ✓ Development of jurisdictional REDD+ projects based on carbon market demands. Regional /site specific REDD+ projects allows more accurate validation, allows buyers with small commitments
- ✓ Kenya may allocate the reference level (52 million Tones of CO2 eq) to the regional projects and provide a consistent method of accounting
- ✓ Participation of the private sector requires more targeted assessment of private forests e.g. develop a mapping procedure that separates such forests from the natural forests in a way equivalent to what has been done for Public plantations
- ✓ Participation of indigenous communities may require identification of specific forests where the IPs have special interests as described above
- ✓ Kenya may need a local validation mechanism for REDD+ projects that do not necessarily market their carbon but are geared towards supporting the NDC/or FRL – **Anchored in the Registry**

Emerging issues from SIS

- ✓ Monitoring of Safeguards like Biodiversity requires clarity of methodology based on standard operating procedures for monitoring such biodiversity aspects
- ✓ The Monitoring of safeguards by the NFMS needs to be linked to the SIS

Linkage to the National GHG/MRV system

- ✓ Data from the NFMS has been used to develop the 3rd NGHG Inventory for Kenya which was supposed to support the 3rd NC
- ✓ Forest sector statistics were
  - ✓ Tier 3 – Land cover change (this was completely locally generated data)
  - ✓ Tier 2 – EF (Used a combination of local ad Default factors)
- ✓ The process of data entry into the National MRV platform is manual for all sectors

Way forward

- ✓ Draft of the NFMS document Version 1 has been discussed and opportunities for finalizing the document availed in this meeting.
  - ✓ Availability of such a document allows upcoming REDD+ projects adopt nationally accepted Standard operating procedures to allows comparability among projects and assessment of performance based on FRL allocation
  - ✓ The document also provides opportunities for enhancing local decision making e.g. use of Deforestation alerts
  - ✓ The version 1 document is also a step in Kenya's REDD+ process where already a FRL is approved and a REDD+ strategy is being finalized
- ✓ A stepwise improvement procedure has been provided towards developing version 2 of the NFMS document

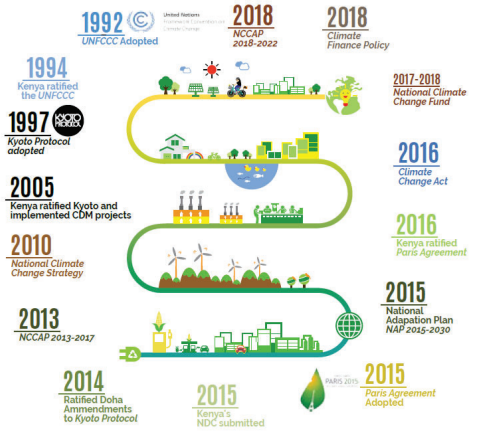
IMPLEMENTATION OF AN INTEGRATED MRV FRAMEWORK- KENYA EXPERIENCE

PRESENTATION BY:
YVONNE NYOKABI

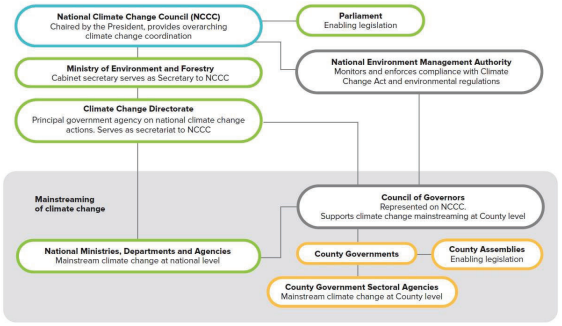
CLIMATE CHANGE SPECIALIST

UNDP KENYA

Y



Kenya's Climate Change Journey including legal frameworks



CLIMATE CHANGE GOVERNANCE IN KENYA

KENYA'S NDC AND IMPLICATIONS FOR THE FORESTRY SECTOR

MITIGATION CONTRIBUTION

UPDATED NDC TARGET MITIGATION CONTRIBUTION

Updated Target

Abate GHG emissions by 32% by 2030 relative to the BAU scenario of 143 MtCO2eq; and in line with our sustainable development agenda and national circumstances.

MITIGATION CONTRIBUTION

MITIGATION CONTRIBUTION

- The restoration of forests on degraded lands is the mitigation option with the greatest potential.
- This is complemented by actions that seek to limit or reduce deforestation and forest degradation. Such initiatives include protection and conservation actions such as limiting or prohibiting access to forests, community management programmes and preventing disturbances through enforcement and monitoring.

Total estimated mitigation cost is USD 17, 725 Million between 2020 and 2030. Kenya commits to bear 21% (equivalent to USD 3,725 Million) of the mitigation costs from domestic sources, while 79% (equivalent to USD 14,000 Million) of this is subject to international support in the form of finance, investment, technology development and transfer, and capacity building.

MITIGATION CONTRIBUTION CONT'D

MITIGATION CONTRIBUTION CONT'D (ART 4 AND 6)

The net results of the 2020-2030 projections for the new NDC target are as follows:

1. All sectors can contribute up to **86 *MtCO2e*** by 2030 compared to the first NDC target of **43MtCO2e**.

2. Out of the ***86MtCO2e***, forestry sector can contribute 20.8 ***MtCO2e***,

3. Out of the total ***86MtCO2e***, we are committing ***46MtCO2e*** to NDC target, hence 32 percent of the original BAU.

4. Remaining **40MtCO2e** is secured for carbon credits or trading. All sectors have been allocated percentages for potential trading.

5. The BAU remains **143MtCO2e by 2030.**

	Action up to 2022	Action up to 2025	2030 Target without markets
Energy	23.2	33	48.1
Transport	1.9	3	4.7
Forestry	10.4	14.3	20.8
Agriculture	2.7	5.3	9.7
IPPU	0.8	1.4	2.4
Waste	0.7	0.7	0.8
TOTAL	39.7	57.7	86.5

LULUCF Sector Sector/Sub-sector	LULUCF Sector Prioritised Mitigation Action	Annual Emission Reduction ($MtCO_2e$)		
		Action up to 2022	Action up to 2025	Action up to 2030
Forestry	Reduce deforestation and forest degradation by rehabilitation and protection of additional 100,000 ha of natural forests (including mangroves) by 2030	2	2	2
Forestry	Afforestation/reforestation/agroforestry of additional 100,000 ha of land by 2030	2	3.1	4.8
Forestry	Restoration of 200,000 ha of forest on degraded landscapes (ASALs, rangelands) by 2030	5.4	8.3	13
Forestry	Increase area under private sector-based commercial and industrial plantations from 71,000 ha to at least 121,000 Ha	1	1.0	1
Total Sector Emission Reduction Potential of the Prioritised Actions		10.4	14.3	20.8

Source: Ministry of Environment and Forestry, NDC Technical Analysis Report, 2020

INFORMATION TO FACILITATE CLARITY, TRANSPARENCY AND UNDERSTATING

INFORMATION TO FACILITATE CLARITY, TRANSPARENCY AND UNDERSTATING

- The **timeframe** for implementation of the NDC is 2030, with milestone targets 2050 with milestone targets for 2025;
- **Prioritised gases**: Carbon dioxide (CO2), Methane (CH4), and Nitrous Oxide (N2O)
- **Sectors covered by the contribution**: The IPCC Guidelines for all sectors: Energy, Transportation, Industrial Processes, Agriculture, Land Use, Land Use Change and Forestry (LULUCF) and waste sector
- **Contribution of International Market and Non-Market Mechanism:** Kenya will participate in both market and non-market mechanisms in line with agreed accounting and other rules, subject to domestic legislations and institutional frameworks developed.
- **BAU projection methodology:** detailed within the NCCAP 2013-2017 and the Second National Communication (SNC), including key assumptions, drivers and methodologies for each sector. The base year is 2010

ADAPTATION CONTRIBUTION

ADAPTATION CONTRIBUTION

Kenya aims to ensure an enhanced resilience to climate change towards the attainment of Vision 2030 by mainstreaming climate change adaptation into the Medium-Term Plans (MTPs) and County Integrated Development Plans (CIDPs) and implementing adaptation actions.

ADAPTATION CONTRIBUTION

ADAPTATION CONTRIBUTION

- Mainstreaming and upscaling adaptation across all sector (including blue economy) and county plans;
- Enhance grassroots resilience by supporting the financing of locally led climate change initiatives
- Uptake and use of climate information in decision making and planning across sectors and counties;
- Uptake of adaptation technology especially of women, youth and other vulnerable groups;
- Institutional strengthening of Climate Change Units across sectors and counties; and Adaptation monitoring and evaluation

ADAPTATION CONTRIBUTION

ADAPTATION CONTRIBUTION

- These will be achieved across activities targeting early warning systems, climate proofing infrastructure, reducing flood and drought risks and protecting natural assets such as forests, mangroves, seagrass and coral ecosystems. Some of these programmes have mitigation co-benefits.
- The total estimated cost of adaptation actions upto 2030 is USD 43,927 Million.

90% of the adaptation cost will require international support in form of finance, investment, technology development and transfer, and capacity building support, while 10% will be from domestic sources.

Adaptation priorities – forest sector

ADAPTATION CONTRIBUTION

- Protect and conserve an additional 100,000 hectares of community forests for ecosystem benefits
- Promote forest economic incentives/ subsidies
- Establish at least 2,000 hectares of nature based (non-wood forest products) enterprises across the country, to promote non-wood forest products and increase forest cover
- Establish150,000 ha commercial private forests plantations
- Establish 50,000 ha Bamboo plantations established
- Plant 350,000 agro-forestry trees in farmlands established
- Establish 70,000 woodlots, botanical gardens, boundary planting

Source : NDC technical Analysis Report, 2020

INTERGRATED MONITORING REPORTING AND VERIFICATION (IMRV) KENYA

IMRV/MRV+

- The NCCAP defines Kenya's Monitoring Reporting and Verification (MRV) framework as "*an integrated framework for measuring, monitoring, evaluating, verifying and reporting results of mitigation actions, adaptation actions and the synergies between them; and support*".
- *Kenya has developed an Integrated MRV system that will capture both mitigation and adaptation actions.*
- *This Integrated MRV system will be linked with the already existing monitoring systems include the National Integrated Monitoring System (NIMES) and County Integrated Monitoring and System (CIMES).*
- *Counties and various sectors are expected to downscale and contextualise the indicators into their county and sector planning documents*
- Must interface with the rrequirements under Article 13 of the PA as well as Article 6 of the PA.
- Budget Codes

Basis for MRV in Kenya

In the context of NDC implementation and according to the National Climate Change Action Plan (NCCAP) 2018-2022, Kenya's MRV/transparency system entails the process by which the following will be tracked and reported at the national and international levels:

1. The implementation and impacts of **mitigation actions**, including the national **GHG inventory** to enable tracking of progress on implementing and achieving the mitigation component of the NDC.
2. The implementation and impacts of **adaptation actions,** including information related to climate change impacts, vulnerabilities and adaptation
3. The **external support needed and received (finance)** towards these actions, including information on financial, technology development and transfer, and capacity building needs and support received from developed countries. Such support could be financial, technology transfer or capacity building.

Challenges	Needs
Lack of an **overall framework for MRV system**/ Complex MRV systems proposed in the NCCAP, there is need to have an integrated and simplified reporting and verification system	Need for a **simple and integrated MRV framework**
There is danger of people working in segregation without a harmonized output/ Varied types of data across different actors	• **Guidelines for reporting** and harmonized outputs • **Standardized form of activity data collection** and **reporting instruments** across all sectors
Low level of capacity (expertise, technology, equipment) within sectors to undertake the MRV work	**Strengthened capacity** to undertake MRV in the country Need for **robust and coordinated MRV capacity building plan**
Unavailability of Data and **uncoordinated data sharing mechanisms**	**Data Collection Systems** to ensure data availability Data **quality control and assurance** protocols
Limited funding for reporting requirements by the Government	Establishment of **institutional frameworks** at both national and county level that with **adequate funding for mandate**
Lack of a **subsidiary legislation** for reporting under the Climate Change Act, 2016 to guide on reporting	Legislative framework required for **mainstreamed reporting**

Challenges and needs in designing Kenya's integrated MRV

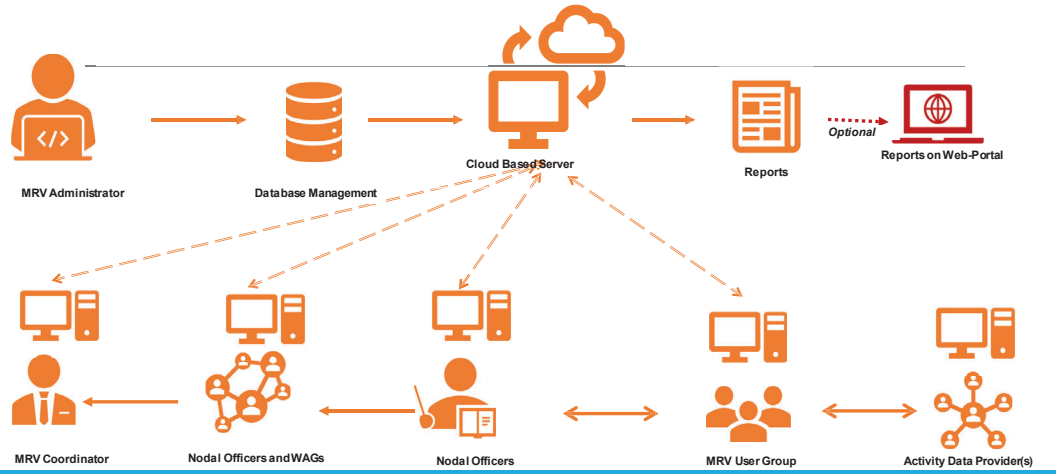
Elements of Kenya's Integrated MRV Framework

Integrated National MRV Framework

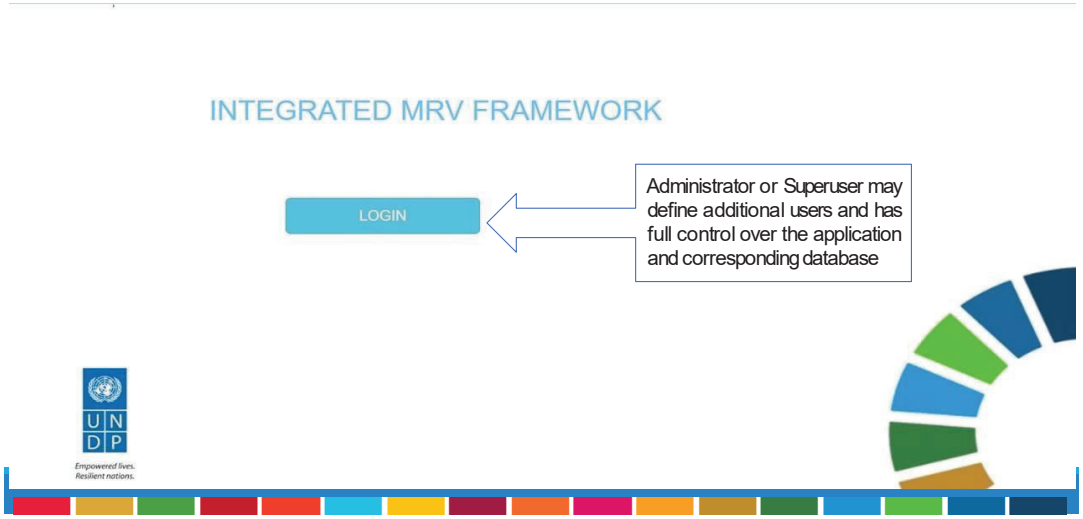
Component 1: National GHG Inventory	Component 2: NDC Implementation/ Mitigation Actions	Component 3: NDC Adaptation Actions	Component 4: Climate Finance Flow	Component 5: Sustainable Development Goals (SDGs)
-GHG emission sectors - Monitoring and data collection - GHG emission calculation - Analysis and reporting - Results and communication	- NDC implementation roadmap - Priority mitigation actions - Tracking mitigation actions - Monitoring and reporting - Results and communication	- NDC implementation roadmap - Priority Adaptation actions - Tracking NDC adaptation actions - Monitoring and reporting - Results and communication	- Climate finance for NDC implementation actions - Finance & resources deployment schedule - Monitoring and reporting - Results and communication	- SDGs mapping and Monitoring - Data for SDGs impact monitoring - Review and analysis - SDGs Impact Reporting

Integrated MRV Report , NDC Report (National GHG Inventory Report (NIR), National Communications (NC), Biennial reports (BR) and Biennial Update Reports (BUR), International Financial & Technical Support

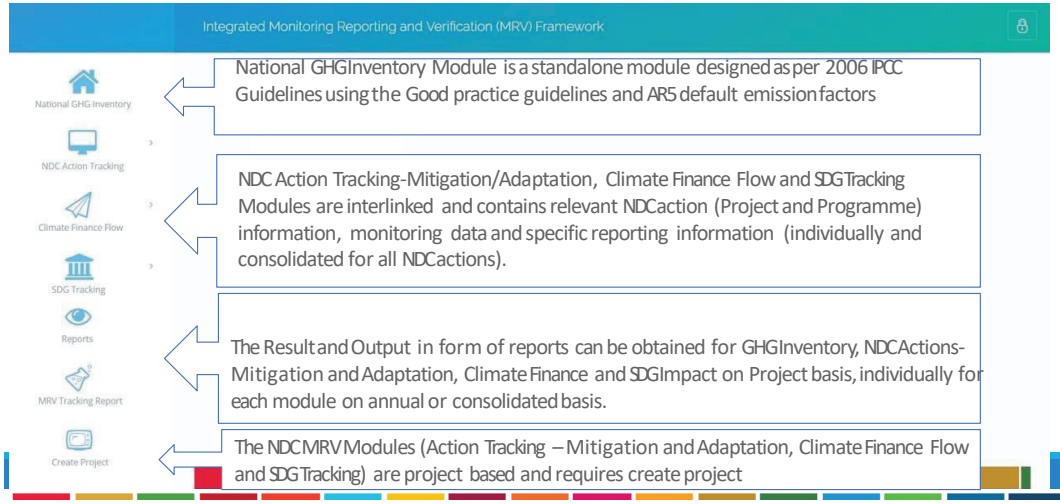
Operational Structure of Integrated MRV Tool



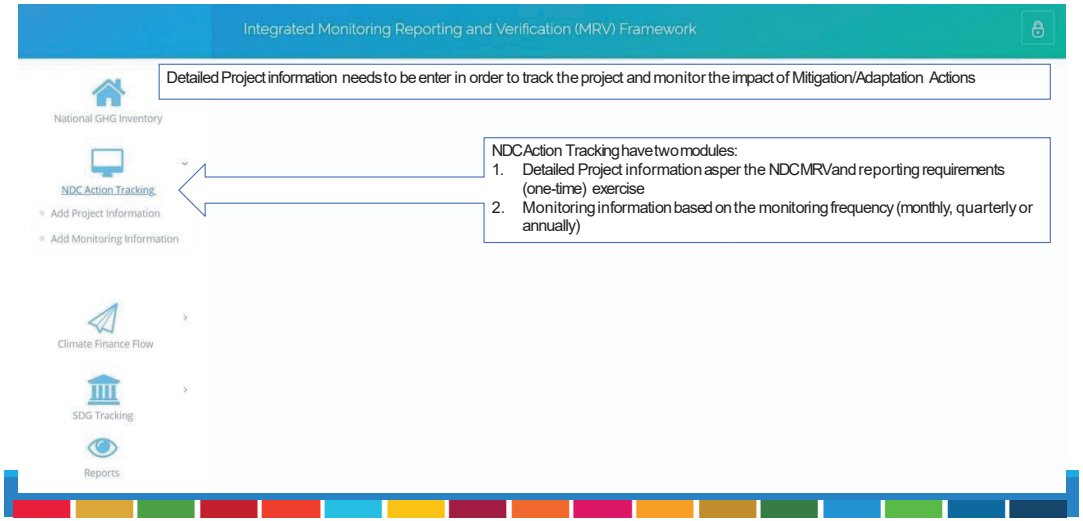
INTEGRATED MRV TOOL (LOG IN SCREEN)



INTEGRATED MRV TOOL (DASHBOARD)



NDC ACTION TRACKING (SAMPLE)



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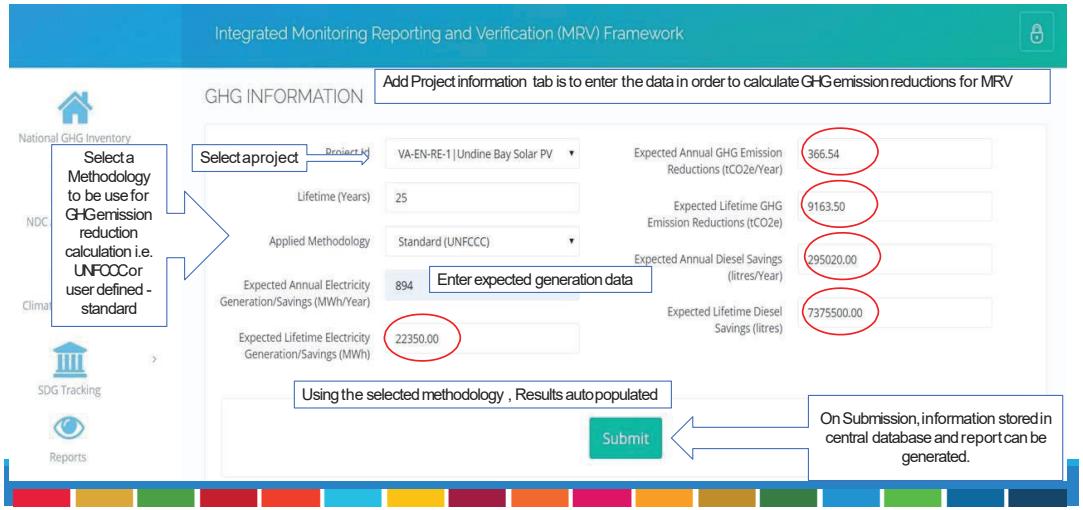

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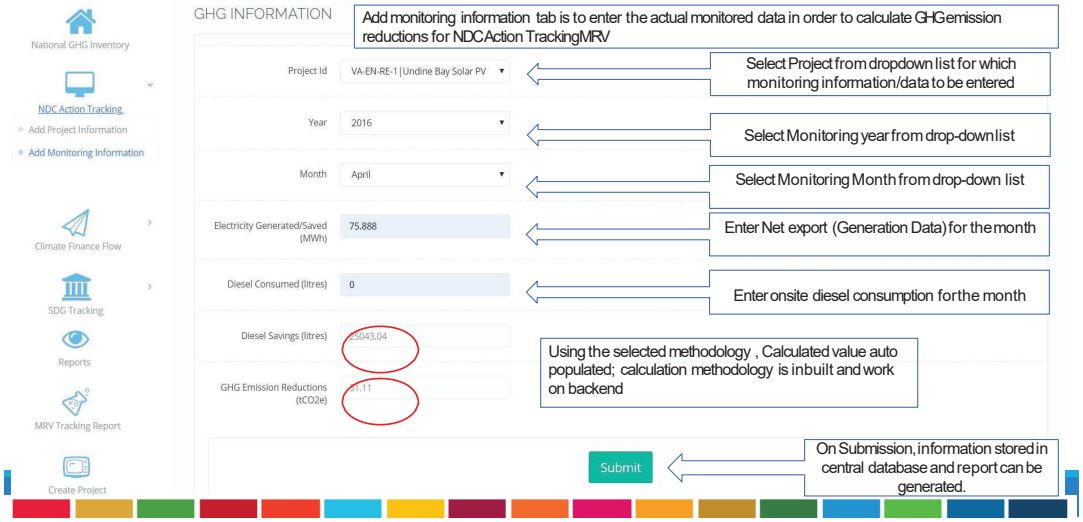
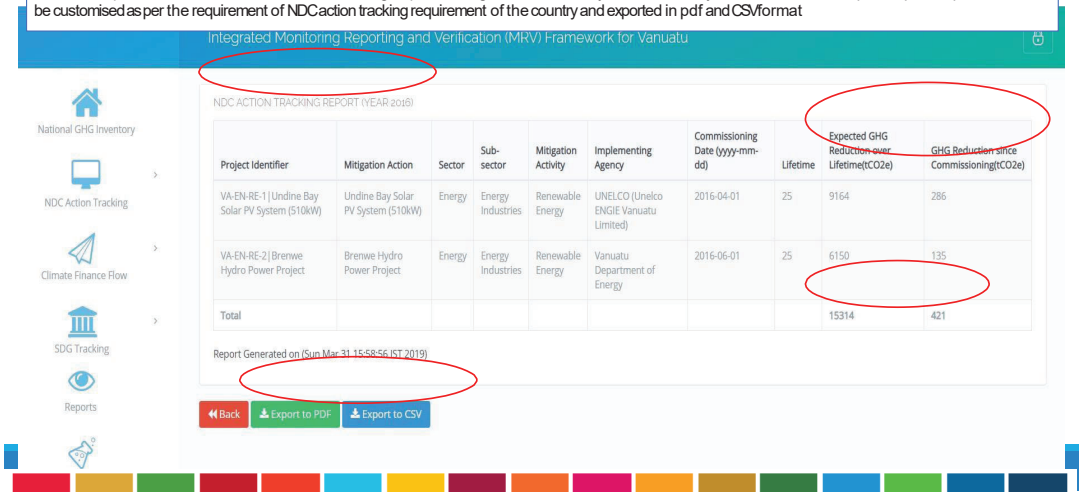
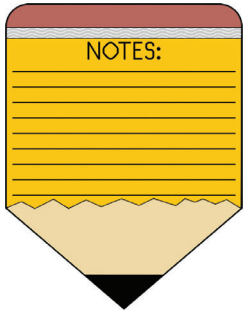


NDC ACTION TRACKING REPORT (SAMPLE)



Parting Shot!



- System to be updated to provide linkage between the National MRV system and sectoral monitoring systems
- The National MRV system will specifically monitor progress in implementation of the Country's NDC which is implemented through the National Climate Change Action Plans
- Multiple actors will play a role in transparency under the MRV therefore a robust Institutional framework needed for MRV in the country

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