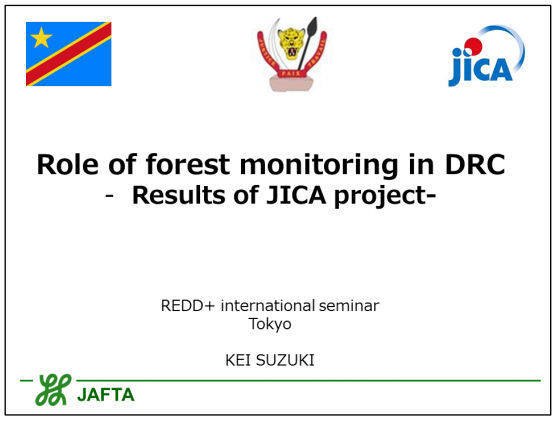
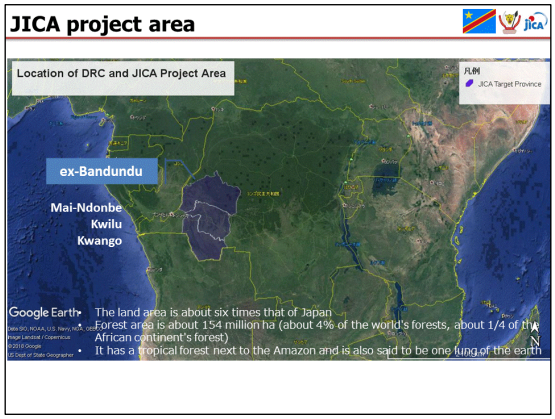
Role of Forest Monitoring in the Democratic Republic of the Congo

Kei Suzuki (Japan Forest Technology Association (JAFTA))



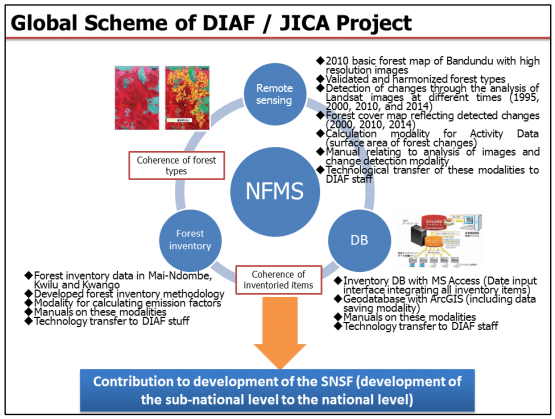
I would like to introduce to you results of a JICA project in the Congo as a case study. In the latter half, I will talk about the role of forest monitoring by using a case study, and will focus on how project-level forest monitoring should be conducted. Then I would like to pose a question.

The Location and Purpose of the JICA Project



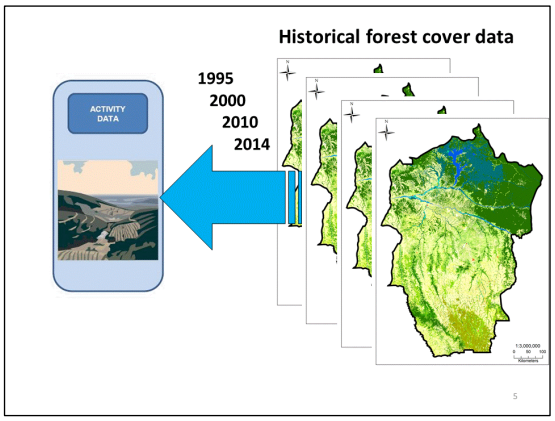
This map shows the location of DRC. The area is about six times as big as Japan, so it is a huge country. The forest area is about 154 million hectares, and it is about one-fourth of the African continent's forests. It is on the other side from the Amazon, and it is called 'one lung of the earth'. JICA's project takes place in this area, which used to be called Bandundu district, but is currently divided into the three regions of Mai-Ndombe, Kwilu, and Kwango. In Mai-Ndombe a FCPF project by the World Bank[1] is also taking place.

[1] http://www.worldbank.org/



As for the components handled in the JICA project, in order to build a national forest monitoring system[2], mainly there are three components. One is remote sensing to create a forest map to understand the forest loss. This is not just for the forest area, but is also to calculate biomass and the forest carbon stocks. Also, all three states have implemented this project and have also developed databases. Of course, the purpose of this project is to contribute to sustainable forest management at the sub-national level.

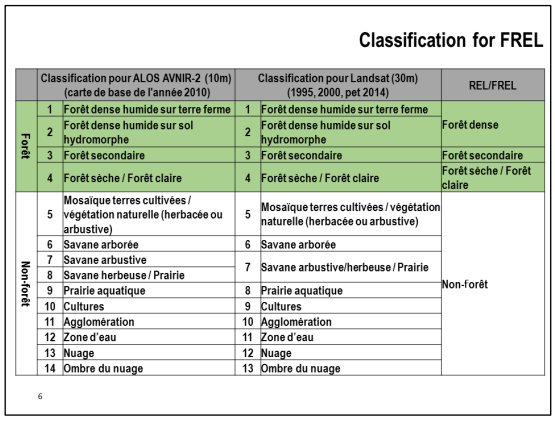
Forest Classification Methods



I would like to explain the results we have achieved, such as maps and above-ground inventories.

The first survey took place in 1995, followed by 2000, 2010, and 2014. We created a map covering the four different time periods. This then becomes the data to determine historical forest cover as well as timepoints to see how the forests changed. This data is called 'activity data' the REDD world. In former Bandundu state, to the north is tropical moist forest that is quite large, covering about 80% of Japan's land area. To the north, there is a tropical humid forest, and then there are dry forests in the south. There is a large variety of different types of forests.

[2] http://redd.unfccc.int/fact-sheets/national-forest-monitoring-system.html



Classification for FREL

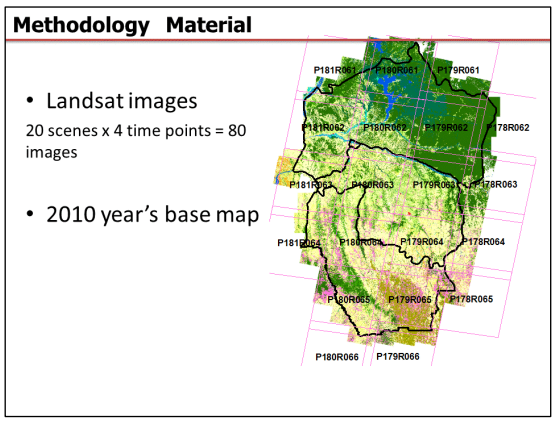
		Classification pour ALOS AVNIR-2 (10m) (carte de base de l'année 2010)		Classification pour Landsat (30m) (1995, 2000, pet 2014)	REL/FREL
Forêt	1	Forêt dense humide sur terre ferme	1	Forêt dense humide sur terre ferme	Forêt dense
	2	Forêt dense humide sur sol hydromorphe	2	Forêt dense humide sur sol hydromorphe	
	3	Forêt secondaire	3	Forêt secondaire	Forêt secondaire
	4	Forêt sèche / Forêt claire	4	Forêt sèche / Forêt claire	Forêt sèche / Forêt claire
Non-forêt	5	Mosaïque terres cultivées / végétation naturelle (herbacée ou arbustive)	5	Mosaïque terres cultivées / végétation naturelle (herbacée ou arbustive)	Non-forêt
	6	Savane arborée	6	Savane arborée	
	7	Savane arbustive	7	Savane arbustive/herbeuse / Prairie	
	8	Savane herbeuse / Prairie			
	9	Prairie aquatique	8	Prairie aquatique	
	10	Cultures	9	Cultures	
	11	Agglomération	10	Agglomération	
	12	Zone d'eau	11	Zone d'eau	
	13	Nuage	12	Nuage	
	14	Ombre du nuage	13	Ombre du nuage	

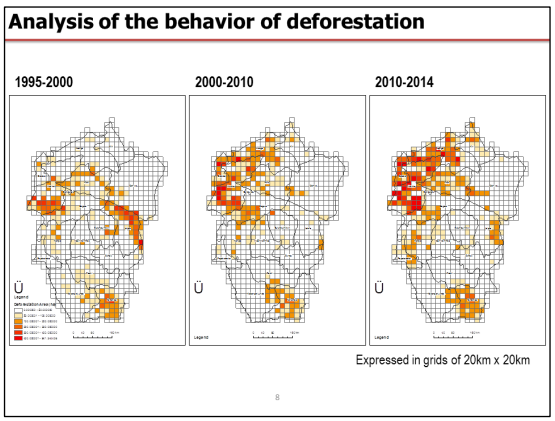
6

When using this map, what sorts of satellite data are used, what categories of forests should be created, and how to classify forests were the first issues to be tackled. There is a limit to remote sensing, and there is a question as to whether it is feasible to use it in forest planning, these two aspects need to be balanced in order to do good categorization. The first category is dense humid tropical forests. The second is quite dense humid forests on flat terrain with a lot of precipitation. The third is secondary forests. The fourth is dry forests. Three categories of open forests are included in the fourth category. The rest are savannah and farmland, which are all non-forests. These are the categories.

We categorized using data from the 10-meter resolution advanced land observing satellite (ALOS) data from 2010, 1995, 2000, and 2014. For other areas, we used 30-meter resolution Landsat data to determine reference levels. In other words, depending on the type of satellite used, we made small changes to the classifications. Categories seven and eight have changed.

Reference levels are divided into forests and non-forests. However, since the biomass levels between the first and the second categories is not that great, we have classified them both simply as 'forest dense'. This completes forest classification.





As mentioned earlier, the area is about 80% to 85% the size of Japan. There are 20 Landsat scenes at four time points, so there are 80 scenes in total. The 10-meter high-resolution images from 2010 were

used as the base, and we see the changes from 2010. There are 80 Landsat scenes, there are quite a few images that the remote sensing experts can work with. The Congo is huge, as you can tell from this.

This shows the results of analysis for three time periods, from 1995 to 2000, 2000 to 2010, and 2010 to 2014. Each grid is 20 kilometers. Each grid shows how much deforestation took place. The map was created by visually checking where deforestation is taking place. In the upper right, you can see that deforestation is getting worse. The reason is that this area is close to the capital of Kinshasa, so fuel wood is being taken to be used in the city. There are also many forest concessions, so logging is taking place.

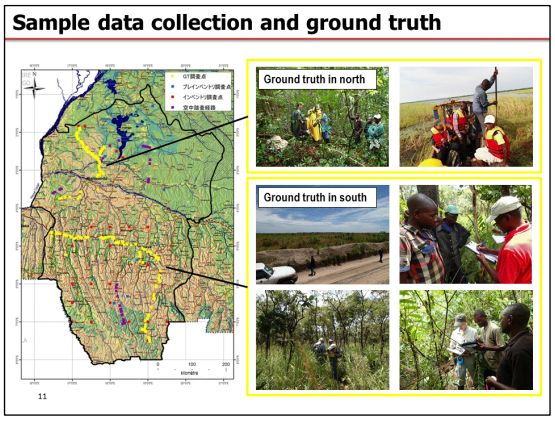
Activity data: Deforestation, forest degradation and gain of the former Bandundu

Change type	Change	AD (ha/yr)			
		1995-2000	2000-2010	2010-2014	Total (95-14)
Deforestation	FD-NF	18,713	16,362	21,477	18,058
	FS-NF	7,534	4,300	20,297	8,519
	FSC-NF	5,510	3,265	5,558	4,339
	Total	31,757	23,928	47,333	30,915
Degradation	FD-FS	5,883	9,093	20,755	10,703
	FD-FSC	23	9	2	11
	FS-FSC	20	2	0	6
	Total	5,925	9,103	20,757	10,720
Gain	NF-FD	278	731	1,338	739
	NF-FS	248	544	13,719	3,240
	NF-FSC	35	5	20	16
	FS-FD	1,311	1,100	492	1,027
	FSC-FD	81	48	0	46
	FSC-FS	12	9	3	9
	Total	1,965	2,437	15,572	5,078

9

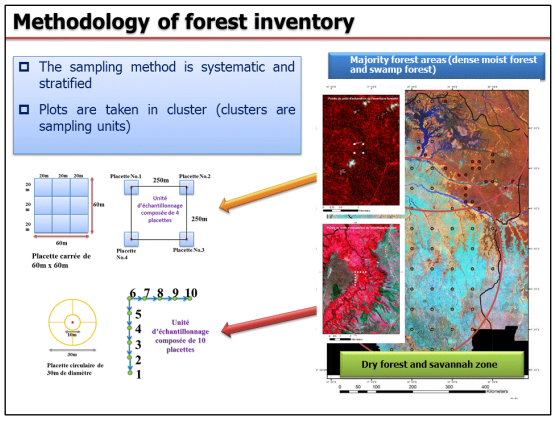
This is the aggregate calculation of the area. On the left you see the three categories of deforestation, degradation, and gain (forest recovery). You can see deforestation caused dense forest (FD) areas to go to non-forest areas (NF), and secondary forests (FSC) to non-forest areas. Then you see open forest areas going to non-forest areas. Degradation is a shift from one forest type to another, such as going from dense forest to secondary forest, so there is qualitative degradation. Gain shown in the change matrix are areas going from non-forest to forest dense, or from non-forest to secondary forest. The unit is hectares per year, so this shows a decrease in area each year. For instance, from 1995 to 2000, the high-quality dense forests disappeared to the extent of 18,713 hectares per year. Naturally, a change of dense forest into non-forest is deforestation. However, if we look just at deforestation, from 1995 to 2014, about 30,915 hectares per year were deforested. The area of the 23 wards of Tokyo is about twice that, so roughly an area equal to half of Tokyo has been disappearing every year since 1995 until the present. This gives you an idea of the scale and the impact of deforestation. This represents only a few percent of the overall land area, but even so, the scale is quite large.

Calculating Emission Levels



Next, I would like to explain about the calculation of carbon emissions and the results of investigations on the ground.

The former state of Bandundu is shown on the left of the map. You have to go to the field to do sampling. A lot of the areas are swamps, so you have to endure difficult travel by boat. It may take several days to travel to the spot and collect the data. In the case of moist forest, there are a large number of trees and each tree is quite large. In the case of the open or dry forests, there is a lot of open areas without canopy cover.

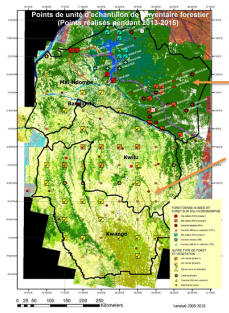


When calculating national forest inventories (NFI), we need to avoid bias by establishing sampling grids in a systematic manner, and by collecting data based on sampling methods. You cannot collect data based on convenience or ease of access. You have to go wherever the random sampling indicates you must go to collect the data, which makes it quite difficult.

We divided our sampling methods into two types, one for use in moist forests and one for use in dry forests. In the case of moist forests, we established four sub-plots in an area. Each square is 60 meters by 60 meters. We would collect data from four areas with a length and width of 60 meters each. In the case of the dry forests, we used a sampling method where we went along an L-shaped trajectory. At an

equal distance, we would establish an area with a diameter of 30 meters and collect all of the sample data in that area at each of these 10 points. There are good reasons why we used different sampling methods.

Number of sampling units inventoried



Number of SU finished up to the end of phase 2

Zone	Type	Ph. 1	Ph. 2	Total
majority forest area	Dense moist forest	4	20	24
	Swamp forest	-	6	6
Mixed zone	Dry forest and savannah with woody vegetation	6	27	33
Total		10	53	63

Here we see the results of our very difficult sampling exercise. In the case of dense moist forests and swamp forests, we got about 30 points, and since there were four areas we sampled, we got data from a total of 120 points. In the case of dry forests, we also got 33 points, so in total we got 63 sets of data. In the case of the dense moist forests, we collected data at the points indicated in red.

Stock by stratum and Emission Factor

Table : Stock by stratum

Forest type	Biomass (t ha^{-1})	Carbon (t ha^{-1})	CO_2 (t ha^{-1})
Dense moist forest (Forêt dense humide (FD))	372.34	175.00	**641.67**
Secondary forest (Forêt secondaire (SD))	259.12	121.79	**446.55**
Dry forest / open forest (Forêt sèche / forêt Claire (FSC))	78.17	36.75	**134.75**
Non forest (Non forêt (NF))	27.84	13.08	**47.98**

Table : Emission Factor of deforestation and forest degradation

Change type	Change type	CO_2 (=EF)
Deforestation	FD-NF	593.69
	FS-NF	398.57
	FSC-NF	86.77
Degradation	FD-FS	195.12
	FD-FSC	506.92
	FS-FSC	311.80

EF = (Quantity of CO_2 after conversion) - (Quantity of CO_2 before conversion)

14

Establishment of database

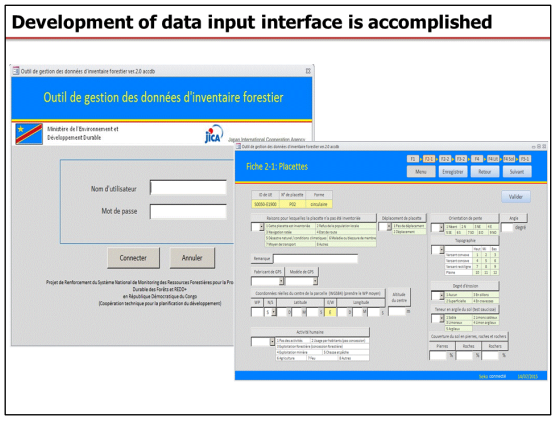
The results of the sampling were used to estimate biomass per hectare. Regarding dense moist forests, we found there were 372 tons of biomass per hectare corresponding to 175 tons per hectare of carbon, which then corresponds to 641 tons of CO_2 per hectare. In the case of secondary forests, we found 446 tons per hectare of CO_2 equivalence. Dry forest was 134 tons of CO_2 per hectare. Even in the case of non-forests, there is some biomass. There may be trees growing there even though it does not fit the definition of a forest, so there is some aboveground biomass even in non-forest areas. When you look at the numbers, the amount of biomass in non-forest areas is not insignificant.

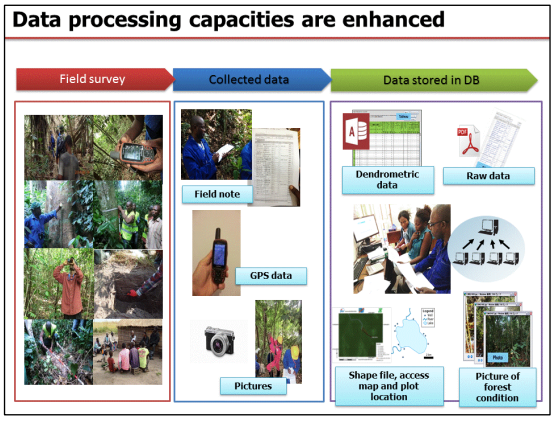
Using this data, we developed an emission factor based on changes in forest type, which was quite easy. For a change from dense forest to non-forest, we subtracted 47.98 from 641, which means a loss of 593 tons of carbon per hectare. When dense forest changes to non-forest, per hectare you have emissions

corresponding to 539 tons of CO_2, which is multiplied by the number of hectares that changed

We got map data from four time points, and we got data from more than 60 sampling plots on the ground. That was the basis for our data, and I would also like to explain our development of a database, which is also important.

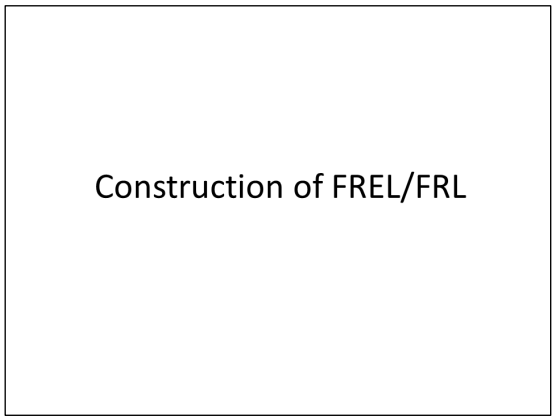
Database System Development

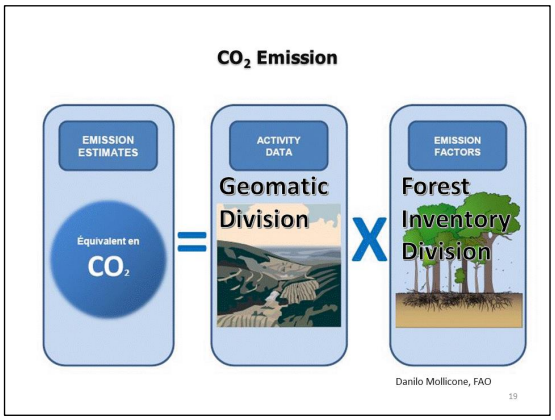




In the JICA project, we developed a data input system for the database. You may think this is a mere data entry interface and that it is not important, but this is actually very important. We apply various restrictions on inputting the data. By doing this, we can standardize the data input done by different people, and that helps increase the reliability of the data. From the perspective of quality control and quality assurance, having such a system is quite important.

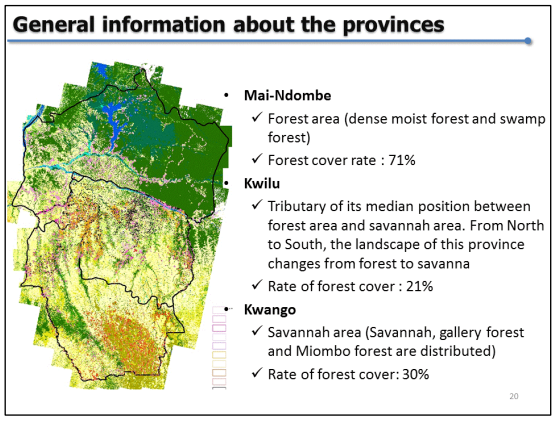
Here is the overall input flow.

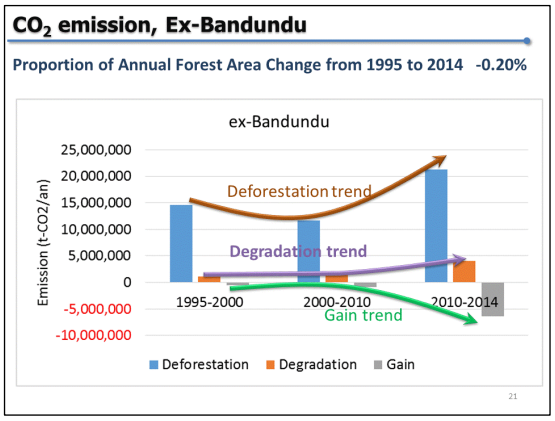




Session 1

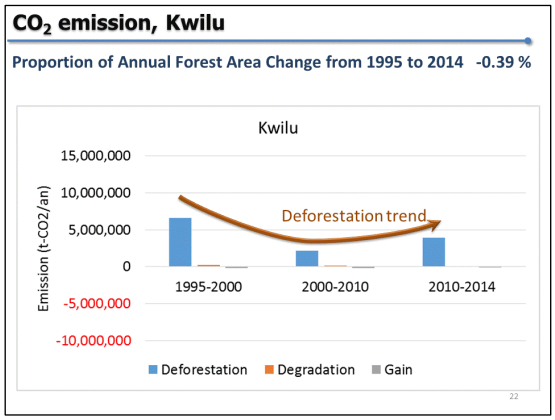
Structure of FREL/FRL

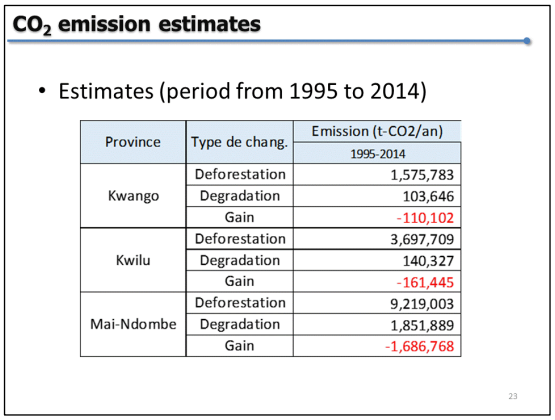




Let me explain what we got in terms of reference levels. We compared dense forests, areas in transition, and dry forests, for which the forest cover ratio was 71%, 21%, and 30% respectively.

This shows the reference levels., and you can see that deforestation is increasing, degradation not so much. In terms of the gain, we are seeing a slight gain in recent years.



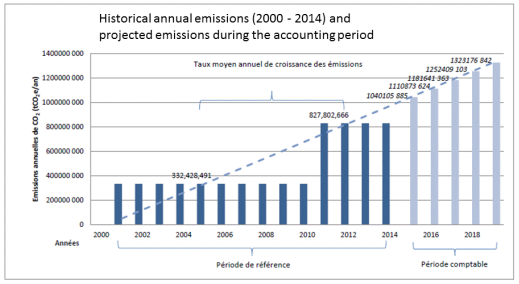


Province	Type de chang.	Emission (t-CO2/an) 1995-2014
Kwango	Deforestation	1,575,783
	Degradation	103,646
	Gain	-110,102
Kwilu	Deforestation	3,697,709
	Degradation	140,327
	Gain	-161,445
Mai-Ndombe	Deforestation	9,219,003
	Degradation	1,851,889
	Gain	-1,686,768

When we look at central Kwilu Province, we get the results as shown here.

Finally, I would like to explain the estimates of annual CO_2 emissions from 1995 to 2014. These are the reference levels for the three provinces of former Bandundu state. FAO, with the support of JICA, has been working on reference levels for DRC as a whole, and these are the results of that effort. It was a very difficult job to complete these reference levels for DRC.

National FREL/FRL in DRC



Achievements of JICA Project

- DRC-JICA successfully develop national forest monitoring system in sub-national scale and it has been upgraded to NFMS and contribute to FREL/FRL submission
- Applying collected data, DRC-JICA developed sub-national FREL/FRL
- DRC-JICA will address to improve forest monitoring and forest governance by applying our assets including JJ-FAST.
- DRC-JICA project will shift to implementation phase to realize emission reduction in Kwilu province (and GHG reduction will be evaluated using NFMS as PAMs)

The data from two time periods are being used to get the data, 2000 and 2014. This is the data for the entire country.

A number of achievements were made by JICA. Being able to get the reference levels was a great achievement, and sub-national reference levels could also be attained. In the next phase, JICA wants to focus more on project activities rather than just national monitoring activities. They will be focusing on Kwilu Province and carrying out projects there.

The Role of Forest Monitoring

What is roles of forest monitoring in different implementation scale?

Expectation for project by approach types

Approach type 1

- National FREL/FRL dose not exist
- Project scale REDD+ put in place as a **demonstration**
- Project scale FREL/FRL shall be **influenced** to national FREL/FRL

Approach type 2

- National FREL/FRL dose exisit
- Project scale REDD+ put in place as **implementation**
- Project scale FREL/FRL shall be **followed** national FREL/FRL

I have been explaining the results of the JICA project in DRC. Next, I would like to change gears and explain about monitoring and its role in more detail.

If we focus just on the project level, there are two approaches. If there is no national FREL and FRL, then you would want to create a reference level as a demonstration, and try to use that to influence the national FREL. The other case is where national FREL and FRL already exist. In that case, a REDD project would be carried out for implementation. Therefore, the FRL and FREL for the project will follow the national FRL and FREL.

Session 1

Current stats of FREL/FRL submission

Necessary items to be monitored under REDD+

Monitoring items	NFMS	Project
Deforestation	◎	
Degradation of forest	○	
Forest Improvement	△	
Bio-diversity	△	◎
Policy and measures	△	○
Livelihood improvement	×	

Quite a few countries have already established FRL and FREL, so approach one of doing evaluation as a demonstration and inputting it at the national level is not so common. Pattern two where these evaluations are done after the national FREL and FRL have been established is more common. You might ask why is it necessary to do forest monitoring at a project level.

I would like to express my thoughts on this. In national forest monitoring systems, generally only deforestation and degradation are evaluated. Biodiversity, policy, and livelihood are generally not monitored in the national forest monitoring systems. Meanwhile, in projects it is possible to cover other topics. Especially biodiversity, policy, and livelihood can be covered as part of projects. If projects can contribute to the SDGs, it is very important to collect data on these aspects as part of projects.

Discussion

- Increase the submission of FREL/REL to UNFCCC in tropical forest countries which have high expectation to REDD+ result-based payment.
- Development of FREL/REL as trial at the project level REDD+ activities were achieved. However, it is necessary to re-recognize the roles of forest monitoring.

Discussion (cont.)

- Under circumstances that REDD+ activities shift to implementation phase, it is expected to collect important information for REDD+, which is not able to collect national level forest monitoring.
- These above points will connect to add values of project itself.
- Let's discus the roles of forest monitoring in different scale such as national, sub-national, local administration, or project !!

I have some topics for discussion. Regarding the reference levels, quite a few countries have been submitting their reference levels in the hope of getting results-based finance, but project monitoring is important not just for financing. From a broader prospective, we need to think about what is necessary.

As countries develop their reference levels, they are moving from the preparatory stage to the implementation stage for REDD+. At the time of implementation, the way monitoring should be carried out, the purpose, and the contents of monitoring should also be considered. Also, if the project measures

diversity, then that will enhance the value of the project and it is meaningful to do so. Lastly, I would like to discuss the different scales of sub-national, national, and project-level forest monitoring. I would like to thank JICA because they helped us a great deal with the Congo project.