What is the point of forest carbon monitoring in REDD-plus?

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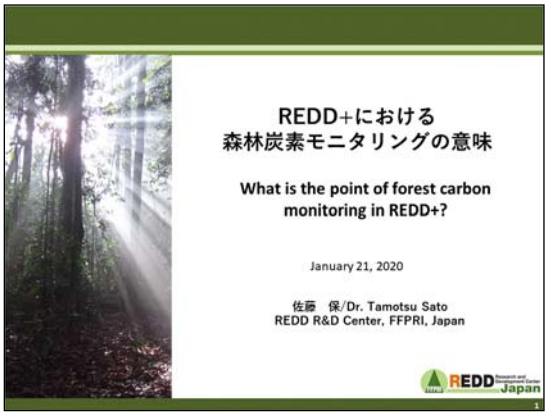
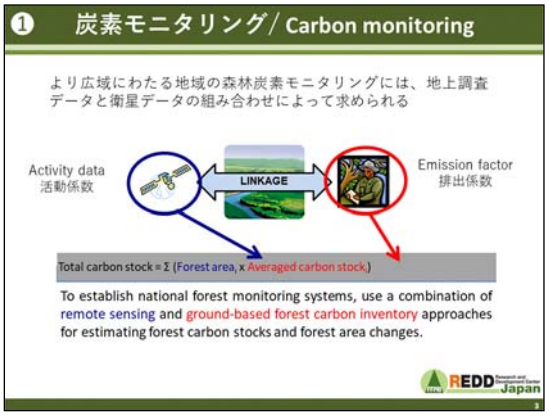


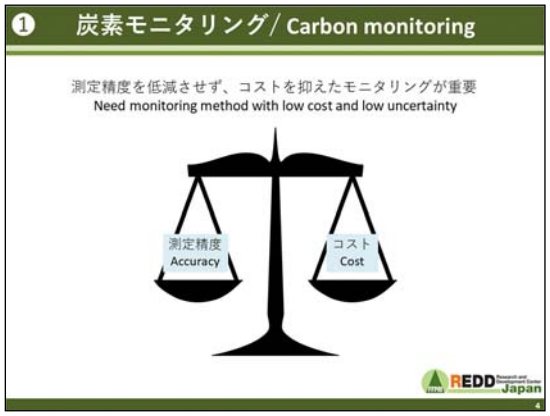
There are four main topics I would like to cover. First, I will briefly explain the mechanism for forest carbon monitoring. Second, I will briefly explain why carbon is not the only target. Third, I will explain why forest degradation is an indispensable component. Emissions from forests include emissions from forest degradation, as well as deforestation. I will also explain the reason for that. Fourth, I will explain how we can conduct monitoring continuously.

What is "forest carbon monitoring"?



First, I would like to explain the mechanism for conducting carbon monitoring. Forest carbon monitoring targets a relatively large area and tries to understand the carbon stock in the area. At the REDD Research and Development Center, we use the same methodology as IPCC, and use remote sensing to identify changes in the forest area. We also do ground-based investigations of the carbon stock per area, and we multiply the forest area and the averaged carbon stock to identify the overall carbon stock. We recommend this approach.

REDD has been around for 10 years and various methodologies have been proposed.



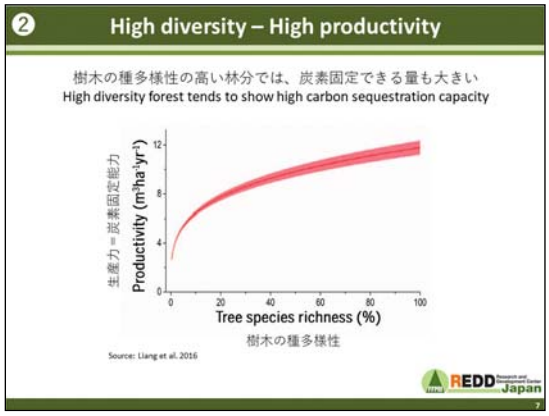
An issue arises. How can we reduce the cost of monitoring without reducing the accuracy? Technology is evolving day by day. If we spend more money on technology, we can naturally get more accurate results, but we need a balance between accuracy and cost. Right now, there is a need to achieve higher accuracy, while also controlling costs.

FFPRI has developed the REDD-plus Cookbook Annex[1], which is a survey manual. If you want to measure the carbon stock per area, you can use "Vol. 1: Ground-Based Inventory[2]." If you want to measure the carbon stock using an Allometric equation, you can use "Vol. 2: Destructive Sampling for Tree Biomass[3]." You can also use the manual for ground-truth surveys or remote sensing analysis. These guidebooks allow you to get high-accuracy measurement results without incurring a lot of cost. These are materials that the REDD Research and Development Center has developed.

1 http://redd.ffpri.affrc.go.jp/pub_db/publications/cookbook_annex/index_en.html
2 http://redd.ffpri.affrc.go.jp/pub_db/publications/cookbook_annex/_img/cookbook_annex_vol1_en.pdf
3 http://redd.ffpri.affrc.go.jp/pub_db/publications/cookbook_annex/_img/cookbook_annex_vol2_en.pdf

Carbon is not the only target

Carbon monitoring is not limited to carbon. As Dr. Buszko-Briggs presented this morning, multiple benefits can be gained from the forest. The forest provides us with various services and as such is called "ecosystem services." This time, we have been focusing on carbon sequestration, but that is not the only benefit. We can also conserve biodiversity. As I said in the beginning, carbon monitoring is not limited to carbon. We also need to monitor biodiversity. Biodiversity and carbon sequestration are like two wheels of a car, one cannot move without the other. For carbon monitoring, we also need to always keep biodiversity in mind. In addition to carbon sequestration, we can get biodiversity conservation and various other services from the forest. We need to keep all these benefits in mind.



This is an example. This is from a recently announced report. It is based on a bunch of meta-data from forests around the world. In the figure, the x-axis shows tree species richness, and the y-axis shows productivity. It shows the higher the tree species diversity, the higher the capability of the forest to sequester forest carbon. It shows that protecting biodiversity and the condition of a forest can contribute to having better forest carbon sinks and more possibly sequestration.

This is from our original data. We made an experimental plot of six hectares in Malaysia, and we measured the number of species of trees with a diameter at breast height of five centimeters or more, and we found over 500 species. Some had a diameter of more than 90 centimeters, but there were other trees that never became more than 10 centimeters in stem diameter. If we think only about carbon sequestration, we might tend to focus only on the large trees and focus on how many big trees there are, but when we think about biodiversity, we need to see that one-fourth of the overall tree species have a diameter of less than 10 centimeters. We tend to focus just on measuring the diameter of large trees, but when we think about diversity, we also need to focus on the smaller tree species.

Forest degradation is an indispensable component

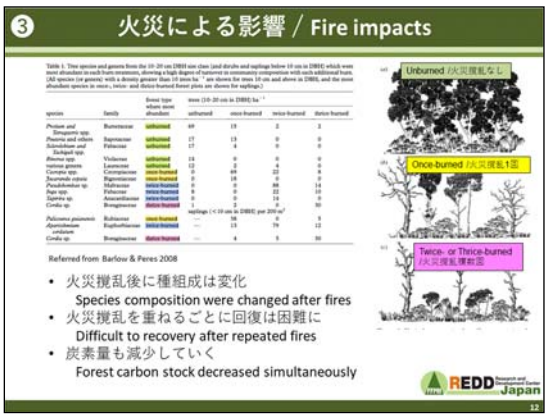
Moving on to third topic, I will talk about forest degradation. Forest degradation is a situation where a good quality forest degrades due to various impacts. Forests are defined differently by different countries. It may be based on the canopy coverage or the height or area of the canopy. If it exceeds a certain level, then it is considered to be a forest. There may be some areas that are defined as forest, but have degraded and have a lower quantity of carbon. Such degraded forests are going to be an issue in the future. Let me explain why. A 2017 report said that GHG emissions from forests are the result of both deforestation and forest degradation. GHG emissions from forest degradation are only a quarter of the total, but it was found that

out of 74 developing countries, 28 countries had GHG emissions from forest degradation exceed emissions from deforestation. In other words, it is important to identify the emissions due to forest degradation in each country; otherwise it will not be possible to have an accurate understanding of the overall GHG emissions. That is why evaluation of forest degradation is an indispensable component.

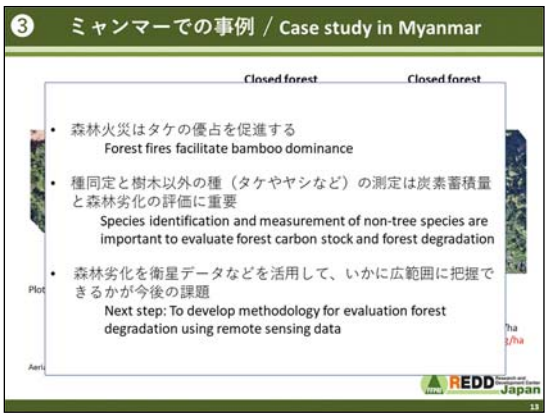
There are drivers of forest degradation that are uniquely different from deforestation. One example is logging which can be both legal and illegal. Some other examples are forest fires, collection of wood for fuel, or the production of charcoal. Livestock grazing in the forest can be another factor. These factors interact with each other to cause forest degradation.

On the left is one of our research areas which shows a forest fire of a peat forest in Palangkaraya in Indonesia. Normally, there would be very few forest fires in a peat forest, but when the ground is dug and the earth dries up, it becomes more likely.

The right shows a forest in Cambodia. Forest degradation makes the occurrence of forest fires like this more likely.



This is an example from Brazil of an unburned forest in good shape, as seen in the top figure. Once it has been burned, the trees that are weak to fire disappear. Each time a fire occurs, the trees that are weak to fire become less in number, so the composition of tree species changes the more disturbances from fire there are. The more forest fires there are, the more difficult it is for the forests to recover. Everybody is hearing about the forest fires in Australia, which you perhaps have seen on the news. I think everyone believes that a recovery from that forest fire will be very difficult. The more fires that occur, the more good trees disappear. As the forests are disturbed by fires again and again, the carbon stock also declines. We need to grasp accurately how much the carbon stock declines as a result of forest fires.

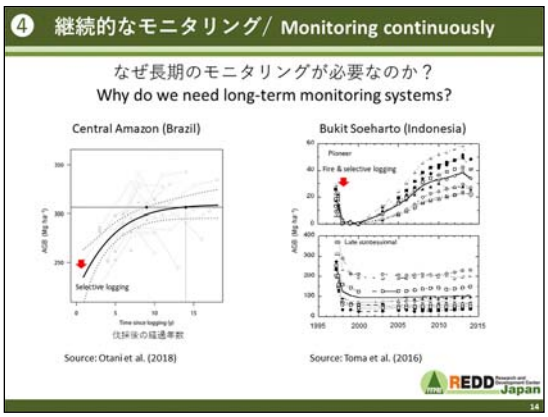


Here is an example from Myanmar. This is a result of cooperation with the Forest Department (FD) and the Forest Research Institute (FRI). There are also pictures from Asia Air Survey[4]. In some areas, bamboo is very common, but in other areas, there is very little bamboo and a lot of normal trees. Bamboo coverage is very important to understand the carbon stock. It is well-known that forest fires facilitate bamboo dominance, so it is important to identify tree species, as well as non-tree species such as bamboo and palms. The measurement of non-tree species is important for the evaluation of carbon stock and forest degradation. One of the next steps is to develop methodology to evaluate forest degradation through the use of remote

[4] https://www.ajiko.co.jp/en/index.html

sensing data. My talk so far has been based on ground-based investigations, but we need to work from the ground and combine the ground data with remote sensing data in the future. Evaluation using remote sensing to understand the level of forest degradation will be very important in the future.

How do we conduct monitoring continuously?

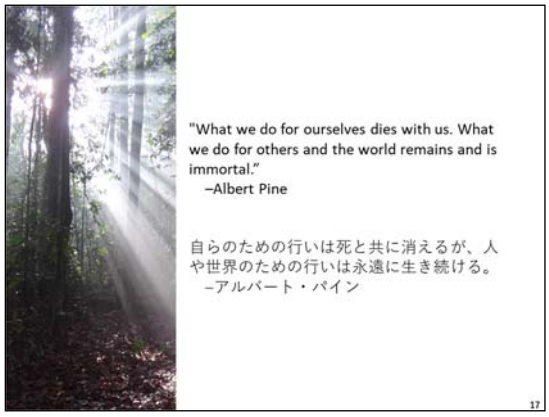


Finally, I would like to talk about why we need long-term monitoring systems. In the diagram on the right, we can see the situation of a tropical forest in Indonesia showing the above-ground biomass after a fire and selective logging. At the top, we can see the line for pioneer species, which grow very rapidly after a fire. These species can only survive in areas where there is a lot of sunlight. Late successional species normally grow under good conditions under the canopy, but once a fire has occurred and there is disturbance, it is very hard for the late successional species to grow, whereas the pioneer species grow very rapidly. By evaluating just one point in time, we cannot understand the situation. We need to understand the change of species over time as the recovery of different species have different trajectories. If we evaluate just one point in time, we might underestimate or overestimate the carbon stock. That is why we need long-term, continuous monitoring.

In order to achieve long-term monitoring, I think there are two main points. The first is to reduce the

inaccuracy of measurements by defining rules for measurement. It is impossible for one person to continue monitoring for 20 or 30 years, so we need clear rules. Just as soccer or rugby can be played by different countries and by different generations because of clear rules, we can accumulate accurate data if we do the same. The other important point is to do capacity building. The picture on the right shows the training of university students by the Forestry Department of Myanmar. Through training like this, the future generation needs to carry on the knowledge of the previous generation.

We need cooperation from not only scientists and engineers, but also from the local people who benefit from the forests. Without their cooperation, it will be very difficult to have long-term monitoring.



Finally, I would like to share a quote that I like. This is a quote by Albert Pine, an author from the 19th century. He said, "What we do for ourselves dies with us. What we do for others and the world remains and is immortal." I believe this thinking is very in line with REDD.