Multiple Benefits in Deramakot Production Forests:

Reduced-impact logging in Deramakot can harmonize timber production with carbon sequestration and biodiversity conservation.

Photo by Hisashi Matsubayashi

Contributed by the Sabah Forestry Department & the Deramakot Japanese Research Team

Forest Certification and Reduced-Impact Logging

Reduced-impact logging and forest certification are the two mechanisms to harmonize timber production with carbon sequestration and biodiversity conservation. Reduced-impact logging is a special method to minimize the impacts of timber harvest on forest environments with careful planning and harvesting. The cost of timber production and its eco-friendly forest management is much higher than that of conventional logging. Forest certification is an economic mechanism to compensate for the high cost incurred during the application of reduced-impact logging. Principally, it works through the collaboration with green consumers who wish to assure that timber production does not cause an excessive damage on forest environments. On the other hand, forest certification gives producers an eco-friendly label so that they obtain a better market access.

How forest certification works. Supports from green consumers help implementing reduced-impact logging through forest certification. Biodiversity (BD) works as an indicator of sustainable forestry.

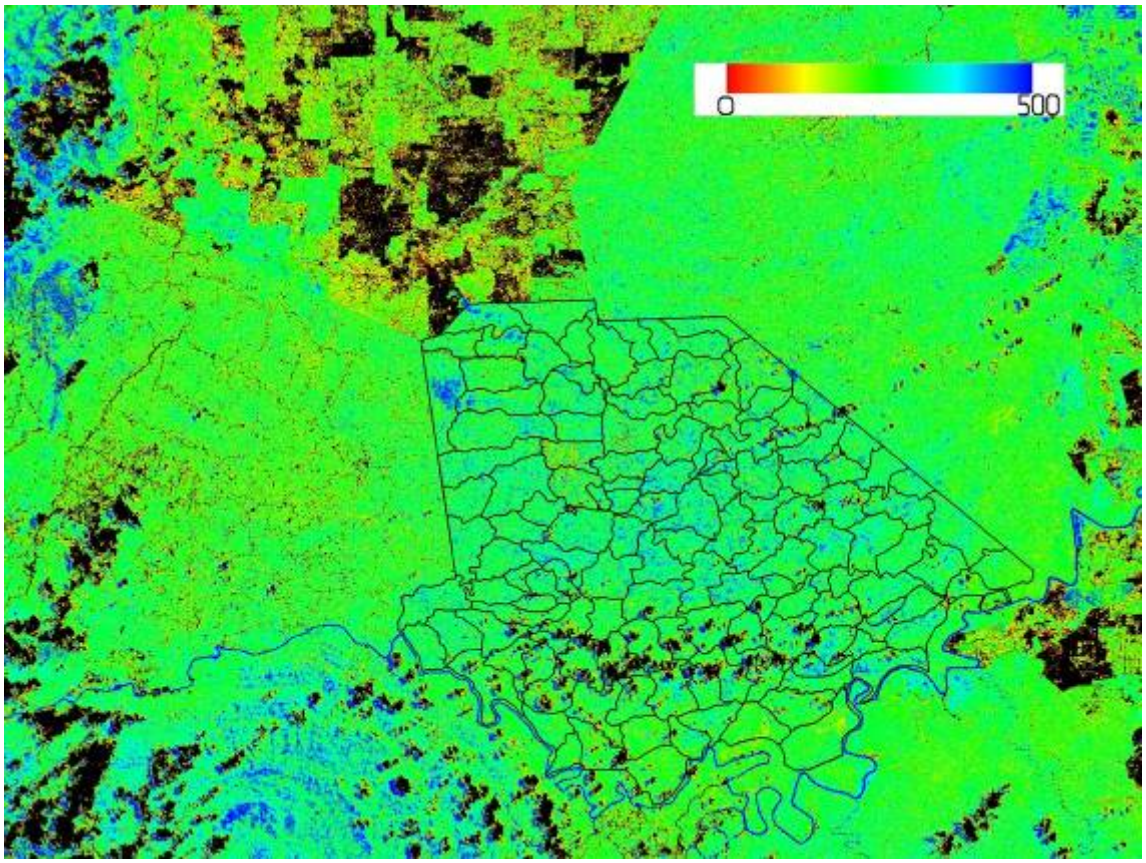
Deramakot Forest

Deramakot Forest Reserve is one of the Forest Management Units set aside for sustainable timber production in the state of Sabah, Malaysia. It is managed directly by the state government through the Sabah Forestry Department. Reduced-impact logging has been employed for harvesting timber with minimal impacts on the physical environment. Deramakot Forest Reserve was certified as “well managed” by the Forest Stewardship Council (FSC) in 1997 and, was the first natural forest reserve in Southeast Asia managed in accordance with sustainable forestry principles. It is a model of eco-friendly management for producing timber in natural tropical rain forests. Deramakot has an area of 55,083 ha and is divided into 135 compartments of varying sizes. Annual harvest is planned on a compartment basis. A strict protection area (4,000 ha in area) is set aside for biodiversity conservation within the reserve.

Location of Deramakot Forest Reserve with its internally divided compartments, the smallest unit of management.

Carbon stocking

Although reduced-impact logging is a method to reduce mechanical impacts, it has beneficial effects also to stock carbon in the forests. In Deramakot, researchers developed a method to estimate the amount of carbon stocked in the above-ground vegetation by using satellite data. The mean amount of carbon in above-ground vegetation was estimated to be 153±15 ton/ha in Deramakot where reduced-impact logging is being practiced, while it was 119±14 ton/ha in the adjacent forest which was not harvested by reduced-impact logging. The difference of 34 ton carbon per ha is considered as the beneficial effect that is added by reduced-impact logging. Reduced-impact logging could therefore bring a net addition of 1.87 million ton carbon for the entire area (55,083 ha) compared with less eco-friendly management.

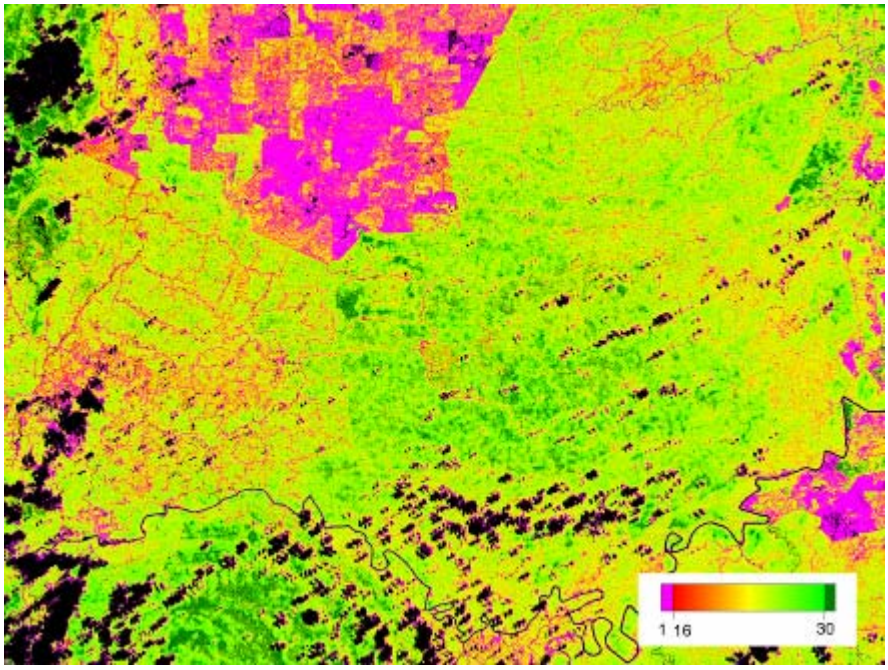


Map showing the amount of carbon in terms of the above-ground biomass in Deramakot Forest Reserve, the bounded area in the right (reduced-impact logged) and that of the adjacent reserve (conventionally harvested). The bluer the color is, the greater the amount of carbon is. Black crumbs are clouds (mostly lower left corner) that hamper the application of satellite analysis.

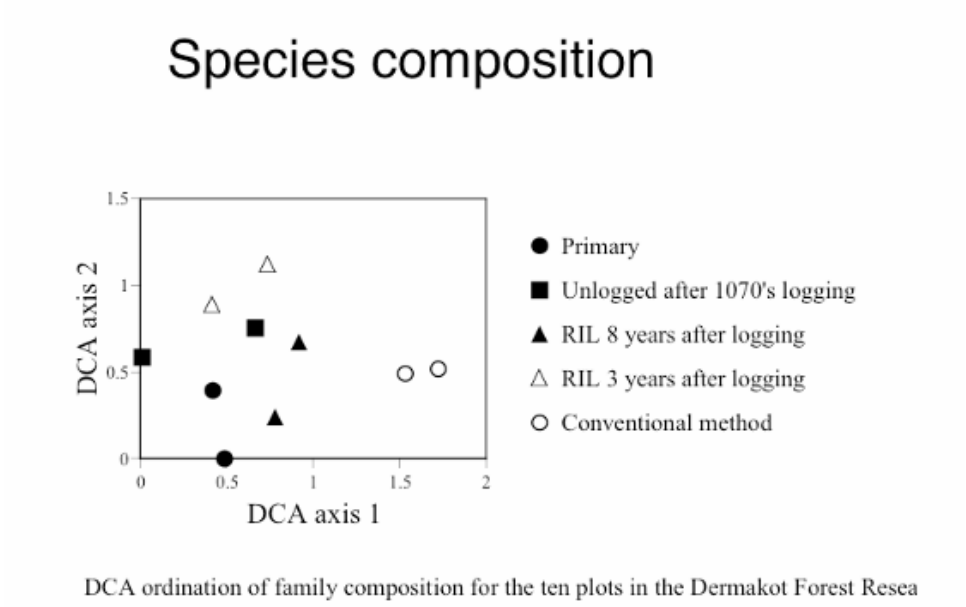
Biodiversity

Reduced-impact logging is beneficial to keep biodiversity nearly as a pristine natural forest. Researchers compared tree species, macro soil fauna, flying insects, fungi and large mammals between Deramakot (reduced-impact logged) and the adjacent forest (conventionally logged) and found that reduced-impact logging was effective in maintaining the assemblages of species (association). Effectiveness varies with organism groups and researchers are still working to better elucidate the relationships between biodiversity and sustainable forest management.

Tree species: The richness of species and families of canopy trees (per small plot basis) is significantly greater in Deramakot than in the conventionally-logged forest. The richness of species and families in Deramakot is nearly as high as that of the nearby pristine forest. Reduced-impact logging can maintain the richness and composition of canopy tree community at a level equivalent to the pristine forest.



Map showing the diversity of canopy trees in Deramakot Forest Reserve in the right (reduced-impact logged) and that of the adjacent reserve (conventionally harvested). The diversity is indicated by the number of tree families per 0.2ha, estimated on several assumptions using satellite data.



DCA ordination of family composition for the ten plots in the Dermakot Forest Resea

This diagram elucidates the relationships among several forest types that differ in the magnitude of logging impacts ranging from primary forests without logging to RIL (reduced-impact logged) forests to conventionally logged high-impact forests. The diagram indicates that four reduced-impact logged forests (solid and hollow triangles) are more closely located with the primary forests than to the conventionally-logged forests, suggesting that reduced-impact logging is effective in keeping tree species assemblage.

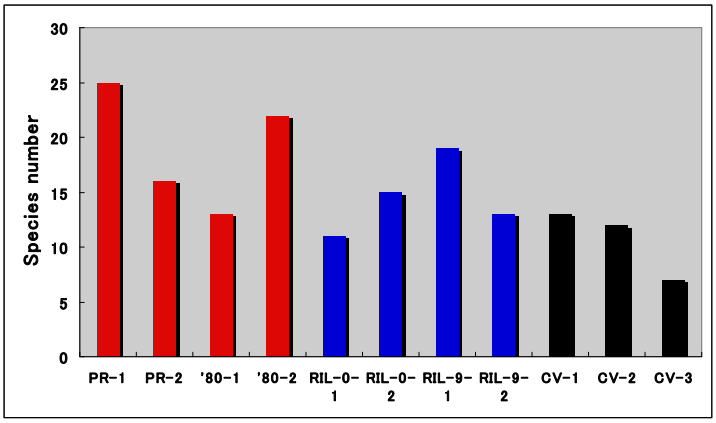
Soil animals: Soil animals consist of various organisms such as earthworms, termites, ants and insects found in litter and surface soil horizons. They include the important decomposers that function in nutrient cycling and sustain tree growth. Many soil animals are relatively not mobile compared with those living above the ground, and hence are more “representative” to indicate ecosystem naturalness. They are collected by a special tool called

"Turgren." After careful examination, researchers have found that the composition of soil animal community is reasonably well preserved by reduced-impact logging but not by the conventional logging although more work needs to better elucidate soil animals.

Various soil animals found in Deramakot (above), a Trugren apparatus in Deramakot (lower left) and the surface litter layer where the majority of soil animals inhabit (lower middle and right). Photos by Motohiro Hasegawa.

Pictures depicting three methods to collect ants on the ground. Hand sorting method (left), bait trap method (middle) and pitfall trap method (right). Photos by Tomohiro Yoshida.

Wood decaying fungi: Wood decaying fungi including bracket fungi and other wood inhabiting mushrooms are the most important decomposers of woody debris in forest ecosystems. Researchers established research plots in primary areas (PR), reduced-impact logging areas (RIL) and conventionally logged areas (CV), and compared the species number of wood decaying fungi recorded in each plot. In PR and RIL plots, 13-25 species and 11-19 were recorded respectively while only 7-13 species were listed in CV plots. Most species recorded in CV plots are those frequently seen in open areas such as *Earliella scabrosa*. On the other hand, researchers recorded some rare species such as *Elmerina holophaea* and *Microporellus grandiporus* in RIL plots. These species are more frequently seen in old growth forests in Southeast Asia.

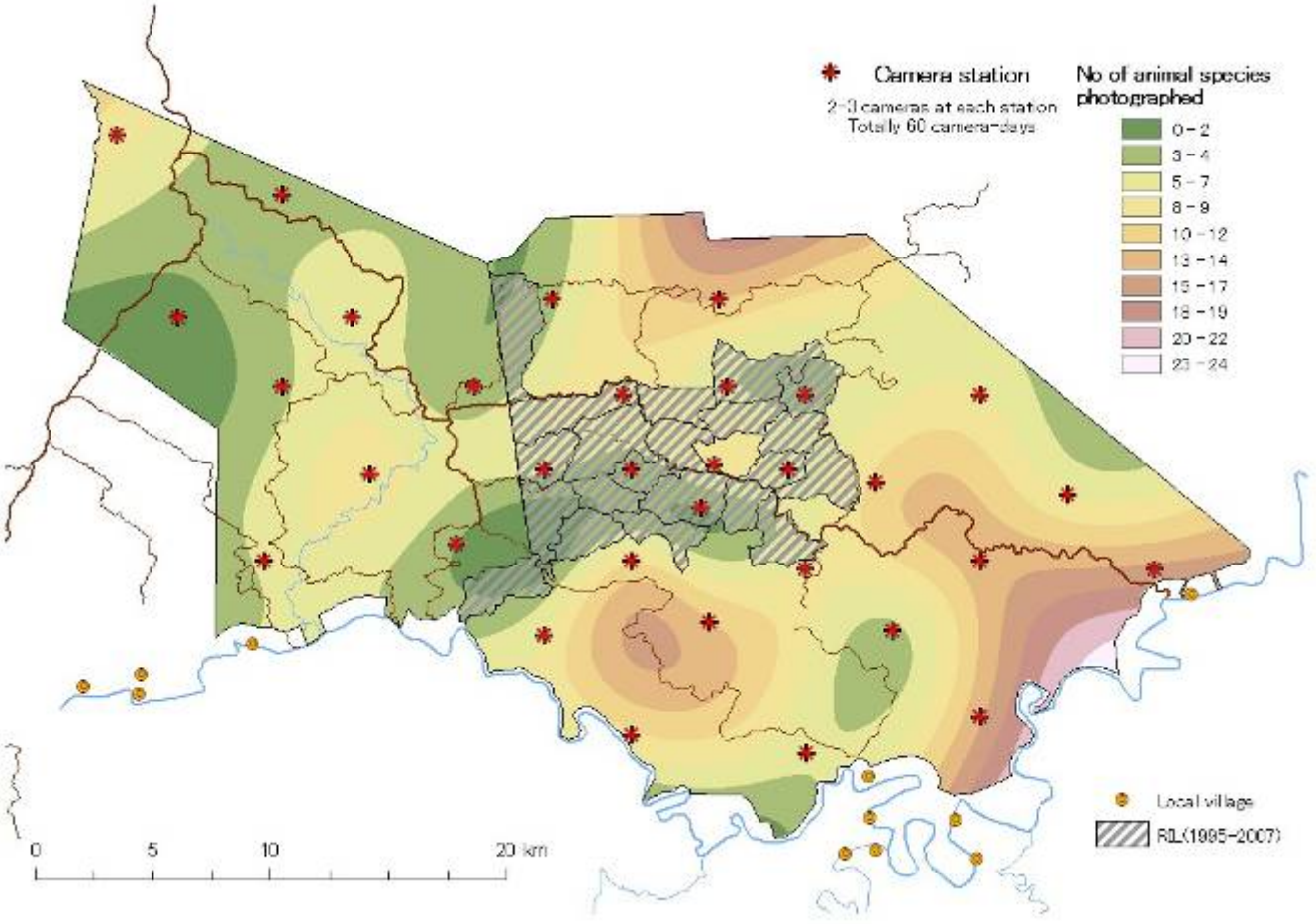


Species richness of wood decaying fungi in research plot. Red bars: species numbers recorded in primary forests (PR). Blue bars: species numbers recorded in reduced-impact forests (RIL). Black bars: species numbers recorded in conventionally-logged forests (CV).

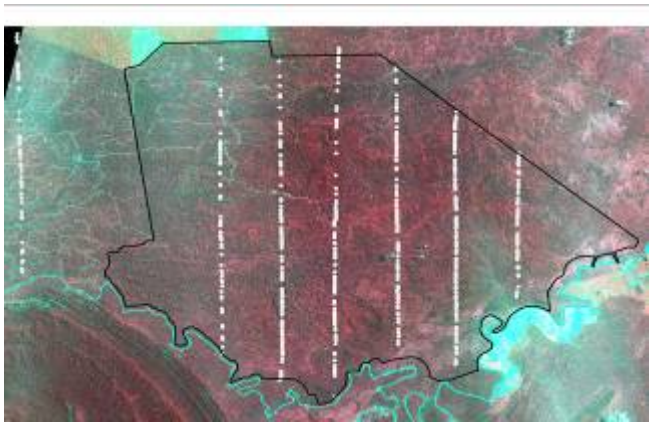
Earliella scabrosa (left), one of the most conspicuous species in conventionally-logged forests, is a common species frequently seen in open areas in the forests. *Microporellus grandiporus* (middle), recorded in a reduced-impact logged forest, is a rare species and grows from the basal area of huge standing trees. *Elmerina holophaea* (right), recorded in a reduced-impact logged forest, is a rare species usually seen on well decomposed logs in old growth forests. Photos by Tsutomu Hattori.

Middle to large mammals: Although surveys are still rigorously being conducted, results so far indicate that reduced-impact logging maintains the assemblage of mammals nearly intact. In the entire area of Deramakot, a set of three heat-sensor cameras are placed on the ground at a random point at about 5km intervals to monitor the species diversity and the abundances of middle and large mammals. Data obtained by those surveys are being converted to digital geographic information and their habitat preferences are mathematically modeled. Moreover, censuses of orangutan nests are regularly being conducted from the air using a helicopter. Six transect lines, along which a helicopter flies over and nests are counted, are located at regular intervals in Deramakot. The locations of orangutan nests are digitally recorded and are correlated with environmental factors to model the habitat preference of orangutans to help designate the high-priority conservation area.

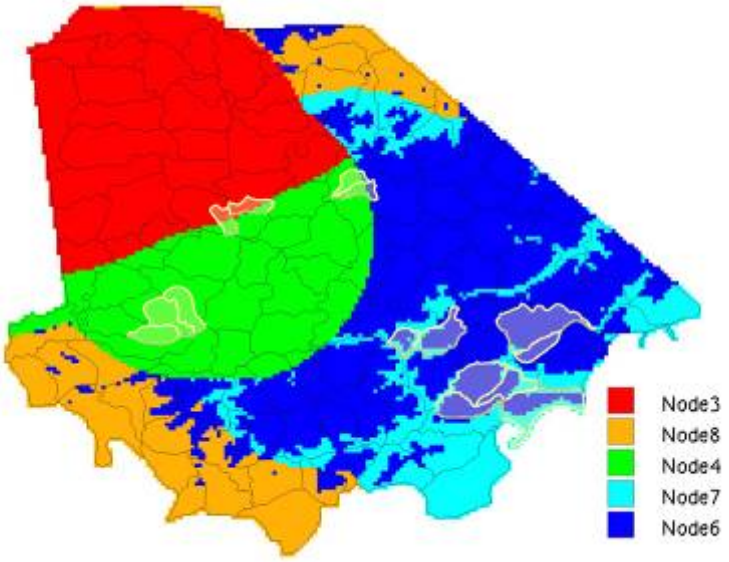
One of the unique features of Deramakot is the occurrence of salt licks in spite of its remote locality away from the ocean. Salt licks become a hotspot of wildlife diversity in Deramakot because salt is an essential element for mammals and tends to be short in tropical rain forests. Sabah Forestry Department pays a special attention to protect salt licks to conserve wildlife.



Estimated species diversity of middle and large mammals in Deramakot (right) and the adjacent conventionally-logged forest (left) using ground-installed sensor cameras. Richness of mammals is not homogeneous and appears to be rapidly recovering in sustainably managed Deramakot with reduced-impact logging.



Locations of observed nests indicated by white dots along the six transect lines for the helicopter census. Right photo shows a nest of orangutan in the canopy of a tree. Photo by Hisashi Matsubayashi.



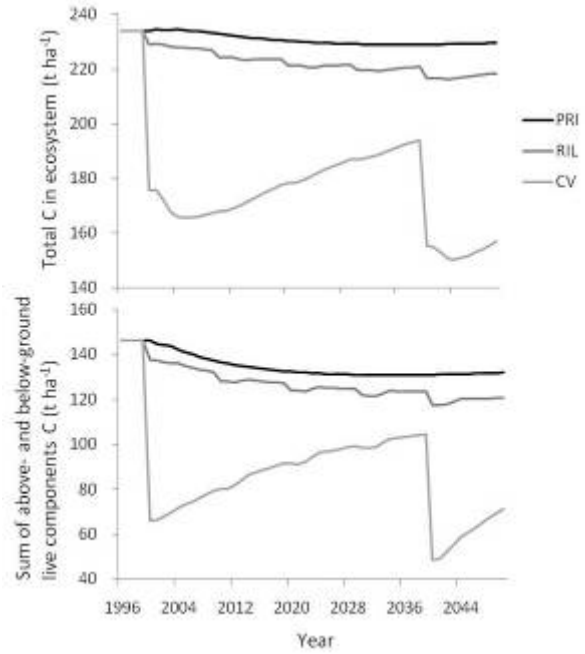
Map showing the suitable habitats for orangutans in Deramakot. The dark-blue areas are most suitable habits.

Various animals that inhabit the forests of Deramakot. Photos by Hisashi Matsubayashi.

Climate change and reduced-impact logging

Global warming can threaten every ecosystem on earth and tropical rain forests are not an exception. Increasing temperature will affect biota and physical environments in a complex way. The abundance and the strength of biological interactions may change non-linearly in response to a liner temperature increase. Therefore, predicting the responses of biota, including tree species, to the future warming is challenging. In South East Asia, the magnitude of droughts is also expected to rise during global warming. Forestry management needs to be adaptive to the changing climate in the future. However, without a prediction how the future looks like, concrete adaptive

policies cannot be developed. Unfortunately, it is not readily possible to predict the changes in biota for the tropical rain forests of Deramakot, but the dynamics of carbon in a tropical rain forest can be predicted using an ecosystem model. Researchers developed the following simulation to predict the carbon dynamics in the production forests of Deramakot. Reduced-impact logging (RIL) can maintain the amount of carbon in the forest under a warmer and droughty condition whereas the amount of carbon in conventionally- logged forests (CV) will greatly oscillate in response to heavy logging and changing climate.



Left Photo: Researchers investigating the carbon sequestered in soils. Right diagrams: How a sustainably managed versus unmanaged forest looks like in the future? These diagrams were developed to answer the question. Because carbon is one of the most important elements in a forest, simulations were conducted to predict the dynamics of carbon in primary (PRI), reduced-impact logged (RIL) and conventionally logged (CV) forests under a warmer and droughty condition. Upper diagram indicates the total amount of carbon including soils, while the lower diagram indicates the carbon in plants only.

Suggestions

Scientific findings described in this leaflet may be still far from complete. However, many pieces of evidence indicate that reduced-impact logging is beneficial to conserve biodiversity and sequester carbon. It is a logging method benign to biota and environments if applied with strict compliance to management guidelines. Moreover, it is a management method that is adaptive to global warming. The high cost of timber production in reduced-impact logging needs to be compensated by the extra payment that each consumer is willing to add through the forest certification. In order to meet the expectation to conserve biodiversity, even greater prices must be added to the timbers produced from a certified forest to increase the area of sustainable management. Higher prices will become a further economic incentive for foresters to sustainably manage our tropical rain forests. Considering that biodiversity and carbon are the two ecosystem services of global importance that a tropical rain forest can provide, sustainable forest management is beneficial for global environments.

This is a contribution from the Japanese Research Team conducting a collaborative research project with Sabah Forestry Department with the grant of the Global Environment Research Fund (F-071) of the Ministry of the Environment, Japan. Following researchers contributed the results in this leaflet: Shin-ichiro Aiba, Motohiro Hasegawa, Tsutomu Hattori, Nobuo Imai, Satoshi Kita, Kanehiro Kitayama, Lee Ying Fah, Hisashi Matsubayashi, Etsuko Nakazono, Robert Ong, Hiromitsu Samejima, Tatsuyuki Seino, Masaaki Takyu, Jupiri Titin, Tomohiro Yoshida, Nobuhiko Wakamatsu, Peter Lagan, Chey Vun Khen, Anuar Mohammad, Noreen Majalap, Reuben Nilus, John Sugau & Arthur Chung. Text by Kanehiro Kitayama.