

## WS on Ecosystem function and conservation of tropical forests

Date: August 12<sup>th</sup> – 13<sup>th</sup>, 2008

Place: Boarding room, CGER, National Institute Of Environmental Studies, Tsukuba, Japan

August 12, 08

9:00-9:10	Opening remarks	T. OKUDA, Hiroshima University
9:10-9:20	Welcome remarks	DG or DDG of NIES

### Presentation

<b>Session -1</b>		
<b>Carbon stocks and change,</b>		
	<b>Time</b>	<b>Speaker</b>
1	9:20-9:40	Kosugi, Y., Tani, M., (Kyoto Univ)
2	9:40-10:00	Adachi, M. (NIEAS)
3	10:00-10:20	Niiyama, K. (FFPRI)
4	10:20-10:40	Saito, T., Yokouchi, Y. (NIES)
	10:40-11:00	<b>Coffee break</b>
<b>Session-2 Biodiversity, Forest Structure</b>		
5	11:00-11:20	Yoneda, T. (Kagoshima Univ.)
6	11:20-11:40	Yamada, T. (Hiroshima Univ.)
7	11:40-12:00	Suzuki, R. (Tokyo Metro Univ.)
	12:00-13:00	<b>Lunch break</b>
<b>Session-3 Landuse, Landuse change and management, local community</b>		
8	13:00-13:20	Mazlan, H. (Universiti Teknologi Malaysia)
9	13:20-13:40	Abe, K. (Research Institute for Humanity and Nature)
10	13:40-14:00	Okuda, T. (Hiroshima Univ.)
<b>Session-4: database and Institutional networking</b>		
11	14:00-14:20	Kobayashi, S. (Kyoto Univ)
12	14:20-14:40	Makmom, Abd. (Universiti Putra Malaysia)
13	14:40-15:00	Tabuchi, R. (Forestry and Forest Products Research Inst.)
	15:00-15:20	<b>Coffee break</b>
14	15:20-15:40	Supardi, N. (FRIM)
15	15:40-16:00	Yusof, S.M. (Forest Department, Negeri Sembilan and Malacca)
16	16:00-16:20	Mukai, H. (NIES)
17	16:20-16:40	<b>Closing remarks (FRIM)</b>
	16:40	<b>adjourned</b>

**Understanding the roles of tropical forest in climate change  
through the energy/H<sub>2</sub>O/CO<sub>2</sub> exchange processes  
- three years of canopy CO<sub>2</sub> exchange and spatial and temporal  
variation in soil respiration at Pasoh in Peninsular Malaysia -**

Abdul Rahim Nik (FRIM)  
Elizabeth Philip (FRIM)  
Siti Aisah Shamsuddin (FRIM)  
Mohd Md Sahat (FRIM)

Yoshiko Kosugi (Kyoto Univ.)  
Makoto Tani (Kyoto Univ.)  
Naoko Matsuo (Mie Univ.)  
Satoru Takanashi (FFPRI)  
Masayuki Itoh (NIAES)  
Ken'ichi Osaka (NIAES)  
Shinjiro Ohkubo (Kyoto Univ.)  
Naoto Yokoyama (Kyoto Univ.)  
Shoji Noguchi (FFPRI)  
Toshinori Okuda (Hiroshima Univ.)

The eddy covariance method was used to observe carbon dioxide flux ( $F_c$ ) for 3 years over an old-growth tropical rainforest at Pasoh in Peninsular Malaysia. The influence of soil temperature and water content on soil respiration rate, and its spatio-temporal variation, were also evaluated.

Soil respiration rate, temperature and water content were measured in a 50 × 50-m plot with a nested sampling design of varying grid size. The variation in soil respiration rate increased with plot size. Spatially, the soil respiration rate was low where soil water content was high. In contrast, temporally, the soil respiration rate was low when the soil was dry. During dry periods, the soil respiration rate was still lower in wetter areas. These results suggest that a physical factor such as the restriction of gas diffusivity in water-saturated soil is not the primary cause of the low soil respiration rates in wetter places, and that several physical, biological and chemical properties co-varying with soil water drive the bipolar spatial and temporal variation of soil respiration rate.

The comparison of  $F_c$ , NEE and soil respiration strongly suggests that nighttime CO<sub>2</sub> efflux was underestimated even when the CO<sub>2</sub> storage term is considered. The correction of  $F_c$  data for low  $u^*$  did not correct this underestimate, and it was strongly suggested that this forest was not a strong carbon sink, as raw  $F_c$  data, even with the  $u^*$  filtering, implied. Monthly average daytime diurnal changes in CO<sub>2</sub> exchange over the canopy were fairly constant from 2003 to 2005 despite fluctuations in soil moisture, solar radiation, air temperature and vapour pressure deficit between dry and wet periods. An obvious inhibition of canopy CO<sub>2</sub> exchange in the afternoon coupling with increases in VPD and air temperature was observed year-round irrespective of soil moisture. In the case of nighttime NEE, a slight increase in wet period was observed. Diurnal pattern of CO<sub>2</sub> exchange revealed that obvious restriction of canopy photosynthesis in the afternoon was occurred in this forest irrespective of soil moisture. Seasonal and annual patterns of CO<sub>2</sub> exchange reveals that one of the main causes which induce the difference in NEE pattern between Amazonian and Southeast Asian rainforests was not the difference in daytime photosynthesis but the difference in ecosystem respiration related with dry and rainy seasons. The decrease of CO<sub>2</sub> uptake (increase of NEE) at wet period was also observed at this site, but did not form an obvious seasonality such as in Amazonian forests.

**Abstract**

Soil respiration, CO<sub>2</sub> efflux from the soil surface, is an important process of the carbon (C) cycle in terrestrial ecosystems. Soil respiration includes many processes involving biotic factors, such as respiration from roots and microorganisms, along with abiotic factors and various temporal and spatial factors. Many researchers have examined soil respiration of various ecosystems. Recently, tropical forests have been converted into secondary forests or agricultural forests. This land use change might strongly affect the global C cycle; nevertheless, few data are available to reflect land use effects on dynamics of soil organic carbon (SOC) in Southeast Asia. Therefore, we established study sites at four different ecosystems (primary forest, secondary forest, oil palm plantation, and rubber plantation) in the Pasoh area of Malaysia in Southeast Asia. This study was designed to determine spatial and temporal variations (diurnal and seasonal change) of the soil respiration rate and to estimate the annual C efflux from soil and dynamics of SOC in different ecosystems.

Seasonal data suggest that the soil respiration rate is negatively correlated with soil water contents in the primary forest, secondary forest, and rubber plantation. The soil water content shows a negative correlation with the gaseous phase content. The gaseous phase content shows a positive correlation with soil respiration rate at all sites. The annual C efflux from soil was estimated as 16.9–19.2 t C ha<sup>-1</sup> in the primary forest, 17.5–18.5 t C ha<sup>-1</sup> in the secondary forest, 14.3–14.5 t C ha<sup>-1</sup> in the oil palm plantation, and 9.0–11.2 t C ha<sup>-1</sup> in the rubber plantation. Moreover, we estimated the annual SOC budgets using the three-box model. Results suggest that the biomass of dead roots, turnover time, and contribution of heterotrophic respiration are important factors for accurate evaluation of soil C dynamics and budgets.

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## Estimating root biomass based on the excavation of whole root system in a primary dipterocarp forest of Pasoh forest reserve in Peninsular Malaysia

Kaoru Niiyama (FFPRI), Takuya Kajimoto (FFPRI), Yojiro Matsuura (FFPRI), Tamon Yamashita (Shimane Univ.), Azizi Ripin (FRIM), Abd. Rahman Kassim (FRIM) and Nur Supardi Noor (FRIM),

**Abstract:** Root biomass is one of major components in a carbon cycling in forest ecosystems. However, it is difficult to excavate whole root system in large trees, and the underestimation of root biomass caused by destruction of roots during excavation has been reported repeatedly. In this study, we directly excavated whole roots of 122 trees ranging from 0.5 cm to 116 cm in stem diameter at a lowland dipterocarp forest in Peninsular Malaysia. First, an allometric equation to estimate coarse root mass (diameter >5 mm) from stem diameter was obtained based on the excavated root mass. Second, lost root mass during excavation was corrected by the measurement of broken root diameters. As a result, a desirable equation,  $M_R = 0.0262 D^{2.497}$  for estimating accurate individual root mass ( $M_R$ ) from stem diameter ( $D$ ), was obtained. Using this corrected equation, average belowground biomass in stand level was corrected from  $53.6 \pm 8.9 \text{ Mg ha}^{-1}$  to  $66.8 \pm 11.1 \text{ Mg ha}^{-1}$ . Average aboveground biomass was estimated as  $393.1 \pm 59 \text{ Mg ha}^{-1}$  by the existing allometric equations in the same forest. The ratio of belowground biomass to aboveground biomass was corrected from 0.14 to 0.17 by the lost root correction. On the other hand fine root mass (< 5 mm) was estimated by the pipe model theory that predicts area-preserved root branching. The pipe-model correction increased the ratio 0.14 to 0.16. The combination of individual based allometric equations between stem diameter and root mass, and the lost root corrections attains more accurate estimation of belowground biomass in primary dipterocarp forests in South east Asia.

## Methyl chloride emission from tropical rain forest in Malaysia

T. Saito and Y. Yokouchi (NIES)

Methyl chloride ( $\text{CH}_3\text{Cl}$ ) fluxes were investigated at leaf and forest-canopy scales in tropical forests in Malaysia. Screening of  $\text{CH}_3\text{Cl}$ -emitting species showed that 21% of 117 tree species were  $\text{CH}_3\text{Cl}$  emitters; the percentage was markedly higher for dipterocarps (66%) than non-dipterocarps (6%). The dipterocarp-derived  $\text{CH}_3\text{Cl}$  was characterized by high emissions (median:  $0.03 \mu\text{g g}^{-1} \text{h}^{-1}$ ) and low stable carbon isotope ratios (mean:  $-88.9 \pm 11.0\text{‰}$ ). Measurements of  $\text{CH}_3\text{Cl}$  above the canopy showed a slight decrease in the mixing ratios with increasing height. These values were used to estimate the canopy-scale flux of about  $14 \mu\text{g m}^{-2} \text{h}^{-1}$ , comparable to that extrapolated from the leaf-scale emissions. Using the canopy-scale flux, global  $\text{CH}_3\text{Cl}$  emission by tropical forests was estimated to be  $1.3 \text{ Tg yr}^{-1}$ , representing approximately 30% of the global emissions.

Abstract

Decay ratio of storm-generated CWD in the Pasoh Forest Reserve

Yoneda, T., H. Mizunaga, T. Okuda & W.R. Kadir

Decay ratios of storm-generated CWD were observed to evaluate temporal and spatial variances of NEP through gap-phase dynamics in a tropical rain forest. Average decay ratio of these CWD was estimated from decrease of their bulk density under the decay process. Observation was conducted at three years later after the storm occurring in September 2004. Decay ratio of snags showed hyperbolic relationships with their remained tree height, and was not significantly different with one of fallen logs. Root-up CWD also had large variances of decay ratios because of different damages in their root and stem systems among individuals. The average value was significantly lower than one of snags. These traits of decay ratios of storm-generated CWD were examined through the comparison with one of CWD without record of storm attacks. Mathematical model of NEP suggests that that flash of CO<sub>2</sub> release from CWD occurs at around 10 years later after the storm.

## Habitat association of trees in a 50-ha Malaysian rain forest plot

TOSHIHIRO YAMADA<sup>1</sup>, NUR SUPARDII MD NOOR<sup>2</sup>, TOSHINORI OKUDA<sup>1</sup>

<sup>1</sup>Graduate School of Integrated Arts and Sciences, Hiroshima University, 1-7-1 Higashi-Hiroshima, 739-8521, Japan.

<sup>2</sup>Forest Research Institute Malaysia, Kepong, 52109 Kuala Lumpur, Malaysia.

### Abstract

We divided a 50-ha forest dynamic project plot in the Pasoh forest reserve, Malaysia into 5000, 10 m × 10 m quadrates and assigned each quadrate to one of three soil type habitats base on parent materials and drainage: well drained hilly parts (soil type 1), moderately drained flat lands (soil type 2) and poorly drained riverine (soil type 3). Then species association with the soil type habitats was examined. Chi-square goodness-of-fit test and torus-translation test resulted in 91% and 60%, respectively, of 492 species studied that had significantly either positively or negatively associated with at least one of the three soil type habitats. Density difference of a species among the three soil type habitats provoked difference in the species's relative importance among the habitats. For example, the most abundant species in habitat on the soil type 2 (*Anaxagorea javanica* Blume) was no longer the most abundant species in the other habitats and was the 52<sup>nd</sup> and second most abundance species in the habitats on soil type 1 and 3, respectively. These results suggest that habitat-species association play an important role in placing trees in the 50 ha plot and in deciding local floristic composition of the Pasoh forest.

Key-wards: edaphic specialization, environmental heterogeneity, habitat preference, niche differentiation, torus-translation test, tropical rain forest

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**Relationship between growth strategy and spatial pattern of 11 dipterocarp species in a 50-ha plot at the Pasoh Forest Reserve**

Ryo O. Suzuki, Shinya Numata, Toshinori Okuda, Nur Supardi MD Noor, and Naoki Kachi

**Abstract**

Using the data from 11 dipterocarp species in the Pasoh 50-ha plot, we examined relationships between demographic rates and spatial patterns of three growth stages for these tree species. The mortality rates for the 11 species were positively correlated with RGRs. Seven species with the high growth and mortality rates exhibited peaks in spatial aggregation at small distances (< 100 m) during the youngest stage, but this aggregation disappeared at the later two growth stages. In contrast, the other four species with the low growth and mortality rates aggregated at large distances (> 200 m) throughout three growth stages in all but one species. Negative associations between different growth stages were observed only for high-mortality species, suggesting density-dependent mortality. High-mortality species showed habitat associations with topography and soil type, whereas most of low-mortality species exhibited no habitat association. A randomization procedure revealed that these habitat associations explained little of their spatial aggregation. Our results suggest that the growth strategy has a large effect on structuring the spatial distribution of tree species through mortality processes.



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# MAMMAL BIODIVERSITY INDEX OF PASOH FOREST RESERVE: REVISITED USING INTEGRATED REMOTE SENSING AND GIS TECHNIQUE

<sup>1\*</sup>Mazlan Hashim, <sup>1</sup>Mohd. Rizaludin Mahmud, <sup>2</sup>Toshinori Okuda, <sup>3</sup>Shinya Numata

<sup>1</sup>Faculty of Geoinformation Engineering & Sciences  
Universiti Teknologi Malaysia,  
81310 UTM, Skudai, Johor Bahru, Malaysia

<sup>2</sup>Integrated Graduate Studies for Art & Science,  
University of Hiroshima, Hiroshima, Japan

<sup>3</sup>Japan Science & Technology Agency  
Tokyo, Japan

**KEYWORDS:** Biodiversity Index, Mammals, Remote Sensing, and GIS.

## ABSTRACT

This article reports on the study of deriving mammal biodiversity index in Pasoh Forest Reserve using integrated remote sensing and GIS approach, revisiting the biodiversity information gathered from related studies completed in 2004. Emphasis of the study is to investigate on the applicability of biodiversity model based on input derived from satellite remotely sensed data and ancillary data with spatial modelling within GIS environment. Landsat TM data are used to derive forest biophysical parameters that represent mammal habitat environment. Main output of this study is mammal biodiversity model namely richness, diversity and evenness indices which are later used to estimate the mammal biodiversity of the study area. Up-scaled biodiversity mapping of larger forested area in Pasoh Forest Reserve is also carried out.

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\* Corresponding author

# NET PRIMARY PRODUCTIVITY OF TROPICAL RAIN FOREST ECOSYSTEM FROM MODIS SATELLITE DATA

Ab. Latif Ibrahim, Abd Wahid Rasib, Mazlan Hashim, A.P. Cracknell, and Mohd Azahari Faidi

Department of Remote Sensing  
Faculty of Geoinformation Science and Engineering  
University Teknologi Malaysia, 81310, Skudai, Johor, MALAYSIA

ablatif@utm.my

Toshinori Okuda  
Graduate School of Integrated Arts and Sciences  
Hiroshima University  
1-7-1, KAGAMIYAMA, HIROSHIMA, JAPAN

**KEY WORDS:** Local scale, mapping, Net Primary Productivity, MODIS, Tropical Rain Forest

## ABSTRACT

Satellite data from Moderate Resolution Imaging Radiometer (MODIS) is currently being used to extract global scale net primary productivity (NPP). This global scale MODIS NPP has been validated using on-ground flux tower measurements using the eddy covariance method have been used to validate the global MODIS NPP at a number of test sites. Nevertheless, in anticipation of local scale NPP, MODIS satellite data is inadequately attempted to map NPP at plot size particularly in tropical rain forest region. This is due to the low spatial resolution (250m to 1000m) of MODIS satellite data and the variability of NPP with locations. Thus, in this study, MODIS satellite data is used to map local scale NPP for Pasoh Forest Reserve in Malaysia. Micrometeorological approach based on Monteith's equation is used to map NPP from MODIS satellite data for three years (2004, 2005 and 2006). The result shows that the pattern of NPP concentration is slightly decrease from 2004 to 2006. NPP estimated using MODIS satellite data for Pasoh Forest Reserve are in the range from 412.29 to 710.36  $\text{gCm}^2\text{y}^{-1}$ , 392.16 to 684.96  $\text{gCm}^2\text{y}^{-1}$  and 411.19 to 631.65  $\text{gCm}^2\text{y}^{-1}$  for year 2004, 2005 and 2006, respectively. These indicate that MODIS satellite data is appropriate to map local scale NPP of tropical rain forest.

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## The Design and Building of Spectral Library of Selected Timber Species in Pasoh Forest Reserve

<sup>1</sup>Alvin Lau Ming Shin, <sup>1\*</sup>Mazlan Hashim, <sup>2</sup>Toshinori Okuda, <sup>3</sup>Shinya Numata

<sup>1</sup>Faculty of Geoinformation Engineering & Sciences  
Universiti Teknologi Malaysia,  
81310 UTM, Skudai, Johor Bahru, Malaysia

<sup>2</sup>Integrated Graduate Studies for Art & Science,  
University of Hiroshima, Hiroshima, Japan

<sup>3</sup>Japan Science & Technology Agency  
Tokyo, Japan

### Abstract

This paper reports the design and building of a spectral library of a selected tropical rainforest species in Pasoh Forest Reserve. Several approaches to building the vegetation spectral library have been discussed. Spectral analysis were performed to the 37 vegetation species spectra and found that the vegetation spectra are very sensitive to environmental parameters such as leaf condition, vigorous and other physiological and biochemical parameters. The separability analyses of each tree species in built spectral library was also conducted using three-best combination of narrow spectral window of 515.9 nm, 672nm, 721.6nm and 838.2nm of all 512 bands generated. The creation of a spectral library is crucial and varies on applications and the accuracy of the processing is much depends on the feature extraction techniques of hyperspectral data used.

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\* Corresponding author

# Landuse change and its impacts on the ecosystem services of the lowland tropical landscape in a peninsular Malaysia – need of ecosystem approach for the landuse management

Toshinori Okuda<sup>1)4)</sup>, Shinya Numata<sup>1)5)</sup>, Kenneth Parker<sup>1)6)</sup>, Zulkifli Yusop<sup>2)</sup>, Mazlan Hashim<sup>2)</sup>, Ab.Latif Ibrahim<sup>2)</sup>, Alvin Lau Meng Shin<sup>2)</sup>, Naoki, Tagashira<sup>3)</sup>, Masatoshi Chiba<sup>3)</sup>, Kennichi Abe<sup>7)</sup>, Daisuke Naito<sup>8)</sup>

- 1) National Institute for Environmental Studies, Tsukuba, Japan
- 2) Universiti Teknologi Malaysia, Johor Bahru, Malaysia
- 3) CTI Engineering Co. Ltd., Tokyo Japan
- 4) Present Address: Graduate School, Hiroshima University, Higashi-Hiroshima, Japan
- 5) Present Address: Center for Research and Development Strategy, Japan Science and Technology Agency, Tokyo, Japan
- 6) Bird/Land Ecosystem Management, British Columbia, Canada.
- 7) Research Institute for Humanity and Nature
- 8) Graduate School, Kyoto University

## Abstract

With the aim of providing new and strategic environmental assessment tools to view the current state of degradation of forests and to forecast future environmental threats to forests from landscape changes, we have focused our efforts on a pilot study site (about 60 x 60 km) in Peninsular Malaysia and gathered available information on ecosystem services and established database by analyzing the inter-linkage between these ecosystem services and values.

Within the pilot study site, forest land was reduced by 50% from 1971 to late 1996. At the same time, the area of oil palm plantations tripled and rubber plantations nearly doubled. Much of the remaining forest has been logged to various extents so as to yield a different structure from the original climax forest. For example, the number of mammals recorded previously for core area of the site (Pasoh Forest Reserve and its vicinities) was reduced from 111 to 68 species. Elephants were extirpated from the core area. There are no scientific evidence so far that tigers still inhabit there. Carbon stock was reduced by 38% in total area of the pilot site during the period of 25 years. We also surveyed the effects of logging and landuse changes (from 1995 to 2003) upon soil erosion and found that total estimated soil loss from a watershed within the area was 7.15 mil t/yr (or 35.9 t/ha/yr). The highest rate of soil loss was obtained for non-tree sundry cultivation (477 t/ha/yr) and the least for undisturbed forest (12.1 t/ha/yr). Annual loss of ecosystem service value attributed mainly to the soil losses above was approximately 8.1 mil US\$.

We also developed a risk assessment tool that can provide baseline information for costs (environmental risks) and benefits of different landuse changes (e.g. logging, forest clearing for plantation development, etc.). This served to optimize ecosystem service values and goods, and will eventually contribute to the making of hazard maps and ecosystem service maps at the national level.

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**Japanese contributions to the sustainable management of tropical forests in  
Malaysia and Indonesia**

Shigeo Kobayashi  
Graduate School of Asian and African Area Studies,  
Kyoto University

**Abstract:** I have tried to summarize Japanese contributions to the sustainable forest management in South-east Asia, especially in Malaysia and Indonesia. In initial stage of Japanese contribution, there were two main projects such as International Biological Program (IBP, main subject is Productivity of Terrestrial Communities) started at 1965 to 1973 in Pasoh, Malaysia and JICA Pantabangan Forestry Development Project at 1975 in Pantabangan, Philippine. Following these projects, JIRCAS have set the research project titled the Eco-Physiological Study of Dipterocarpaceae collaborated with FRIM in 1971 in Malaysia and JICA started the Project of Forestry Resource Survey at 1976 in Pukarongan, Java, Indonesia. There are many Japanese contributions to Malaysia and Indonesia, but main theme is considered as the sustainable tropical forest management which includes different contributors, approach, subjects and methods. I have analyzed these contributions through contributors who are classified into four categories such as (1) Government, (2) Universities and Institutions, (3) Enterprises and (4) NGO and discussed the situation of each contribution. I have also discussed on some difficulties, directions of research, collaboration for the sustainable tropical forest management in South-east Asia.

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## Universiti Putra Malaysia Involvement in NIES-UPM-FRIM Collaboration

Ahmad Makmom Abdullah

Department of Environmental Science, Faculty of Environment Studies  
Universiti Putra Malaysia, 43400 UPM Serdang  
Tel. No.: 03-89466734  
Fax. No.: 03-89467463

### Abstract

Universiti Putra Malaysia (UPM) participated in the preparatory phase of the determining indicators for sustainable management of tropical forest during 1991-1995 and jointly to implement NIES-UPM-FRIM Collaboration activities on a regular basis. Earlier research activities were started by comparative study on composition, distribution patterns and population structure of tree species in disturbed and undisturbed forest has been conducted at Pasoh Forest Reserve (PFR) and UPM forest. Growth and physiological performances of selected tropical tree species have been studied utilizing canopy tower and forest gaps created by fallen trees. At the same time study on physiological responses of Durian (*Durio zibethinus* Murray) was jointly conducted with NIES, UPM and Nagoya University researchers starting in 1992. The research field continued with soil respiration in Air Hitam Puchong Forest Reserve using chemical and infrared CO<sub>2</sub> detection method. Similar activities were also conducted in PFR utilizing canopy tower in determining CO<sub>2</sub> profile in forest environment. A trial plot (0.9 ha) forest environment has been established in UPM campus in which 2500 seedlings of 25 tropical tree species have been planted. Ever since, the growth and physiological performances of selected species and microclimatic conditions have been monitored. A new diversity plot has been established in Sg. Lalang Forest Reserve where more than 1000 species with DBH more than 5 cm has been recorded, 128 species has been identified from 300 species found in the plot. The plot will be used for quantifying carbon in different pool namely litter, forest stand and soil. Significant outputs have been achieved in terms of publications, monitoring system, sharing technologies and capacity building from the collaboration. Strong networking has been established during the course of the research activities. However, the research collaboration was come to a stall for a period of time due to mis-communication, lack of funding and focus. Revision on the state-of the art of research needs, involvement of key researchers and distribution of funding might be the solutions to improve on the collaboration.

Keyword: Collaboration, Tropical Forest, Sustainable, Forest Environment.

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## Networking of forest science by FFPRI, Japan Bureau of International Partnership -Its role and function-

TABUCHI Ryuichi  
Bureau of International Partnership  
FFPRI, Japan

The Bureau of International Partnership (BIP) is a young section established in 2006 for assisting and accelerating the networking of forest research groups both intra and international.

### Background

1. *Disappearing world forest:* Forests are diminishing in alarmingly high rate.
2. *Valuable forests:* Forest is one of the fundamentals for human life security in many regions in the world in various manners.
3. *Several studies/activities on forests:* There are a lot of studies on resources, ecologies and socio-economical aspects including cultures.

However, we still have hazard in exchanging knowledge, experiences and information.

### Role

1. To promote exchanges of the knowledge, experiences and information among research groups in order to contribute to the conservation and sustainable use of forests in the world.
2. To promote information provision for global forest studies through the enhancement of partnership among related institutions

### Functions

1. To improve Intra- and International network of forest science.
2. To assist International activities as Japanese secretariat e.g. IUFRO, AFP (Asian Forest Partnership).
3. To support international research activities e.g. CIFOR, IUFRO and APAFRI (Asia Pacific Association of Forest Research Institute), constructing institute based international relationship (MOU, LOA etc.) and project formation.

The members of BIP are performing their own international studies in several aspects as active forest scientists, at the same time.

## Species Diversity and Abundance of Lianas at the Lowland Dipterocarp Forest of Pasoh

Nur Supardi Md. Noor & Nurfazliza KamarulBahrin

Ecology plots were established in the 50-ha plot of Pasoh in order to determine possible effect of soils on the species diversity of liana. The study also aimed to list down all species of liana above 1 cm in diameter. Preliminary analyses of data collected showed that there is no variation in the abundance of liana on three soil types (wet or dry alluvium and shale; mean of 670 ha<sup>-1</sup> (±14), but a momentous difference between the three with that on lateritic soils (526 ha<sup>-1</sup>).

Of the 1673 individuals recorded from a total area 2.56 ha, there were at least 144 species in 58 genus and 28 families of liana. The number of liana species on wet alluvium, dry alluvium and lateritic soils (each 0.64 ha) was at least 82, 83 and 72, respectively. The forest on shale derived soils had only 63 liana species. The most abundant liana species was *Byttneria maingayi* (Sterculiaceae; 236 ha<sup>-1</sup>), especially on shale and lateritic soils. *Combretum nigrescens* (Combretaceae; 144 ha<sup>-1</sup>) is the second most abundant and was found in large number on wet alluvium. Two legumes, *Caesalpinia parvifolia* (123 ha<sup>-1</sup>) and *Bauhinia bidentata* (73 ha<sup>-1</sup>) were also abundant.



## Forestry Sector in Negeri Sembilan

Shuhaimi Mohd. Yusof  
(Forest Department of Negeri Sembilan, Malaysia)

The state Forestry Department of Negeri Sembilan was established in 1900 is responsible for the administration and regulation of forest harvesting, forest revenue collection and the development of forest resources and planning and development of wood based industries in the state of Negeri Sembilan. The Permanent Forest Estate is 160,151 ha which is about 24 % of the total land area in Negeri Sembilan of which 105,227 ha is for timber production. The forest type ranges from coastal hill forest to Upper Dipterocarp Forest. There are 107 mills of various types namely sawmills and furniture mills. Negeri Sembilan Forestry Department practices sustainable forest management with annual coupe of 2460 ha through Selective Management System and adopts The Malaysian Criteria and Indicator (MC & I) for Forest Management Certification.

# Expanding NIES carbon cycle research network

Hitoshi Mukai,, Naishin Liang Nobuko Saigusa, Sasano yasuhiro (Center for Global Environmental Research, National Institute for Environmental Studies)

## 1. Air monitoring network

CO2 is one of the most important GHGs and its concentration has been increasing every year. CGER/NIES has a project on greenhouse gas observation and CO2 budget research. We are trying to expand observation network from Japan to Asian regions. At present, in southeastern Asian region there is little atmospheric observation site. CGER is conducting monitoring in this region using a commercial cargo ship. Because CO2 flux at El Nino year is considered to be large in this region due to a number of forest fires, establishment of observation sites there is important to monitor variation of CO2 flux in this region.

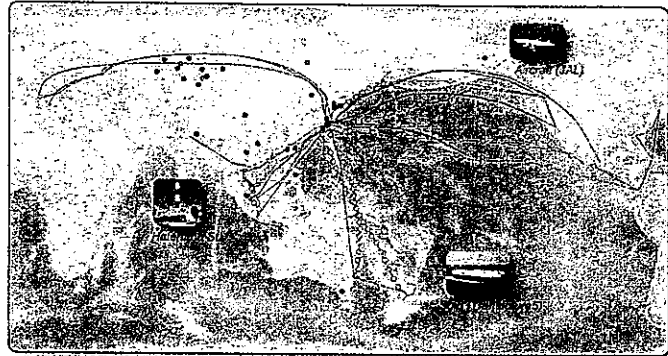


Fig.1 Observation site and routs for the Project

## 2. Research activities in Pasoh.

Soil respiration rate has been observed by Liang in Pasoh since 2004. Its rate was found to be over 30 t-C/ha/y on average, which is two times higher than the rate in Japanese forest.

Flask air samplings were tried last summer to see the level of GHGs in Pasoh forest. In the daytime, concentrations of CO2 and CH4 were found to be similar to background levels. To sample air periodically in such a field site, a handy automatic flask-sampling device was made recently. We would like to place this sampler at somewhere in southeastern Asia to monitor GHGs level for long period.



Manual flask sampling.

Package of sampling bottles.

Auto-sampling device