We are delighted to be launching our online Newsletter. The main purpose to issue this newsletter is to share research digests related to our nodal office with broader readers.

Functioning as one of four nodal offices worldwide, the Global Land Project (GLP) Sapporo Nodal Office works on the following main objectives: (1) to identify the causal processes of land system vulnerability, (2) to identify the quality of coping capacity linked to different perturbations, and (3) to assess the role of governance in bolstering land system resilience.

The International Project Office (IPO) in Brazil also issues its Newsletter as you may be aware. However, we, as a nodal office, would like to focus more on our office’s objectives and update activities conducted by our office, so that you can be more beneficial.

This issue highlights the outcome from a GLP-endorsed research project, ‘Wild fire and carbon management in peat-forest in Indonesia’. This issue also reports the Winter School held in Hokkaido in January.

GLP Sapporo Nodal Office Newsletter will continue to be available online on the website of our office. On behalf of the GLP Sapporo Nodal Office, I do hope that you enjoy reading this issue and welcome your manuscript and inputs related to the coverage of our nodal office.

Teiji Watanabe
Executive Director

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**Article**

**Wild fire and carbon management in peat-forest in Indonesia**

In Central Kalimantan Province, Indonesia, peatland drainage causes repeated peat fire, which, in turn, causes severe problems such as global warming and health damage by smoke hazard. The Global Land Project (GLP) endorsed project “Wild fire and carbon management in peat-forest in Indonesia” aims to construct the integrated carbon management system based on interdisciplinary knowledge. International collaborative researches are conducted to promote self-dependent and sustainable development for the developing country.

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**Photo 1** Peat fire. White smoke is the under-ground peat fire. Flame is the above-ground vegetation fire. (By Hiroshi Hayasaka, 2009).
What is “Tropical peatland”?

Indonesia has the largest area of the tropical peatland in the world and it accounts for 6% of the world’s. The Central Kalimantan province located in the Kalimantan Island in Indonesia used to be one of the very few places where the vast tropical peatland stretched out. The tropical peatland are distributed in low lying areas and along rivers, where forests are subject to flooding of 10 cm to several meters depth during the rainy season (Photo 2). Plant residues such as fallen leaves, branches, and trunks are soaked in the water, and the activities of the soil microorganisms are suppressed. As a result, the decomposition by microorganisms is delayed and

Why this project had selected for the GLP endorsed project?

One of the aims of the GLP is to understand and model how the interaction between human and environment (i.e., coupled human-environmental system) has affected the sustainability of terrestrial biosphere, and the interactions among various terrestrial systems. To accomplish this purpose, we need to understand how human actions affect natural processes of the terrestrial biosphere, and to determine the prime societal drivers and dynamics of these actions; there is an even greater need to evaluate the consequences of these changes (Kates et al., 2001; NRC, 1999) across different land systems. The GLP will play a critical role in improving the understanding of regional and global-scale land systems, as well as promoting strong scientific synergy across the global change programs. The GLP Sapporo Nodal Office, based in Hokkaido University, manages research on vulnerability, resilience, and sustainability of the land systems. The vulnerability of coupled human-environment system is a major focused of sustainability research. Vulnerability results not only from exposure to biophysical and social perturbations, but also resides in the sensitivity and adaptive capacity of the system experiencing such stresses. Thus, overall goal is to improve the understanding of the causal processes of vulnerability, the quality of coping capacity linked to different perturbations, and the role of governance in bolstering resilience.

Fifty one projects are endorsed by the GLP at present. In this article, we introduce one of the GLP endorsed projects, “Wild fire and carbon management in peat-forest in Indonesia” funded by SATREPS (Science and Technology Research Partnership for Sustainable Development, Project leader: Prof. Mitsuru Osaki, Hokkaido University). In Central Kalimantan Province, Indonesia, repeated peat fire, which results from drainage of peatlands, is causing severe problems such as global warming and health damage by smoke hazard. The project’s aims are 1) estimation of carbon stock in peat soil, 2) economical estimation of peatlands affected by land use and climate change, 3) development of the strategy to reduce the carbon emission from peatlands and making recommendation for institutional design of REDD-plus (Reducing Emissions from Deforestation and Degradation) in peatland ecosystems. The project will determine the ongoing modification of natural ecosystems by human activities, reveal the factors, structures and traits of various issues that were caused by the modification. Through the project, we will evaluate the vulnerability of land systems and the causal process of vulnerability. Furthermore, the project collaborates with local peoples as well as local researchers to prevent the forest/peat fires and to improve welfare of local societies.

Therefore, the results of the project would answer the questions proposed by the GLP science plan such as “how do the atmospheric, biogeochemical and biophysical dimensions of global change affect ecosystem structure and function?”, and “how do the vulnerability and resilience of land systems to hazards and disturbances vary in response to changes in human–environment interactions?” (Ojima et al. 2005).
Plant residues accumulate as peat soil. Such tropical peat is called “woody peat”, and can be distinguished from the peat in high latitudes that is formed from herb debris due to low temperature and ample water. The organic matters in the soil is maintained as a peat in stable state, and tropical peatland store large amounts of carbon. Tropical peatland abound with many endemic species that adapted to its specific environment and have served as habitats of the endangered species (animals such as the orangutan and tree cat, and rare tree species such as Gonystylus bancanus and Meranti). Thus, tropical peatland are cradle of biodiversity (Photo 3).

“Cold combustion” and “Hot combustion”

However, the situation drastically changed because the mega-rice project that was designed to develop large-scale farmland by constructing drainage canals. The project started in 1977 and was planned to change the 100 million ha of peatland into a large-scale rice field by constructing drainage canals that run like meshes and dry the land by draining the groundwater in the peat layer (Figure 1, Photo 4). The project did not succeed because the peat is acid and containing detrimental components such as sulfur, and is not suitable for agriculture. Large area of peatland, which used to be rich in biodiversity, has been converted to degraded land. Furthermore, many other problems occurred. When the peatland are soaked in the water, decomposition of organic matters in the soil is suppressed by the anaerobic condition.

However, once the dehydration of the soil starts by drainage, the organic matters in the soil come into contact with oxygen and microorganisms become activated. As a result, the organic matters that have been stored in the peat over a long period of time are decomposed by the activated microorganisms in the soil, and large amounts of carbon dioxide will be emitted to the atmosphere. This process is called “cold combustion” (Osaki and Iwakuma, 2008). In addition, when dehydration in the soil continues, peat fires occur frequently in the dry season with hardly any rains due to the El Nino effect. Peat fires are different from forest fires because the peat itself burns. This phenomenon is called “hot combustion” (Photo 1). Due to cold and hot combustion, a vast amount of carbon dioxide is emitted. Every year Central Kalimantan alone...
emits as much carbon dioxide as the Japanese annual emission (Figure 2). Smoke hazard by peat fire (haze) becomes a big domestic and international issue including neighboring nations such as Malaysia or Singapore. Modification of peatland by human activity disrupted the natural ecosystem balance and caused negative feedback to human society. It illustrates the vulnerability of human-environmental system, the issues raised in the GLP Science Plan.

Figure 2 Carbon emission from Indonesia and the world (Indonesia’s greenhouse gas abatement cost curve, DNPI, 2010) (From project leaflet).

For establishment of integrated carbon management system

The one of the aims of this project is to quantify carbon stock and to establish the integrated carbon management system in peatland. The project would also contribute ultimately to the inhibition of global warming. The following four programs are implemented to understand peatland ecology accurately and to conduct the integrated carbon management (Figure 3).

Program 1. Fire Detection and Fire Protection

Peat fires burn not only above-ground vegetation but also under-ground peat soil. Thus, fire extinction is difficult once peat fire has occurred. When peat fire starts at the midterm of the peatlands, fire extinction will be very difficult because of limited access to the site and water shortage. Therefore, to prevent peat fire, fire prediction, detection and construction of fire extinction system are the most important issues. However, these systems are not well developed in Central Kalimantan. The program constructed a system to detect and simulate forest/peat fire by understanding vegetation and soil water contents with a technology of remote sensing, unmanned aerial vehicle (UAV), and geographic information systems (GIS) (Figure 4 and 5, Photo 5). Fire-fighting team network were facilitated to regulate forest/peat fire effectively. The information about forest/peat fire will be send as

Figure 3 Project frameworks (From project leaflet).
soon as possible by short mail service using cell phone. Water wells for fire extinction were built in the frequently burnt area. As a result, speedy fire extinction became possible.

**Program 2. Carbon Assessment**

Peat soil in peatland was a huge sink of carbon dioxide. However, carbon emission from terrestrial ecosystem to the air is increasing drastically due to human-induced reforestation, which became a global issue. The amount of greenhouse gas release from peat soil to the air is influenced by environmental disturbance, such as drainage of forest, logging, forest fire, changing rain fall by El Niño/La Niña (drought etc.). This program totally evaluated the carbon balances (absorption and emission) of tropical peatland ecosystems using CO₂ flux tower, observation balloon with observational instruments, satellite data, and airborne laser sensing (Figure 6, Hirano et al. 2012). The program found out that the amount of carbon dioxide emitted annually from the site of ex-mega rice project were 3% of annual emission of carbon dioxide in entire Japan based on 1990 (Figure 6, Hirano et al. 2012).

**Program 3. Carbon Management**

It is not exaggerating to say that peatlands are regulated by water regime. So, it is necessary for the management of peatlands to understand present status of water regime, to keep high groundwater level, and to recover terrestrial vegetation. What is required is a multidisciplinary approach from hydrology, water quality, soil type, civil engineering, forestry, terrestrial ecology and limnology. In peatlands, the huge runoff of groundwater through drainage canal is the most critical factor for environmental degradation. Thus, we collected the information and data for regional water management, and established the watershed management model including development of water environmental rehabilitation method and validation of its impact. We also monitor the changes in vegetation of peat-swamp forest ecosystems (and heath ecosystems) in response to human land modification, in terms of plant-species composition, biomass, and net primary productivity. We verified effects to water qualities of open waters (lakes, rivers, and canals) and groundwater in the ex-mega rice project area. Concentrations of total organic carbon and humic substances were monitored to assess the loss of carbon from the peatlands (Figure 7).

We selected *Shorea balangeran*, which is local and useful species in peatland, for forest rehabilitation. We are developing the seed sampling and storage method and seedling nursing technique of the species. We also researched suitable habitats for reforestation and growth rate (carbon assimilation). In addition, we
also clarified characteristics of forests/peat fires at the ex-mega rice project area and the methods to manage the fires, and developed effective prevention methods for local peoples.

Program 4. Integrated Peat Management

The dynamics of peat carbon depends heavily on soil water contents. Under the condition that the soil is filled with plenty of water, the soil decomposition is suppressed. However, once, the canal is constructed and peat water was drained, soil decomposition will be started. As a result, a huge amount of carbon dioxide will be released from peatlands both aerobic microbial decomposition and by peat fire during dry season. Therefore, we constructed the integrated carbon flux estimation model which was based on the relationships between water, fire damage, microorganism decomposition, vegetation, and reforestation.

Based on the model, we involved in the designing of institutional arrangements of REDD-plus and proposed it to the Indonesian government. Furthermore, we developed the integrated MRV (Measuring, Reporting, Verification) system under the collaboration with the Indonesian government. This is “simple”, “frequently measurable”, and “economical” system, which enable the Indonesian government to operate independently (Figure 8). We suggested the new system which is based on free satellite image data (MODIS and LANDSAT) and inexpensive data (ASTER) with environmental measurement by UAV. We exchange opinion and made international network with Indonesian governmental officers, international donors, NGOs, NPOs for establishment of MRV system.

**Contribution to “invisible outcomes”**

SATREPS is a Japanese government program that prompts international joint research targeting global issues. This program is made by collaboration between two Japanese government agencies: the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA). To support independent and sustainable development of developing countries, SATREPS conducts an international collaborative research for 1) international cooperation: enhancing international cooperation in science and technology between Japan and developing countries; 2) addressing global issues and advancing science: developing and applying new technology for the resolution of global issues and acquiring new knowledge that can lead to advancing the level of science and technology; 3) capacity development: boosting self-reliant research and capacity development in developing countries through international joint research, constructing sustainable research systems that can contribute to resolving issues, coordinating networking between researchers, and training future human resources in developing countries and Japan. Therefore, international contributions to “invisible outcomes” as well as scientific research output, is important. “Invisible outcomes” of our project are 1) capacity development as a collaboration with governmental institution of Japan and Indonesia, universities, private companies, and other projects, and formulation of Trans Kalimantan University Network (combination organization of five universities in Kalimantan), 2) public relations of our project and human resource development by study tours, environmental education for local societies, and lecture in local
universities (Photo 6), 3) development of new technology and acquisition of patent such as LCTF (liquid crystal tunable filter system), new type dendrometer, larger distance meter for peat subsidence, 4) provision of measurement data for construction of REDD-plus and MRV system in Indonesia, and construction of carbon model.

We introduce one of our “invisible outcomes”. We constructed “Trans Kalimantan University Network”, which is university network of five universities in Kalimantan Island. The network is for research and educational activities for suppression of carbon emission in Kalimantan Island. The meeting for construction of network was held in January and March, 2012 organized by Hokkaido University. The five universities from Kalimantan Island were Tanjungpura University, Palangka Raya University, Lambung Mangkurat University, Mulawarman University and Borneo University. In Trans Kalimantan University Network Meeting, we discussed 1) maintenance of communication and cooperative framework, 2) strengthen ties with local and international research institutes, 3) information exchange about research results, 4) development of training system for human resource cultivation, 5) development of new ideas, and 6) policy making based on scientific understandings. We consider to transition from “Trans Kalimantan University Network” to “Kalimantan University Consortium” toward stronger substantive cooperation.

We also established “Japan Peatland Society (JPS)” in October, 2013 under the collaboration with “The Foundation of Science, Engineering and Agriculture” which is made up by Hokkaido and Kyoto Universities. The objectives of JPS are to continue our activities and to give positive impacts on the world even after this project has been finished. JPS became a member of International Peat Society (IPS). We will continue not only the researches to evaluate peatland ecosystems, but also researches to develop techniques for preservation, management and conservation in future. At the same time, we will develop social and economic frameworks for In Indonesia, peat fire occurs every year in dry season. Degraded lands, once used to be extensive peat swamp forests, are expanding. We think that our project has successively assessed the phenomena which are occurring at peat swamp forests in tropical regions. At the same time, we collaborated not only with local researchers, but also with local peoples to suppress the peat fires. We also made a small, but important step toward better life of local societies (Photo 7).

Importance of contribution to uplift of local society’s life

The GLP science plan (Ojima et al. 2005) states that “GLP success will depend on the extent to which the project contributes to the broader effort to develop an improved and more balanced strategy to deal with the environment in a sustainable manner”. To contribute substantively in this regard, the research undertaken in GLP must be policy-relevant. This does not mean solely undertaking applied research, nor only research dictated by politics; but it does mean that a significant portion of the research should be directed towards responding to the issues facing society (Clark et al., 2004). This implies a shift of emphasis from question-driven research to solution-driven policy support and testing. Research is still required to answer questions, but the choice of questions to answer is strategic, giving priority to questions that need to be answered to make scientific results policy-relevant.” The GLP endorsed project “Wild fire and carbon management in peat-forest in Indonesia” contributes considerably to peat management policy in Indonesia, which fits the GLP science plan.
Key publications from the research project


Reference Cited


Event Report

GLP International Winter School

International Winter School 2013 “Changing land systems: Training course of ecological monitoring, advanced modeling and integration” was held at Hokkaido University during January 8-10th, 2014. Participants included 26 undergraduate, master and PhD students (15 from Hokkaido University; 2 from Rakuno Gakuen University; 2 from Chinese Academy of Sciences (China); 2 from National Taiwan University (Taiwan); 4 from National Dong Hwa University (Taiwan); 1 from National University of Mongolia (Mongolia)) with 12 academic staffs (3 from National Dong Hwa University; 1 from Rakuno Gakuen University; 8 from Hokkaido University).

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This intensive three-day course focused on environmental and social issues caused by changes in land systems. The goal of this winter school was to obtain scientific knowledge and learn various methods to solve these issues, to find their own research questions, and to extend their ability needed for discussion through lectures, work sessions, and excursions. This course was organized by GLP Sapporo Nodal Office.

On the first day, students learned various theories, modelling, empirical and experimental studies related to biodiversity, ecosystem functions, and biogeochemical cycling, and their responses to climate change and natural/anthropogenic disturbances. Students also presented self-introduction about their research backgrounds and interests.

On the second day, they visited Tomakomai Experimental Forest (TOEF) of Field Science Center for Northern Biosphere, Hokkaido University, a core-site of Japan Long-Term Ecological Research Network (JaLTER). Although it was very cold, students were excited to experience snowy winter forest. They were introduced to the facilities and researches of TOEF. They learned the methods of identifying tree species and measuring biomass stock, river water quality and quantity. They observed frozen soil in deciduous forest and evergreen forest. They saw wildlife and tree specimen and woody crafts at the Forest Museum.

On the third day, students learned techniques, tools, and resources to detect and evaluate changes in land systems such as remote sensing by micro-satellites, ecosystem service evaluation by InVEST model, web-based databases of ecological parameters, and whole-landscape trail of research forest. Methods to study the environmental issues (land degradation, endangered wildlife, deforestation etc.) caused by human society (land use, transhumance, agriculture, poverty) and frameworks to sustainable socio-ecological system such as Satoyama Initiative were also presented in the lecture. Research projects and networks such as “GLP”, “LTER”, and “Future Earth” were also introduced as “good practice” of international research activities.

After the lectures, there were group discussion and presentation by students to identify the most important research topics for future research on “Changing Land System”. The key topics of the five break-out group were plant dynamics, soil nutrient, water cycle, sustainable development, and science-people communication, respectively.

Overall, participants were very active to learn and interactive with the lecturers and each other. Because students had diverse backgrounds, we think that this winter school had provided a good opportunity to discuss and think interdisciplinary.

Next winter school are planned to be held in January 2015 at Hokkaido University. Details will be announced through the web site of the GLP Sapporo Nodal Office (http://www.glp.hokudai.ac.jp/GLP/).

This course was conducted as “Sustainability Science VII” of HUSTEP and common graduate course of Hokkaido University. It was financially supported through the Federal Ministry for Education and Research (BMBF) as part of the research project ‘GLP-Sapporo’ (German Long-Term Ecological Research Project).
Three Asian GLP Nodal Offices (Sapporo, Taipei, Beijing) will organize a session “Progress of Land Change Sciences in Asia” in GLP Open Science Meeting held in Berlin, Germany from 19th—21st, March, 2014.

Asia has been experiencing rapid and drastic changes in land systems by the rapid increase of both the economic growth in this region and globalization. The vast changes of land-use and land-cover in Asia will impact on the bundles of ecosystem goods, benefits and servicers in various temporal and spatial scales. Thus, the understanding of the Asian land system in the view points of the coupled human and environment systems is critically important to develop the sustainable options not only for Asia, but also for the other regions and global scales. The land change sciences in Asia will provide general perspectives as well as uniqueness of localities including natural environments, and social and cultural characteristics. Three GLP nodal offices in Asia conducted land change studies under global themes.

In this session, each of three Asian GLP nodal offices in Beijing, Taiwan, and Sapporo will overview their progress and the future direction supported by the Ministry of Education, Culture, Sports, Science and Technology and the Environmental Research and Technology Development Fund (S-9-3) of the Ministry of the Environment, Japan.

Asia GLP Conference (Taiwan, September, 2014)

2014 Asia GLP Conference will be held in Taipei, Taiwan on September 24-26th, 2014 organized by GLP Taipei Nodal Office and co-organized by Sapporo Nodal Office. Conference theme is "Sustainable Land Use and Ecosystem Management". For details visit the conference website:
http://www.glp.taipei.ntu.edu.tw/
Asia_Conference_2014/index.html