Activity report

IGBP-MESCC/TEMA

Ecosystems and agro-forestry systems in Luzon Island, Philippines

Period: 12/15/97-1/9/98

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Introduction

So far, International Geosphere-Biosphere Program (IGBP) has been undertaken since 1992 to estimate the dynamics of terrestrial ecosystems in various regions, because the information of terrestrial ecosystem dynamics are almost vague in the present. Of IGBP sub-teams, IGBP-TEMA (global change impact on terrestrial ecosystems in monsoon Asia) has set up several long-term permanent plots in east Asia, i.e., Japan, China, Indonesia, and Malaysia. However, any data from Philippines, which is located in the central part of IGBP-TEMA target region, has not been obtained.

Human activities such as landuse are one of the key factors on global changes in tropical regions. Due to the changes of landuse, global changes (*sensu* GCTE), including CO_2 increase and climatic changes, have been proceeded. Therefore, not only ecological but also socio-economical studies should be conducted in Southeast Asia to understand the mechanisms of global changes.

Fortunately, the continuous monitoring of ecosystems at Los Baños, Luzon Island, Philippines, has been undertaken by UPLB (University of Philippines at Los Baños) and that of social/economical systems, including agro-forestry, has been carried out by ERDB (Ecosystems Research and Development Bureau of Philippines). In addition, most vegetation in Luzon Island receives human activities, such as logging, charcoal production, and settlement. Therefore, we attempted to observe various vegetation in Luzon Island and report here the feasibility of the integrated researches of ecosystems and agro-forestry systems.

Observation sites

All study sites are located around the capital city Manila, Luzon Island, Philippines (Republic of the Philippines). The total area of Philippines is 300,000 km^2 and land area is 298,170 km^2. The estimated population is 73,265,584 at July, 1995, and ethnic divisions are Christian Malay = 91.5%, Muslim Malay = 4%, Chinese = 1.5%, and others = 3%. Religions are Roman Catholic = 83%, Protestant = 9%, Muslim = 5%, Buddhist and others = 3%. Official languages are Pilipino (based on Tagalog) and English.

Our base site was mainly at Los Baños where UPLB and ERDB are situated, and we surveyed the following four sites:

Mt. Makiling Forest Reserve Area (MFR)
Mt. Pinatubo
Dipterocarps forests at Subic
Dipterocarps and mangrove forests at Quezon National Park

Results

MFR

First of all, we should emphasize the importance of Mt. Makiling Long Term Ecological Research Site. The plots was established mainly by Japan International Research Center for Agricultural Sciences (JIRCAS) in 1992 (leader was K. Osumi). Therefore, the crude data have been kept in UPLB and JIRCAS. The characteristics of this permanent plot are as follows: This site is located within MFR (14^o08'N, 121^o11'E, 400 m a.s.l.). The climate station was set up in 1996, and the annual rainfall was 2,397 mm and mean annual temperature was 26.5^{o}C. Topographical nature is diverse, i.e., the plots includes ridges, valleys, and steep to flat slopes. Forest type is categorized into tropical rain forest, although human impacts modified the species composition greatly.

Species density in the plot was 156 spp./ha. Diameters at breast height (DBH) on trees of which DBH > 5 cm were monitored at two year intervals. Thirty litter traps (1 m in diameter) were established within the plot in 1996, and were monitored monthly. The amount of litterfall was evaluated by species level. Seedling emergence and survival were also monitored using seven 4 m x 4 m plots. In the plot and its neighboring areas, *Dipterocarps* trees were less common, due mostly to selective logging. However, this area is worth that non-*Dipterocarps* trees formed a highly-diverse secondary tropical forest.

Not only ecological but also sociological studies have been conducted in MFR. In particular, socio-economical studies in MFR have been intensively conducted by ERDB to find out the coexistence systems between human and nature. There are conflicts between population increase and nature conservation, i.e., the settlements wish increasing farming areas, which mean nature deterioration. ERDB has tried to lead agro-forestry systems in MFR to conserve natural areas. They monitor attributes of the settlements such as family composition, agricultural types, income, education and tribes, and attempt to prevent further encroachment by the settlement in MFR, and enhance institutional capacity to enforce relevant policies, laws, and regulations. In addition, they set up buffer zones between forest and settlement areas, and have established Los Baños Agro-Forestry Experimental Station in the settlement area. Recently, ERDB and UPLB cooperate to save those data by geographical information systems (GIS). Taguiam has got the permission to use those data and will use for her socio-economical studies.

Mt. Pinatubo

Mt. Pinatubo (1759 m in altitude before the 1991 eruption) is located in the western part of Luzon Island. After almost 600 years of silence, Mt. Pinatubo suddenly became active on June 9, 1991, and a huge eruption took place on June 15, 1991. The areas within 20km from the mountain were covered with thick ashes and the smoke went up to the stratosphere. The eruption seriously damaged the environment in global scale. Soon after the 1991 eruption a super-typhoon stroke the area. More than 600 peoples were died mostly by mudflows derived from the typhoon. The accessibility to Mt. Pinatubo is restricted, due to the ground surface unstability and the delay of re-construction. The vegetation cover was still low, i.e., less than 1%, on the mudflows. The dominant plant taxa were herbaceous species represented by Poaceae, Onagraceae, Amaranthaceae and Asteraceae, although those plants are completely swept away by surface erosion in rainy seasons. Thus, the plant communities were categorized into the initial stages of grass communities.

On the foot of mountain, transplantation experiments were conducted by ERDB from 1991 to 1996. On their results, they suggested: 1) nitrogen-fixing plants grew rapidly, and 2) VAM and/or fertilization were effective to plant growth. In the experiment area, a nitrogen-fixing herbaceous plants *Mimosa invisa* developed herbaceous layer. The other herbaceous species dominated there were grasses *Saccharum pontaneum* and *Cynodon dactylon*.

Dipterocarps forests at Subic

In Luzon Island, there are a few natural Dipterocarps forests due mostly to human impacts. Near Los Baños, Dipterocarps-dominated forests were observed in Subic and Quezon, although both forests received intensive logging. Permission from the Luzon Metropolitan Office is required to observe Subic forest areas, and it takes about 2 weeks to

get the permission. Thus, the observation sites were limited in Subic. The observed forest was dominated by White Lauan (*Shorea contorta*) and bamboos. Crown height was 20-30 m. Huge trees were sparse, but the maximum DBH was ca 90 cm for *S. contorta*. A few Dipterocarps species were also established, although they did not reach the forest crown. The tree species diversity was low and the vegetation on the forest floor was very low, perhaps due to the dominance of bamboos.

Dipterocarps and mangrove forests at Quezon National Park

In Quezon National Park, we observed Dipterocarps and mangrove forests.

It is well-known that the area of mangrove vegetation is annually decreasing due mostly to human activities, e.g., prawn nursery, in south-east Asia. The mangrove forest is ca 2 km far from the seacoast. The water is brackish. There are 22 mangrove species recorded, and gen. *Rhizophora* and *Xylocarpus* were common. Tree heights were less than 15 m.

Dipterocarps forests are well-developed in Quezon National Park. The crown height was 40-50 m. The conditions of the forests seemed to be better than those in Subic, i.e., tree species richness is higher and the dominance of Dipterocarps is remarkable. Fern flora was also diverse.

Conclusion

To date, we have obtained various information the on response of terrestrial ecosystems to global change, mostly by using permanent plots. However, the information of vegetation dynamics in Philippines has been lacked. For IGBP-MESSC, the study sites are comparable to the other plots we have established.

The studies on IGPB-TEMA is highly feasible in Philippines, because we are able to obtain most stages of successional sere in Luzon Island. Primary succession and revegetation patterns could be monitored on Mt. Pinatubo, and secondary succession up to semi-climax forests could be made in MFR and Quezon. The intermediate stages are also obtained there. Furthermore, one of the characteristics of those ecosystems is that those received human impacts, more or less. Now, many organizations in Philippines seek to improve the relationships between human activities and nature reserves. Therefore, the primary data have been accumulated in various sites in Philippines. We could manipulate those data and establish the monitoring sites based on the data.

In conclusion, we recommend the immediate decision of serving and monitoring the nature reserve in Philippines for the deeper understanding of the heterogeneous nature of freshwater wetland ecosystems in south-east Asia.

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Schedule

12/15/97 (Mo)	Transfer from Chitise to Los Banos (via Hong Kong and Manila)
12/16 (Tu)	Visit Ecological Resources and Development Beureu (ERDB) and College of Forestry. Discuss about research plans with the staff members.
12/17 (We)	Survey a 4-ha plot in Mt. Makiling with A.C. Luna and C.G. Taguiam. Observe Mud Spring.
12/18 (Th)	Survey the farming systems in MFR with C.G. Taguium. Visit College of Forestry (mainly JIRCAS Office) for discussion of the survey.
12/19 (Fr)	Survey a 4-ha plot in Mt. Makiling with A.C. Luna. Visit Botanical Garden and Eagle Center in UPLB
12/20 (Sa)	Preparation
12/21 (Su)	Measure fern development patterns (number of veins, NV) in UPLB
12/22 (Mo)	Survey Magnetic Hill, which is an old settlement area, with C.G. Taguiam. Visit Philippine Council for Agriculture, Forestry & Natural Resources Research & Development to get information on agro-ecosystems.
12/23 (Tu)	Discuss about schedule changes with ACL and CGT. Preparation. NV
12/24 (We)	NV (Christmas Eve)
12/25 (Th)	Preparation (Christmas = National Holiday)
12/26 (Fr)	Collect information on Mt. Pinatubo and Quezon National Park at College of Forestry and JIRCA.
12/27 (Sa)	Visit International Rice Research Institute (IRRI). NV
12/28 (Su)	NV
12/29 (Mo)	Observe areas denuded by 1991 eruption on Mt. Pinatubo and Dipterocarps forest in Subic (12/30, Declaration Day = National Holiday) with A.C. Luna.
12/30 (Tu)	NV. Get permission to import specimens.
12/31 (We)	NV. Specimen preparation.
1/1/98 (Th)	Off (New Year Day = National Holiday)
1/2 (Sa)	Off.
1/3 (Su) –1/5 (Th)	NV
1/6 (We)	Observe Dipterocarps and mangrove forests at Quezon National Park
1/7 (Th)	Preparation.
1/8 (Fr)	Transport from Los Banos to Narita
1/9 (Sa)	Transport from Narita to Sapporo

Some notes

Number of veins (NV) was measure for a few fern species. Now, data analyses are proceeded. The results will be reported later.

Mud spring is the one of the hot springs in this region. Mt. Makiling is a dormant volcano. Therefore, those springs may have been established for long term on geological scale, and may be derived from deep magma deposits. The gas from Mud Spring contains of sulfur (actually, the sulfur odor is coming from the spring). However, the vegetation adjacent to Mud Spring seems to be damaged little by the gas. A few trees were ripened. It is one of the interesting for me to survey the effects of springs on vegetation patterns.