



日本学術振興会
Japan Society for the Promotion of Science

ABSTRACT

JSPS CORE-TO-CORE PROGRAM

*"International Symposium on Analysis of
Long-Term Monitoring Data in Asian Forests:
Towards Further Understanding of Environmental Changes
and Ecosystem Responses"*

27-28th November 2017

72nd Forestry Building, Faculty of Forestry,
Kasetsart University, Bangkok, Thailand

Jointly organized by
Faculty of Forestry, KU and Japan Society for The Promotion of Science

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JSPS Core-to-Core Program, 27-28th November 2017 Bangkok, THAILAND

About the Joint symposium

We are pleased to inform you that the Faculty of Forestry, Kasetsart University (KUFF) will host the Symposium on Analysis of long-term monitoring data in Asian forests: towards further understanding environmental changes and ecosystem responses, which will be held at Kasetsart University, Bangkok, Thailand on 27 Nov. – 1 Dec, 2017. The Symposium is jointly organized by the University of Tokyo Forests (UTF) under the Japan Society for the Promotion of Science (JSPS) Core-to-Core Program (B. Asia-Africa Science Platforms) “Developing a network of long-term research field stations to monitor environmental changes and ecosystem responses in Asian forests”. It includes one and a half-day symposium and post-symposium excursion to the long-term monitoring sites in climate, hydrology, and ecology.

Research Group Sessions

In the afternoon, three research group (RG) sessions are held in parallel. The general topics of the invited speakers in the research groups are as follows:

RG 1: Water & Climate

- Meteorological data management
- Hydrological data management
- Observation of discharge to determine H-Q equation
- Discussion and potential for long term monitoring station

RG 2: Ecosystem

- Toward the integration of long-term ecological research plots in JSPS-C2C network.
- Ambrosia beetles as new threats to forests in the world
- Insects as forest health indicators
- Forest dynamics based on Long Term Ecological Research (LTER)
- Discussion of potential monitoring and set up of LTER plots in Sabah

RG 3: Management

- Recovering forest carbon storage in hurricane-damaged sites through silviculture treatments
- Carbon offsetting credit projects
- Growth pattern of even-aged coniferous plantation in long-term experimental plots
- Above ground carbon stock estimation in agroforestry system using airborne LiDAR
- Does forest restoration lead to seedling recruitment?
- Understanding forest micro-environmental condition using airborne LiDAR

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in Asian Forests: Towards Further Understanding of
Environmental Changes and Ecosystem Responses
Venue: Faculty of Forestry, Kasetsart University, Thailand
27-28th November 2017**

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FOREWORD BY THE VICE PRESIDENT

On behalf of the Kasetsart University. I have to thank you for inviting me to join you today in this official opening ceremony for International Conference. It is a great pleasure and privilege for me to declare open the Conference on “Analysis of long-term monitoring data in Asian forests: towards further understanding environmental changes and ecosystem responses”. This topic is interesting and important. Study of ecology makes understanding interactions among organisms and their environment. In addition to it makes understanding impacts of human utilization on ecology. Long-term research station provide direct insights into forest development. Results from data stations are crucial to the development and validation of forest process models. Predictions about how forests change over time and respond to climate change, invasions of exotic organisms, wind and fire disturbance, and forest management all need to be grounded in long-term observation.

This is a good opportunity for researchers to meet, discuss, and build network for future collaborations. I am indebted to our committed speakers especially those who come all the way from overseas to share their knowledge and experiences in this conference.

I would like to take this opportunity to thank the Conference Organizing Committee for their diligent work in successfully organizing this conference. I would also like to extend my thanks to JSPS for providing the financial support for this conference.

Lastly, I hope that all of you will enjoy the Conference Thank you.

I wish the participants a very fruitful and productive meeting and with this, I declare the International Conference in 1st Circular Symposium: JSPS Core-to-Core Program Open!

Assoc.Prof.Dr. Laddawan Puangchit
Vice President of Kasetsart University

WELCOME MESSAGE BY DEAN

On behalf of the Faculty of Forestry, Kasetsart University (KU), I would like to take the opportunity to welcome all delegates to the opening of the International Symposium on “**Analysis of Long-Term Monitoring Data in Asian Forests: Towards Further Understanding of Environmental Changes and Ecosystem Responses**”. Those were organized by KU.

First of all, I would like to inform you that KU is the only academic institution in Thailand offering teaching and research in the diverse fields in forest resources and environmental sciences for B.S., M.S. and Ph.D. degrees in both regular and international programs. It was established in 1936 and we have already celebrated the 80th Anniversary last year. Currently there are over 80 well-educated faculty members in six academic departments, namely 1) Forest Management 2) Forest Biology 3) Silviculture 4) Conservation 5) Forest Engineering and 6) Forest Products. The total students are approximately 1,600 individuals. Based on continuing academic performance excellence, I am pleased to report you that KU has been ranked as 1st in Thailand, 3rd in Asia and 29th in the world by *the Quacquarelli Symonds (QS) World University Ranking in the Fields of Agriculture and Forestry in the year 2017*.

I wish to extend a warm welcome to colleagues from the member countries. I would also like to thank participants, coordinator of all member countries, especially project coordinator of Japan, Prof.Dr. Naoto KAMATA, Director of The University of Tokyo Hokkaido Forest, for joining us and sharing your valuable experience and ideas. Faculty of Forestry is proud to represent Thailand as one of the five core institutions in this Asian collaboration effort under the Core to Core Program. Our faculty has 6 the forestry research and training stations. All of you will have a good experience in visiting there, especially, Doi Pui and Wang Nam Khiew forestry research and training station. I'm optimistic that all participants will acquire new skill and knowledge from the five-day Conference.

Once again, I wish you all the resource persons, participants, presenters, discussers, listeners, and organizers a successful and fruitful conference. I hope you all enjoy the 5 days of the symposium. **Good luck and thank you.**

Assist.Prof.Dr. Nikhom Laemsak
Dean of Faculty of Forestry, Kasetsart University

PLENARY PRESENTATION

PLENARY

Introduction of the JSPS Project and Long-Term Monitoring and Inventory Data at the University of Tokyo Forests

Naoto KAMATA

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Under changing environments, long-term monitoring and inventory data are important to detect temporal changes in environments and ecosystems. The University of Tokyo Forests (UTF) has adopted the research exchange project entitled “Developing a network of long-term research field stations to monitor environmental changes and ecosystem responses in Asian forests” for the JSPS Core-to-Core Program. This project is implemented in collaboration with core institutions in five countries (Japan, Korea, Taiwan, Thailand, and Malaysia). It aims to promote the development of long-term research field stations for stable and continuous monitoring, and to establish a multilateral research cooperation network between core institutions through close collaboration. The UTF has accumulated long-term ecological and meteorological data that are available for our forest management and researches: LTER plots, other stand plots, meteorological and hydrological data, bird community, plant and vertebrate inventory, and others. I will present two fruitful outcomes that were obtained from our long-term data.

SYMPOSIUM SESSION
[RG1]
WATER & CLIMATE

**Climatic Classification and Mapping:
Preliminary Results for Asian Experimental Forests
based on Worldclim Database**

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Climate is one of the most important factors for formatting the ecosystem types. Climate zoning would help us to understand the basic characteristics of habitat. Similar research has already been done on a global scale, but it is hard to classify zones under the small spatial scale due to the limitations of the ground-truth microclimate stations.

This study used the free-download Worldclim database (monthly temperature and monthly precipitation) to classify the Trewartha climatic map of some Asian experimental forests. So far, there are 3 universities taking part in this research and they included 8 forests of University of Tokyo (ARI_Aono, ARI_Kano, CBF, CF, ERI, FIWSC, HF and TF), 1 forest of Kasetsart University (Kog_Ma) and 1 forest of National Taiwan University (NTUEF). The preliminary results showed there are 8 of the total 20 climatic types in the research sites. The 8 types are Cfa (subtropical, hot humid summer climate), Cfb (subtropical, cool humid summer climate), Dca (temperate continental, warm summer climate), Dcb (temperate continental, cool summer climate), Doa (temperate oceanic, warm summer climate), Dob (temperate oceanic, cool summer climate), E (boreal climate) and Ft (tundra climate). Due to the altitude of NTUEF, there are dramatic changes between 220 m a.s.l. and 3952 m a.s.l., and it can be classified into 6 climatic types whereas the other forests

can be classified into only 1 or 2 types. The Cfa type can be found at the maximum number of the forests (Kog_Ma, ARI_Aono, ARI_Kano, CBF, ERI, TF and NTUEF). The Dcb type is the second maximum number of the forests (CF, FIWSC, HF and NTUEF).

In order to validate the data taken from the Worldclim database, we are comparing the Worldclim database and ground-based climatic data. Temperature is one of the key parameters for Trewartha climatic classification, we are trying to generate the other monthly mean temperature maps based on the relationship between the 15-years' MODIS land surface temperature datasets and the long-term monthly mean temperature of each forest. The Trewartha climatic results based on the two different temperature maps will be compared. Then, the next step will use the IPCC AR5 climate data to predict future changes. This research encourages other Asian experimental forests to work together to understand how many climatic types are involved in this JSPS Core-to-Core project.

**The Role of Litter Layer on Direct Runoff from
a Secondary Deciduous Forest in the Ecohydrology
Research Institute, The University of Tokyo Forests**

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To identify the role of litter layer on direct runoff, two types of litter removal experiments were conducted. The one was watershed scale litter removal experiment in the Shirasaka Experimental Watershed in the Akazu Research Forest and the other was slope scale litter removal experiment in the Ananomiya Experimental Watershed. The former experiment measure total runoff from both treatment and control watershed, and the latter measure surface runoff from both treatment and control slope. The both peak flow from the treatment watershed and the surface runoff from the treatment slope was increased after litter removal. It was found that the surface runoff from the treatment slope become greater for rainfall event with the low antecedent precipitation index. This may be explained by the soil water repellency in the treatment slope which become greater during dry spells. The litter layer may have an important role to keep the soil water repellency low even during dry spells.

RG1-3

Effects of Vegetation Density on the Net-Rainfall, Surface Runoff and Soil Erosion in Selective-Logged over Tropical Forest, Danum Valley, Sabah, Malaysia

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The effects of vegetation density on net-rainfall, surface runoff, and soil erosion were studied in selective-logged over tropical forest, Danum Valley, Malaysian Borneo. Eighteen runoff plots were set up beneath different densities of above ground forest biomass (AGB), ranged between 240 and 663 t ha⁻¹. Throughfall (net-rainfall) was measured with four storage gauges placed around each runoff plots. For stemflow measurements, 120 trees with different DBH in 20 m x 30 m plot within the study area were collared. The rainfall interception and above ground biomass (AGB) values were found to be linearly related ($R^2=0.6$) which suggest that higher rainfall intercepted by higher AGB. Correspondingly, both surface runoff ($R^2=0.6$) and soil erosion ($R^2=0.3$) were negatively correlated with AGB values. This study suggests that vegetation density able to reduce the volume of rain water to reach the ground surface, resulting less amount of surface runoff generated. Poor regression value ($R^2=0.3$) between vegetation density and sediment yield suggests soil erosion is not only regulated by vegetation density but also site's specific properties of the individual plot.

A Simple Method for Estimating Mean Flow Velocity in Small Mountain Torrents

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Torrent refers typically a steep and cascade waterway over large boulders in mountain regions. Because hydraulic properties vary in many complicated features, accurate understanding of hydraulic process in torrents is very difficult. Among those parameters, flow velocity is an essential determinant that governs the hydraulic and geomorphological processes of torrent. Trace dilution method, which was originally developed to measure closed channel discharge, has employed to indirectly measure reach-averaged flow velocity in torrents where the streambed morphology is typically complex and rough. This technique involves the injection of a tracer into a reach and subsequently detection of the tracer a known distance downstream when complete mixing has occurred. Sodium chloride (salt) used in this study as a tracer, and the electro-conductivity (EC) in a water has been measured with an EC probe. A total of 87 events were observed in 8 different torrents. Mean surface velocity was calculated by using harmonic mean of travel time, which were obtained from the salt-dilution method. Commonly used flow resistance approaches were also examined to represent the relationship between mean flow velocity and hydraulic geometry. Hydraulic geometry is well expressed with a roughness height to account for the influences of hydraulic roughness on flow velocity. Four hydraulic parameters, D_{50} , D_{85} , σ_{pro} and IPR_{90} , were introduced to depict the roughness height of torrent flow. Results showed that both σ_{pro} and IPR_{90} were good estimators to represent the relationship between non-dimensional discharge and velocity in small, steep mountain torrents.

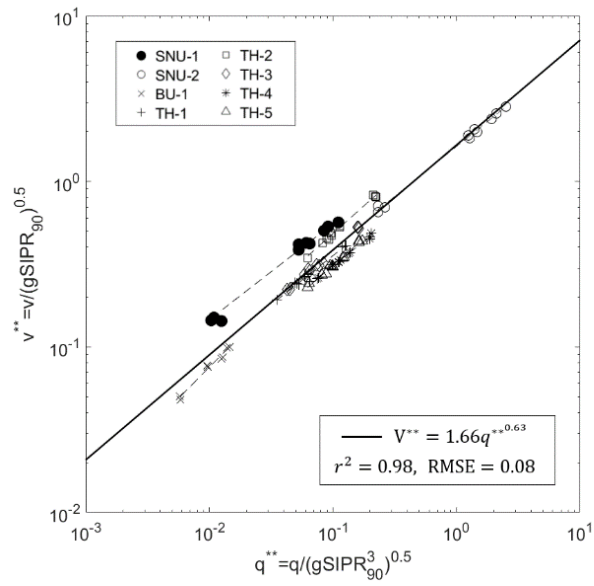


Figure 1 Dimensionless hydraulic geometry relation by using IPR90 as roughness height

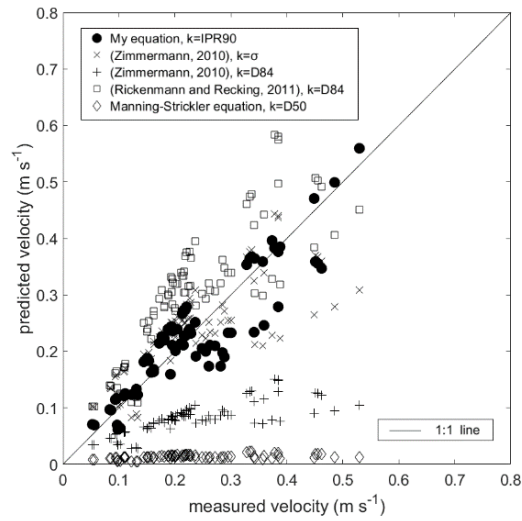


Figure 2 Measured and predicted flow velocity

Long-Term Hydro-Meteorological Data Collected at Two Forested Sites in Northern Thailand

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We have been collected hydro-meteorological variables at an upland hill evergreen forest and a lowland teak plantation in northern Thailand for more than fifteen years each, based on which a variety of individual studies such as those related to water budget, rain-runoff relation, canopy interception and transpiration, tree phenology and physiology, water and energy exchanges with the atmosphere, and soil respiration have been conducted. Though each of the hydro-meteorological variables has data gap periods due, for example, to instrument malfunctions, the long-term data still has a potential to be utilized in the analyses of environmental changes and ecosystem responses in the upland and lowland sites. In this presentation, the long-term data set will be shown, together with selected important findings from the individual studies.

SYMPOSIUM SESSION
[RG2]
ECOSYSTEM

RG2-1

Long-Term Study Site for Flowering Cycle of Moso Bamboo *Phyllostachys Pubescens* in The University of Tokyo Chiba Forest (UTCBF)

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Bamboos are monoecious perennial plants, and exhibit synchronous flowering and flowering periodicity in that they flower once in several decades, and die. However, flowering periods are only predicted based on the literature, and there are few observational evidence. In the UTCBF, a site for studies on the flowering cycle of Moso bamboo, *Phyllostachys pubescens* was established in 1934. In 1930, a Moso bamboo clump in Yokohama, Japan flowered and fruited, and two seedlings were planted in the UTCBF nursery in 1934. This clump flowered and fruited in 1997. Therefore, 67 flowering cycles were recorded. If this finding is correct, the next flowering would occur in 2064. This study site would be maintained for 300 years to confirm flowering at least 4 times. In this symposium, I will describe the management and investigation about culm distribution and genet structure of this site.

Estimating Shifts in Phenological Seasonality: A Growing Degree-Days Approach

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Long-term phenological records indicate that shifts in seasonality have already occurred, likely due to climate warming. In regions that have temperature-driven seasonality, phenophase variations are mainly the result of phase shifts in growing degree-days (GDD). Therefore, we can also estimate seasonality shifts based on phase shifts in GDD. By defining the onset of a phenological season as the date when the corresponding mean 1961-1990 equinox or solstice GDD level is reached, we found that, between 1901 and 2004, spring advanced by 1 day per decade in central Taiwan, whereas winter was delayed by 1.7 days per decade, with a higher advance rate for spring after 1980. This study estimates seasonality shifts directly based on a key cause of phenophase variations. This approach relies only on temperature records and creates a context for examining the cause-effect relationship between phase shifts in GDD and phenology.

Regeneration Dynamics During 20 Years in Abandoned Areas of a Tropical Seasonal Forest

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The study on regeneration dynamics in abandoned areas of a tropical seasonal forest was carried out in Mae Klong Watershed Research Station, western Thailand. A 4 ha permanent plot, 100 x 400 m, was established in 1992 and all trees with girth greater than 15 cm were tagged, measured and identified. Tree monitoring was done every two year since 1992 to 2012 (20 years).

The results showed the changes on species diversity and stem density had significantly different ($P < 0.001$ and $P < 0.001$, respectively) between the first and second ten-year periods. The lower values were detected in the first than second period for species diversity, 70.80 ± 23.18 and 119.17 ± 5.98 species.ha⁻¹, and stem density, 332.28 ± 55.49 and 590.31 ± 19.43 stem.ha⁻¹, respectively). Indicating after abandonment the succession process originated by low species diversity and stem density, then, gathered more diverse during the intermediate of succession time. Tree growth in basal area (in growth and recruitment) was significantly different ($P < 0.001$) among periods and rapidly increased in the second period, 26.78 ± 8.10 and 56.46 ± 4.76 m².ha⁻¹, respectively. While the recruitment and mortality rate were not significant among the periods. However, their highest rates were found in the first two years (1992-1994), 31.66 and 27.71 %.yr⁻¹, respectively, especially when the

pioneer species such as *Trema orientalis* death and followed by forest fire. Indicating the occasional occurrences of forest fire strongly impeded the successful regeneration of trees after abandonment. Thus, the reforestation programs should not be concerned only the ecological niche of species but also disturbances factors such as forest fire, canopy gaps, undergrowth bamboos, etc., for their high successful.

Key words; succession, abandoned areas, forest dynamics, mixed deciduous forest, Mae Klong watershed research station

**Plant Diversity Along Permanent Trails in Maliau
Basin Conservation Area (Mbca), Sabah Malaysia:
Monitoring of Visitor Impacts**

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Maliau Basin Conservation Area (MBCA) is considered among the most susceptible habitats to recreational and other human use. This study emphasized on visitor impact on plant ecology on long-established trails in MBCA, Sabah Malaysia. Five (5) trails with different visitation intensity were selected for comparison. Along trails, points of sampling were predetermined prior to data collection using convenient sampling method which 10 points for every trails. Transect line was established in every point selected which perpendicular to the trail. Along transect line, 5 plots established equally aside the trails. Thus, total of 250 plots were established. Plant ecology changes were indicated using biodiversity indexes particularly Plant individuals, species richness, family richness, Species richness index, species diversity index and species evenness index. The results showed differences in number of individual plants, number of species and number of family found in every trail. Agathis trail indicated highest number of plant with 27% and the lowest was Nepenthes trail with only 13% individual, however species richness was indicated highest in Nepenthes trail at 25%. The calculation of biodiversity indexes showed little differences among trails. However, comparison of biodiversity index among different plot location indicates differences particularly comparison with plot located on trail. Mean Jaccard index (Sj) comparison among trails showed that Ginseng trail indicated high similarity at 0.326 while Nepenthes show the opposite. ANOVA for plot location indicated that there was no significant different among plot located on trail and near trail compared to control at 5m beyond the trail edge.

**SYMPOSIUM SESSION
[RG3]
MANAGEMENT**

Towards Collaborative Research on Long-Term *Cryptomeria Japonica* Growth in Asian University Forests

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Cryptomeria japonica D. Don ('sugi' in Japanese) is one of the important plantation conifers in East Asia including Japan, Taiwan, and South Korea. The University of Tokyo (UTokyo), National Taiwan University (NTU), and Seoul National University (SNU) hold old *C. japonica* plantation stands, which were planted between 1890s–1920s. UTokyo and NTU have continuously been monitoring experimental plots in old *C. japonica* plantations every 5 years. SNU just launched new monitoring projects in old plantations including *C. japonica*. Under the Core-to-Core Program of the Japan Society for the Promotion of Science (JSPS), we initiated a discussion about collaborative research on long-term *C. japonica* growth. Potential research topics include a growth comparison of *C. japonica* plantations in 3 countries in terms of climate response. We jointly applied for a research grant, with the project title of "Quantitative reconstruction of long-term growth process for old *C. japonica* plantation stands using historical forest management records and past aerial photos".

Economic Value of Biodiversity Conservation in Korea

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To reduce the loss of biodiversity, the republic of Korea has implemented the regulation policies which designate protected areas and protected species such as endangered species. However, strict enforcement of biodiversity conservation regulations occurs external opportunity costs. To compensate these opportunity costs as biodiversity conservation cost, payment for ecosystem services (PES) was introduced in some countries. In this study, we aim to identify the economic value of biodiversity perceived by Korean people as a basis for introducing a PES scheme for biodiversity conservation in Korea. We conducted a meta-analysis of economic valuation studies reported in academic papers. A set of literatures were collected by searching with keywords related biodiversity on Research Information Service System (RISS) and National Discovery for Science Library (NDSL) databases. 41 articles published in Korean journals and graduate dissertations reported during the last 18 years from 1990 to 2017 were utilized for our analysis. We analysed people's willingness to pay (WTP) for biodiversity conservation of Korea estimated. Economic value of biodiversity was compared by biodiversity type, including ecosystem diversity and species diversity, ecosystem type, regulation and evaluation method.

Prospects for Community Forestry on the Experimental Forest of National Taiwan University

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Introduction

The Forestry Bureau of Taiwan pursued a new policy---Community Forestry, in 2002. Advocated public participation in the forest conservation and coexistence, being a pilot project for the forestry industry in Taiwan. Advocating the management concept of “Engaging the People; Growing Forestry”, the project has now been implemented for more than ten years. Entrusted by the Forestry Bureau, the NTU Experimental Forest (hereinafter referred to as “the Experimental Forest”) has been managing the Conservation/Coexistence. In 2010, the Experimental Forest received approval from the Ministry of Education on the “NTU Experimental Forest – Procedural Guidelines Governing the Community Forestry Projects” and has since been organizing the projects independently.

The Community Forestry projects facilitated by the Experimental Forest are implemented in two stages, but second stage has carried out from 2014. The main objectives are to encourage public participation, develop community independence and promote collaborative efforts between the Experimental Forest and the Community in managing the forests of the country. The Experimental Forest has achieved some preliminary success after the seven-year effort, till 2016. The projects organized by the Experimental Forest, on the other hand, are aimed at taking care of the forests and the surrounding communities, engaging the community in the forest protection efforts, supporting the development of ecological tourism in forests, increasing community income, promoting environmental harmony, and ensuring sustainable development of the community.

RG3-3

Material and Methods

There are six tracts under the Experimental Forest jurisdiction, including Xitou, Qingshuigou, Shuili, Neimaopu, Heshe, and Duigaoyue etc. During 2010 to 2016 period, there were 18 communities joint community forestry project, 6 of them were aboriginal community (Fig.1), all of them are distributed in or near by the Experimental Forest.

Using Qualitative Research methods, Qingshui, Yongxing, Luona and Wangxiang communities was chosen as case study communities, and unstructured interview (unstandardized interview) were carried out at those 4 communities.

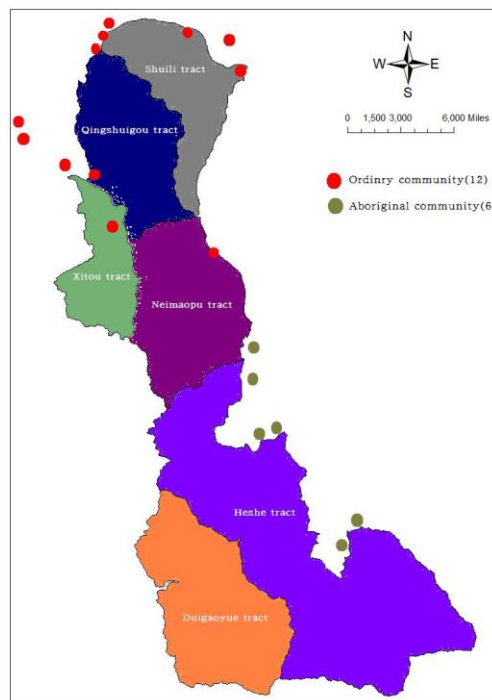


Figure 1 18 communities joint community forestry project of the experimental Forest during 2010 to 2016.

RG3-3

Results and Discussion

1. Achievements of community forestry project

From 2010 to 2013, the research results show that a total of 32 projects have been completed during the four years, three projects, however, were discontinued due to the failure of empowerment in the follow-up process. It is worth mentioning that, in terms of the promoting forestry management concepts and relationship development, the Experimental Forest has achieved good results after completing the first stage of the projects in Qingshui, Yongxing, Luona and Wangxiang communities. We therefore recommend amending the “NTU Experimental Forest – Procedural Guidelines Governing the Community Forestry Projects” for implementing the second stage of the community forestry projects. In 2014, the Experimental Forest received approval from the Ministry of Education, again. From 2014 to 2016, a total of 22 projects have been completed during the three years, including 8 second stage projects have been completed. One of the most important achievements is strengthen community organization, after completed community forestry projects, successfully.

2. Prospects of community forestry project

Adhering to the three principles of “Ecology”, “Life”, and “Production” for forestry management, the communities will focus their efforts on developing the ecological tourism, so as to align the community forestry projects with the community development. The Experimental Forest is hoped that these efforts will help to improve relationship with communities, especially aboriginal community.

Non-timber Forest Products Contribution to the Livelihood of the Local Community in Sabah, Malaysia

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Non-timber forest products (NTFPs) are useful and important materials to communities that live near to forests. The main purpose of this study is to determine the types of NTFPs and its contribution to the livelihood of local communities living near to forests at four districts, namely, Penampang, Tambunan, Tuaran and Ranau at the west coast of Sabah. A total of 365 respondents were interviewed using a structured questionnaire through face-to-face interview technique with convenience household sampling at selected villages. Most of the NTFPs identified were categorized into medicinal plant (40 species), wild edible plant (26 species), wild edible fruit tree (19 species), bamboo (4 species), rattan (5 species), orchid (8 species), fish (7 species), wild animal (4 species) and others (6 species). Those NTFPs were mainly harvested, planted and hunted for their daily own consumption (39.7% respondents) and generate their income (33.7% respondents) up to 35% (RM295.00 = USD70.45) of the average total monthly income (RM427.45 = USD101.75). The average monthly income obtained from selling NTFPs was RM173.20 = USD41.36). The selling of NTFPs were practiced by the local communities from generation to generation to support their livelihood.

Relationship between University Forests and Society in Japan: A short history of expansion and individuation

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The historical transition in the relationship between University Forests (UFs) in Japan and society was investigated by reviewing previous literature. Since their establishment till the mid-1960s, UFs have been important for people living in communities adjacent to or inside these forests; these communities were created by UFs by recruitment. As the employment structure and population of local societies as well as the labor skills demanded by UFs changed, starting the 1960s, a gap in the situations of both sides was identified. After the 1980s, it was observed that UFs were opened to the public in general as recreational spaces, extension lecture spaces, or fields for environmental education for school students. Such movements developed rapidly after the 1990s. Recently, unlike the 1980s and the 1990s, some of these projects are being specialized for a certain target, for example, the contributions to enhancing the skills of local forestry workers.

An Explore to the Forests on Ecohydrology Research Institute from the Perspective of Landscape Planning

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The places where university forests locate have had own history and relationship with local society. In case of Ecohydrology Research Institute (ERI), especially, it located on Seto city where is famous for pottery industrial city in Japan. The backgrounds of establishment of ERI were deeply connected with the issue from pottery industry. Recently, as the city is inclining to develop to the industrial tourism city, understanding the history and character of the city where university forests locate is necessary in order to make a relationship with local society. I present the potential of ERI as tourism resources and how to tie with potential resources on surroundings in order to make a relationship with local society.

Tourism Development in Local Community: A Case Study of the Pha Wang Nam Khiao – Pha Khao Phu Luang Forest Reserve, Thailand

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The primary objectives of this research focused on developing a sustainable tourism model for the Pha Wang Nam Khiao - Pha Khao Phu Luang Forest Reserve in order to sustain forest area and develop local community simultaneously. The sustainable tourism model was created based on site potential, stakeholders' opinions, and cost-benefit analysis. The results showed that the destinations were ranked in high potential for tourism development. The majority of tourists paid attention to forest resources education program and sport outdoor activities. Benefit-cost ratio (BCR) equaled to 1.81 and internal rate of return (IRR) equaled to 16.38, showing suitability and worthiness for developing tourism in Wang Nam Khiao forest reserve. Tourism development strategies have been proposed, including: (1) developing facilities and services for conservation and sustainable tourism; (2) personnel training for sustainable development; and (3) tourism marketing for niche market.

POSTER

Impact of Climate Change on Forest Service at Basin Scale and Cost-Benefits Performance Analysis for the Adaptation

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The objective of this research is finding the optimize land use in Nan province, northern part of Thailand, to adapt the climate change around 2040 – 50. As first step, Conversion of Land Use and its Effects at small extents (CLUEs) model is used to simulate land use in 2040. In this model, the ratio of forest area in 2040 is changed from 20% to 80% (currently almost 70%). And then, hydrological simulations are conducted with Soil and Water Assessment Tool (SWAT) to evaluate impacts of climate change on each land use scenario. SWAT can calculate daily discharge for input rainfall using other 3 input data, land use (result of CLUEs), soil map and digital elevation model. Finally, comparing the cost for changing land use with the reduction of flood damage, the best optimize land use is found based on cost-benefits performance analysis. This will help decision makings in this area.

The Fungal Genus *Rosellinia* (Xylariaceae: Xylariales) in Japan and Necessity of Survey in Asian Countries

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The fungal genus *Rosellinia* plays various ecological roles in forest ecosystems: e.g., root rot pathogens, endophytes of woody plants and wood decomposers. Several new species have recently been reported from Asian countries, suggesting the diversity of *Rosellinia* species still unexplored in this region. In Japan, 9 taxa, including one hypothetical new species, are known. *Rosellinia necatrix* is one of the most important pathogen of woody plants in Japan and many other countries in temperate zones, while in tropical and subtropical zones, *R. arcuata*, *R. bunodes* and/or *R. pepo* are major. Among them, *R. arcuata* resembles *R. necatrix*, and some taxonomists even consider the 2 taxa are synonymous; however, there are no molecular data to solve this problem. An alternative authentic specimen (epitype) should be elected for *R. arcuata* to link its morphological and molecular profiles. Survey in the type locality, Sri Lanka, and surrounding countries is therefore needed.

A Role of a Woodland in an Agricultural Landscape on Diversity of Beetles (Class: Insecta, Order: Coleoptera) in Central Thailand

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It has been well recognized that agricultural intensification reduces biodiversity of insects and their ecosystem services. In this study, a role of a woodland in agricultural landscape on diversity of beetles was studied by traps with three different attractants (alpha-pinene; ethanol, Methyl Phenylacetate). Each trap was set for six different seasons at each of five land use types: aquaculture pool (Aquaculture Research Station: ARS), fruit orchard (FRO), sugarcane plantation (SCP), woodland (WDL), and intermediate between fruit orchard and woodland (INT) at Kamphaeng Saen Campus, Kasetsart University. The family Curculionidae, especially the subfamily Scolytinae, was the most major taxonomic group. Land-use type influenced greatly to the assemblage. Species richness and diversity were greatest at ARS although the family Scolytinae was most abundant at WDL. This result was probably due to high connectivity of ARS to other land-use types. Woodland acted as a source of wood boring beetles in the agricultural landscape.

Bark and Ambrosia Beetle Assemblage Monitored by Ethanol Baited Traps in a Tropical Seasonal Forest at Doi Suthep-Pui National Park, Northern Thailand

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There have been many studies on long-term population dynamics of single species but few for community levels. Bark and ambrosia beetle assemblage was monitored by ethanol-baited traps for three years in a tropical seasonal forest at Doi Suthep-Pui National Park, Thailand. Seasonality and cyclicity of the assemblage were determined and compared to those in a cool temperate forest at Chichibu, Japan. Population cycles of each species depended on species: some showed one-year cycle but many showed shorter cycle. The number of individuals captured by the traps showed one-year cycle, which was significantly influenced by both rainfall and temperature although the rainfall had greater effects. Dynamics of the assemblage also showed one-year cycle. Seasonal change of assemblage was smaller but similarity decreased more greatly in Thailand than in Japan, which was due to greater species turnover rate. These results suggest greater proportion of rare species in Thai assemblage than the Japanese.

Influence of Host Tree Phylogeny on Ambrosia and Bark Beetle Assemblage in a Tropical Seasonal Forest at Doi Suthep-Pui National Park, Northern Thailand

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Host plant phylogeny influences on community structure of herbivores. Relationship between host plant phylogeny and two insect guilds (ambrosia and bark beetles) were studied in a tropical seasonal forest at Doi Suthep-Pui National Park, Thailand and compared to that of Japan. Branches of 20 plant species were exposed to the beetle attacks four times (4-6 weeks each) in 2014-15 or in 2015-16. A total of 65 (53 spp. in 2014-15, 48 spp. in 2015-16) ambrosia and 26 (21 spp. in 2014-15, 14 spp. in 2015-16) bark beetle species were collected. Between Thailand and Japan, mean species richness per host plant was significantly greater in Thailand although host ranges of both ambrosia and bark beetles did not differ. As a result, similarity of both ambrosia and bark beetle assemblages did not show significant relationships with phylogenetic distance between host plant species in Thailand though negative relationships were recognized in Japan.

**Predicting the Above-Ground Biomass Based on
Land Use Changes at Doi Suthep-Pui National Park,
Chiang Mai Province, Thailand**

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This study aimed to detect and predict above-ground biomass (AGB) based on land use change from 2000, 2015 and 2030. The results showed forest and non-forest area fluctuated during study periods. Throughout the first period of 15-year, 5% (2.92 km²) of forest area was changed to agriculture land and urban especially mixed deciduous forest (MDF) and lower montane forest (LMF). It also similar trended as in 2030, and showed the effect of forest fragmentation and high number of patches. Considering total AGB change, it was decreased over 30-year period which 1,206.13 tons and 1,097.06 tons in 2000-2015 and 2015-2030, respectively. Indicating the forest areas declined is the main factors on ABG loss (2,303.19 tons) related to the changes of land use. Furthermore, habitat loss is also activated the decreased biodiversity. Thus, from this problems the management plan on human well-being based on sustainable natural resources should be created.

Long-Term Seedling Dynamics Along an Altitudinal Gradient at Doi Suthep-Pui National Park, Thailand

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Seedling dynamics study was done based on transect permanent plot, 30x600 m, along an altitudinal gradient (900-1,020 m a.s.l.) where covered the deciduous dipterocarp forest (DDF) and lower montane forest (LMF). The results showed air temperature and light intensity, were significantly different ($p < 0.001$) between forests. DDF had the highest air temperature and, light intensity than LMF. The forest ecotone (ETF) between DDF and LMF had moderate conditions so indicating ETF environments may allow coexisted species of deciduous and evergreen species. The total emerged seedlings of 7,797 individuals and 116 species, 85 genera, and 42 families were identified. Most abundant species was *Quercus brandisiana* (57.4%), followed by *Litsea martabanica* (9.6%). Massive recruitment occurred in July 2015. Total 9 species joined the recruitment and *Q. brandisiana* accounted for 98.9% of total number emerged. Massive mortality occurred in April 2016. Total 65 species die due to severe drought associated with 2016 El Niño event.

PO08

**Forest Dynamics and Spatial Distribution of Tree Species
in the Dry Evergreen Forest at Wang Nam Khiao
Forestry Student Training Station,
Nakhon Ratchasima Province, Thailand**

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This study aimed to clarify the forest dynamics after intermediate disturbances and detect the tree spatial distribution related to some environments in permanent plot. The result showed that 150 species 119 genera and 32 families were found. The dominant tree species based on important value was *Pterocarpus macrocarpus* *Dipterocarpus alatus* and *Streblus asper*. Considering the forest dynamics during 2003-2016, the recruitment rate was higher than the mortality rate (2.58 and 2.35 %.y⁻¹, respectively). However, the mortality rate in second period (2009-2016) was greater than first period (2003-2009), based on flooded. As a result of many species have increased their mortality such as *Diospyros mollis* (6.93 %.y⁻¹ and 31.39 %.y⁻¹, respectively). While, tree spatial distribution on topographic factors varied among species. Species of *Pterocarpus macrocarpus* and *Dipterocarpus alatus* relatively distributed in the lowland areas. In contrast, species of *Hydnocarpus ilicifolia* and *Memecylon ovatum* mostly occupied in the highland and steep slope.

Primary Succession in Tropical Coastal Sand Dune, Southern Thailand

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This study aimed to plant community succession at coastal sand dune. The 36 species from 32 genera and 23 families were found. Species diversity based on Shannon-Wiener was 2.81. Trees density and basal area were 3110 ind·ha⁻¹ and 7.34 m²·ha⁻¹, respectively. The DBH class distribution was negatively increased to a power growth form. The dominant trees species based on the importance value were *Pandanus odorifer*, *Syzygium antisepticum*, *Syzygium grande*. The forest structure can be classified into two canopy layer, while, crown canopy was different between windward and leeward, open and close canopy, respectively. The statistical test of species diversity, tree abundance and basal area showed significantly different between windward and leeward, which low quantitative values were found at windward. In addition, the distribution of woody plant was also significantly correlated to aspect. Indicating plant community succession process will be rapidly occurred on the leeward better than windward sides.

Diversity of Fruit Tree Species for Utilization of Frugivores in Lower Montane Forest at Doi Suthep-Pui National Park in Chiang Mai Province, Thailand

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This study aim to clarify diversity and utilization fruit tree species by frugivores between February 2015 to December 2016. The results showed 211 tree species were found and only 55 species were detected for fruit utilization by frugivores. Thirteen frugivore species frequently utilized 5 fruit tree species which provided fruits through the studied period, for instant, *Ficus semicordata*, *Ficus hirta* and *Helicia nilagirica*. This species group is very abundance for mature trees?. In contrast, species of *Madhuca floribunda* which very low tree density but most of frugivores preferred to utilize its fruit. Indicating favorable fruit tree species can be classified as a keystone species to maintain frugivore diversity. Thus, the knowledge about fruit tree species of frugivores in LMF can be applied to restoration program. The appropriate planted species with high relationship to frugivores will be selected to induce the frugivores for their regeneration supporting as seed dispersals.

Hydrological Services of 30 Years for Forest Restoration at Royal-Agriculture Station Angkhang, Chiang Mai Province, Thailand

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The forest restoration at Royal-Agriculture Station Angkhang was conducted for 30 years ago. This study carried out in mixed-exotic tree plantations planted in 1983 and 1984 whereas dominantly planted of 4 species *i.e.* *Acacia confuse* Merr., *Fraxinus griffithii* C.B. Clarke, *Liquidambar formosana* Hance. and *Cinnamomum camphora* (L.) J.S. Presl. Two sub-watersheds were selected in different slope percent to representative area (25.99 % and 32.15 %) and for analysis hydrological services of the highland forest restoration. The streamflow, the suspended sediment and infiltration capacity were used to be the hydrological services indicators. The results were found that both of sub-watershed area were perennial stream although no rainfall. The A and B sub-watershed were generated streamflow at about 55,739.467 and 18,770.10 m³/sq.m., respectively (12.20 and 4.1 % of the rainfall). The infiltration capacity of A and B sub-watershed were ranged from 268.57-100.94 , and 291.96-553.03 mm/h, respectively. The intensities of suspended sediment were generate by A and B sub-watershed as 0.0028 and 0.0079 g/L, respectively. Besides, the relationship between runoff and suspended sediment showed inverse trend in all of sub-watersheds.

Wildlife Diversity Monitoring in Huai Kog Ma Biosphere Reserve, Chiang Mai Province

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The monitoring species diversity of wildlife in Huai Kog Ma permanent plot (16 ha) was conducted during 2011 - 2017. This study aimed to monitoring species for biological database and clarify the adaptation of wildlife on global warming in the study areas. Mist-net method, camera traps, live traps, pitfall traps and direct observation used for the field survey. The results indicated the presence of 196 species consisting of 26 mammals (13%), 127 birds (65%), 29 reptiles (15%) and 14 amphibians (7%). The findings indicate that negative impact of climate changes to a main group of amphibians and reptiles about 4 species including *Tylototriton uyenoi*, *Platysternon megacephalum*, *Manouria impressa* and *Sinonatrix yunnanensis*. The others they 192 species can adaptation to survive. It is recommended that the all concerned parties should consider conducting long-term monitoring of climate changes to wildlife diversity for a prepare mitigation plan for reducing local extinction.

**Continuous Forest Inventory in Huai Tao
Sub-watershed, Ngao Demonstration Forest,
Ngao District, Lampang Province**

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The study on continuous forest inventory in Huai-Tao Sub-watershed, Ngao Demonstration Forest, Ngao District, Lampang Province. That objective aimed to study the dynamic of forest resources, stands that diameter are 4.5 centimeter, during a 15-year term (2002 - 2017), Seven sample plots of 0.01 ha in size. The study samples consisted of remeasured stands in three permanent plots established in January, 2002 and four plots were additional inventory. The remeasured stands data were collected in June, 2017 to compare with past data. They consisted of tree species and growth on cross-section area. The result was demonstrated that, from 2002-2017, an area is 10.22 km² (1022 ha). Finding the species of tree from 33 species increased 65 species and average growth on cross-section area increased 0.6497 cm² / year.

Altitude Increase in Rainfall in Mae Chaem Watershed in Year 2011

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This research focuses on relationships between monthly rainfall and altitude on the mountainous area of northern Thailand in year 2011. Analysis of covariance (ANCOVA) is applied. Fourteen rain gauges were set at the elevations from about 490 to 2,600 m (a.s.l.) for 20 years (1997 – 2016). The monthly rainfall in MCW was come from that projects. The result showed that for pre-monsoon and most of months in the rainy season except July, the slope of regression lines of monthly rainfall against altitude in 2011 was not significantly different from the average of other years, but the intercept in 2011 was significantly larger than the other years. The result was similarly found for a comparison of annual rainfall in 2011 with the average rainfall.

The Influence of Soil Moisture Condition on Transpiration Seasonality in Teak Plantation in Northern Thailand

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To identify the influence of soil moisture condition on transpiration seasonality in plantation grown teak trees, we conducted sap flow and soil water content measurements at two plots in an even-aged teak (*Tectona grandis* Linn. f.) stand planted in 1968 in Mae Mo plantation, Lampang province, northern Thailand. At the onset of the rainy season, both soil water content and sap flow started simultaneously in both plots A and B. On the other hand, at the end of the rainy season, both soil water content and sap flow in plot B decreased earlier than in plot A. The results indicated that there was a spatial variability in transpiration seasonality of teak trees even in a plantation. The results additionally implied that there was a spatial variability in water holding capacity of the soil in the studied plantation, which produced a spatial variation in soil moisture condition particularly at the end of the rainy season.

PO16

Distribution of Termite Mounds in an Area Characterized by Trees in Paddy Fields: A Case Study in a Village in Central Laos

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Termite mounds are a significant source of various products, such as mushrooms and termites as food, in tropical regions. In this study, the distribution of termite mounds in a village in central Laos, characterized by a typical landscape of trees in paddy fields, was examined. For termite mounds, the location, size, and species within circular quadrats were recorded at 1) dry dipterocarp forest, 2) dry evergreen forest, and 3) paddy fields. The density of mounds was much higher in the forests than in paddy fields. While many small mounds were present in the forests, only relatively large mounds were observed in the paddy fields. The composition of termite species did not differ obviously among quadrats. These results suggested that termite mounds under trees in paddy fields remained in the process of developing paddy from forests. These findings indicate that forests are important for the regeneration of termite mounds.

Model of Forest Rehabilitation from Agricultural Monocrop Land for Development of the Wangchan Forest Learning Center, Rayong Province, Eastern Thailand

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Study on Forest Rehabilitation Model from agricultural monocrop land for Development of The Wang Chan Forest Learning Center was carried out in the area of Wang Chan District, Rayong Province Eastern Thailand. The objective of this study was to develop the area of agricultural land for a long period of time to be returned to the ecological forest area. There are 3 different types of tree planting composed of: (1) reforestation with high seedling density (4-3 trees/m²), (2) reforestation to be the natural forest (400-300 trees/rai) and (3) integrated forest plantation, mixed wood in term of agroforestry, and fast growing commercial forest plantations (400 trees/rai). Permanent sampling plots of size 20x40 m. were used to monitoring survivor rate and growth of trees. The diameter growth and height of each tree in the plot were collected. Biomass and carbon sequestration of each sample plots were determined in 2016.

The results showed that the average DBH and average height of the third model were the highest followed by first and second models. The averaged DBH value were 6.98 cm., 5.24 cm. and 3.51 cm. respectively. The average height were 6.11 m, 5.28 m and 3.21 m, respectively. The third model indicated better growth than the other model because of tree species that planted in this model be the fast growing trees species, which resulted in higher growth rates than the first and second model, which mainly planted only local species. The amount of biomass and carbon dioxide absorbed, the first model was the highest value followed by third and second models. The average

biomass were 8.10, 5.21 and 1.18 tons/rai, respectively, and had an average carbon sequestration as 13.97, 8.98 and 2.04 tons of carbon dioxide equivalent, respectively. The rehabilitation models that selected from 3 models were success and could be improve the degraded agricultural land to be forest to use to be the Forest Learning Center in the future.

Key words: Forest Rehabilitation, Tree Growth, Wang Chan Forest Learning Center

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