Joint International Symposium on Sustainable Forest Ecosystem Management (SFEM) by Taiwan, Japan and Korea
– SFEM 2021 Online –

Organizers: Taiwan Society of Forest Ecosystem Management (TWFEM)
Japan Society of Forest Planning
National Institute of Forest Science (NIFoS), Korea
FORMATH Research Society

Date	November 28 (Sun) 13:00 – 14:30 Test Gathering
Date	Taiwanese Time Zone (Japanese Time Zone) November 29 (Mon) 9:00 – 16:30 (10:00 – 17:30) Presentation
Venue	Zoom Online

President: Prof. Chinsu Lin, National Chiayi Univ.

Vice President: Prof. Naoto Matsumura, Mie Univ.

Committee

Prof. Atsushi Yoshimoto, ISM

Prof. Chao-Huan Wang, National Ilan Univ.

Prof. Joosang Chung, Seoul National Univ.

Dr. Masayoshi Takahashi, FFPRI

Program & Abstract

SFEM 2021 Online
Program: November 29 (Mon),

( ): Japanese Time Zone

Date			November 29 (Mon), 2021		
9:00 (10:00)	～	9:10 (10:10)	Opening Remarks	Naoto Matsumura	Mie Univ., Japan
1.			**Measurement**	Coordinator: Dr. Hee Han	NIFoS
9:10 (10:10)	～	9:40 (10:40)	Application of national forest inventories to forest measurement and management in a various spatial extent	Dr. Shingo Obata	National Institute for Mathematical and Biological Synthesis, USA
9:40 (10:40)	～	10:10 (11:10)	Compensation Design and Protected Areas: Limits of Loss Compensation System on Forest Protection Act in South Korea	Sujeong Ju	Seoul National Univ., Korea
10:10 (11:10)	**～**	**10:30 (11:30)**	**Break**		
2.			**Evaluation**	Coordinator: Dr. Yusuke Yamada	FFPRI
10:30 (11:30)	～	11:00 (12:00)	Economic and Ecological Impacts of Constraint on the Period-to-Period Variation in Timber Production: A Case Study of Mt.Gari, South Korea	Dayoung Kim	Seoul National Univ., Korea
11:00 (12:00)	～	11:30 (12:30)	Evaluating forest utilization and conservation of local communities in the buffer zone of Inlay Lake Biosphere Reserve, Myanmar	Khin Thu Wint Kyaw	Kyushu Univ., Japan
11:30 (12:30)	**～**	**13:00 (14:00)**	**Lunch Break**		
3.			**Survey**	Coordinator: Dr. Patrick Asante	BC Government, Canada
13:00 (14:00)	～	13:30 (14:30)	Does abundant rainfall inhibit soil CO2 fluxes in subtropical monsoon forests?	Po-Neng Chiang	National Taiwan University, Taiwan
13:30 (14:30)	～	14:00 (15:00)	Using ALS data to improve the performance of the kNN algorithm for AGB estimation	Nova D. Doyog	National Chiayi Univ., Taiwan
14:00 (15:00)	**～**	**14:20 (15:20)**	**Break**		
4.			**UAV**	Coordinator: Dr. Masashi Konoshima	Univ. of the Ryukyus, Japan
14:20 (15:20)	～	14:50 (15:50)	A UAV-point-cloud based approach for tree diameter modeling	Tatsuki Yoshii	National Chiayi Univ., Taiwan
14:50 (15:50)	～	15:20 (16:20)	A practical method to improve precision accuracy for forest aerial photogrammetry using UAV	Dr. Masayoshi Takahashi	FFPRI, JAPAN
15:20 (16:20)	**～**	**15:40 (16:40)**	**Break**		
15:40 (16:40)	**～**	**16:10 (17:10)**	**Poster Session** Coordinator: Prof. Naoto Matsumura	**Room1** Prof. Chao-Huan WANG **Room2** Han-Ching Hsieh **Room3** Sharaniya Vijitharan **Room4** Prof. Yasushi Mitsuda **Room5** Nozomi Ikeda	
16:10 (17:10)	～	16:30 (17:30)	Closing	Prof. Chinsu Lin	National Chiayi Univ., Taiwan

November 29 (Mon)
9:10～10:10 (10:10 – 11:10) Measurement

Application of National Forest Inventories to Forest Measurement and Management in a Various Spatial Extent

Shingo Obata (National Institute for Mathematical and Biological Synthesis, USA)

National forest inventories (NFI) report estimates of attributes related to the forest area and growing stock volume for the area of interest, such as countries, states, and provinces. The Forest Inventory and Analysis (FIA) program collects tree and stand-level data to produce statistical estimates of forest attributes to analyze the current status and condition of the forests in the USA. To create wall-to-wall estimates of principal forest attributes such as canopy height, Digital Surface Models (DSM) derived from point clouds created from Digital Aerial Photogrammetry (DAP) has been used as auxiliary data. In comparison to LiDAR, DSM costs less but the points acquired are limited to the surface of the landscape. The objective of this presentation is to validate the accuracy of the canopy height estimated by DSM through the comparison with FIA plots and LiDAR point cloud data. Our study area encompasses the entire Virginia and Tennessee, located in the southeastern USA. The National Agriculture Imagery Program (NAIP) dataset is selected as the source of DAP and it is processed to point cloud. LiDAR point clouds are acquired from the 3D Elevation Program managed by the US Geological Survey. DSM is calculated by subtracting the digital elevation model from the elevation of the NAIP point cloud.

Compensation Design and Protected Areas: Limits of Loss Compensation System on Forest Protection Act in South Korea

Sujeong Ju (Seoul National University, Korea)
Inkook kay (Korea University, Korea)
Hee Han (National Institute of Forest Science, Korea)
Joosang Chung(Seoul National University, Korea)

This study aims to identify the structural ineffectiveness of loss compensation system on Forest Protection Act in South Korea, which have compensated nothing over 50 years (based on record till 2012). Under the Forest Protection Act, government compensates ordinarily anticipated losses sustained due to denial of permission on conducting an activity under Article 9 (2) 1 on the ground of public interest in Forest Conservation Zone to the owner or a person with a right to profit. Due to precedent researches claimed that the reason is on a lack of detailed compensation formula, this study examines structural specificity and compensation target and scope of the system. The arguments are based on literature review related to forest science and legal studies. However, the findings indicate legal structure is heterogeneous compared to other related loss compensation system, and paying compensation for loss is difficult in most cases. The reason is pointed out to low compensation possibility of legal structure. Therefore, the paper suggests that designing legal structure is important as same as introducing the system into the law.

November 29 (Mon)
10:30～11:30 (11:30 – 12:30) Evaluation

Economic and Ecological Impacts of Constraint on the Period-to-Period Variation in Timber Production: A Case Study of Mt. Gari, South Korea

Dayoung Kim (Seoul National University, Korea)
Hee Han (National Institute of Forest Science, Korea)
Joosang Chung (Seoul National University, Korea)

The objective of this study is to analyze the economic and ecological impacts caused by limiting the period-to-period variation in timber production, when establishing a long-term forest management plan to improve the imbalanced age-class structure of forests in South Korea. In addition, this study investigated the appropriate variation rate in timber production, which comprehensively considers timber production, carbon storage, and water storage. For this purpose, a forest management planning model using Multi-Objective Linear Programming (MOLP) was developed and a sensitivity analysis was conducted by setting 9 management alternatives with different levels of variation rate in timber production. As a result, the sum of the net present value (NPV) of timber production, carbon storage and water storage during the whole planning horizon decreased as the variation in timber production was constrained to narrower ranges. On the other hand, the total timber production increased with the lower variation rate. These differences were mainly caused by regeneration species according to the constraint on variation in timber production. The area of Pinus rigida with short cutting age increased to reduce the gap of timber production between periods if the variation was strictly restricted. It was identified that species with a short cutting age can be utilized to adjust the age-class structure of forest, where high age stands occupy a high proportion. The appropriate variation rate in timber production, in the perspective of the economic and ecological functions of forest management, was determined to 30%, by analyzing the opportunity costs and the reduction rates in management performances between alternatives.

Evaluating Forest Utilization and Conservation of Local Communities in the Buffer Zone of Inlay Lake Biosphere Reserve, Myanmar

Khin Thu Wint Kyaw (Kyushu University, Japan)

Forests can be identified as a source of forest products and ecosystem services (Chazdon et al., 2016). However, there have been major trends towards deforestation and forest degradation in tropical forests (Lewis et al., 2015). These trends might reduce the supply of forest resources such as firewood (Heltberg et al., 2000). Understanding firewood utilization of local communities in degraded forests is of importance for the sustainable firewood consumption with limited resources. To slow deforestation and forest degradation, community forestry has been conducted in the tropics (Rasolofoson et al., 2015). However, there are limited studies that showed evidence of whether community forestry (CF) could reduce deforestation. The study was conducted in the northern Nyaungshwe Township, the buffer zone of Inlay Lake Biosphere Reserve. A total of 143 households was interviewed for firewood consumption of local communities and firewood consumption rates were regressed against several potentially important factors. The regression analysis clearly showed that open forest ratio, an indicator of forest degradation, had a negative effect on per capita annual firewood rate. For forest conservation, 24 community forests were selected for CF effectiveness and the importance of influencing factors on deforestation risks. The matching method and mixed-effects logistic regression model were used for data analyses. The results showed that community forests were not effective at reducing deforestation on average and geographical factors were critical for the probability of deforestation in community forests. It can be concluded that forest degradation negatively affects firewood consumption and community forestry cannot provide significant evidence of forest conservation.

November 29 (Mon)
13:00～14:00 (14:00 – 15:00) Survey

Does Abundant Rainfall Inhibit Soil CO2 Fluxes in Subtropical Monsoon Forests?

Po-Neng Chiang (National Taiwan University, Taiwan)

Soil respiration represents the second largest carbon flux, next to photosynthesis of the terrestrial biosphere, and thus plays a dual role in regional and global carbon cycles. However, soil respiration in Asian monsoon forests with high rainfall has rarely been studied. In this study, we continuously measured soil respiration using a 12-channel automated chamber system in a 61-year-old Japanese cedar forest in central Taiwan with annual rainfall greater than 2500 mm. A 4-year (2011-2014) continuous half-hourly dataset was used to quantify the influences of soil temperature and moisture, especially rainfall events, on both total soil respiration (Rs) and heterotrophic respiration (Rh). The annual mean Rs was approximately 10.8 t C ha 奸 1 (ranging from 10.7 to 10.9) t C ha 奸 1, with Rh contributing approximately 74.6% (ranging from 71.7% to 80.2%). Large seasonal variations in both Rs and Rh were primarily controlled by soil temperature. Over 45.8% of total annual rainfall amounts were provided by strong rainfall events (over 50 mm), and over 40% of rainfall events occurred during summers between 2012 and 2014. These strong rainfall events caused rainwater to enter soil pores and cover the soil surface, which resulted in limited soil microorganism activity and, consequently, restricted CO2 production. Both Rs and Rh were negatively correlated with soil moisture, which indicated that the soil moisture levels in the studied forest were usually under saturated conditions. These results also provide the lack of data for respiration in the Asian monsoon region under high-rainfall conditions.

Using ALS Data to Improve the Performance of the kNN Algorithm for AGB Estimation

Nova D. Doyog[1, 2], Chinsu Lin[1*]
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This study was conducted to determine the effects of ALS data in the improvement of the performance of the kNN algorithm in aboveground biomass (AGB) estimation. The performance of the kNN model was assessed using different parameter combinations based on Sentinel-2 image and ALS-derived data specifically the topographical features such as DEM, aspect and slope, and biological features such as LAI, tree height, and forest type. The overall accuracy provided by the confusion matrix was used as evaluation criteria. A total of 606 plots having an area of 0.01 ha per plot was served as the ground truth. 80% served as reference data while 20% as validation data. The AGB of the ground data was estimated using the parameters derived from the ALS data by an IPCC-compatible remote sensing technique while the kNN model derived AGB was used for the validation. Results showed that the kNN model had the best estimation accuracy when the combination of Sentinel-2, topographical and biological features was used with an overall accuracy of 85% as compared when using the combination of Sentinel data and topographic features which provided an overall accuracy of 82% and using Sentinel data only provided an overall accuracy of 76%.

Keywords: forest biomass; non-parametric model; model improvement

November 29 (Mon)
14:20～15:20 (15:20 – 16:20) UAV

A UAV-Point-Cloud Based Approach for Tree Diameter Modeling
Tatsuki Yoshii (National Chiayi University, Taiwan)

A low-cost but accurate forest monitoring tool is necessary for sustainable forest management. Unmanned-Aerial-Vehicle (UAV) remote sensing is low cost and has flexibility in high frequency data collection with a satisfactory image resolution net. This study investigates the potential of integrating UAV and Airborne Laser Scanner (ALS) technology in the evaluation of tree properties in plantation forest consisting of Japanese cedar (Cryptomeria japonica) and Japanese cypress (*Chamaecyparis obtusa*). The UAV aerial photographs collected in a series of inventory were used to generate multi-temporal DSM of forest stands by Structure from Motion (SfM) technique. To generate CHM, point cloud of UAV was georeferenced with ICP algorithm without grand control points (GCPs). And the DSM of UAV-SfM and the DEM of ALS were combined with CHM generation. Comparison of with CHM of UAV and ALS in the same period, UAV-SfM technique showed the same performance to ALS to evaluate tree height. PRMSE of ALS = 6.88%, PRMSE of UAV-SfM = 7.61%. Furthermore, this study developed DBH estimation model based on remote sensing parameters. Multi regression model and generalized linear model (GLM) were applied to estimate DBH of individual trees. Tree height and crown width were used to multi regression model as explanatory variables, and tree height, crown area, competition indices, and crown shape indices were used to GLM. As a result, GLM was the best model to estimate. Adopted explanation variables were tree height, crown area, and competition index for Japanese cypress, and crown shape indices were also adapted for Japanese cedar. The competition index improved the performance of DBH estimation model in each species. The performance indicates that the approach of integrating UAV-SfM-DSM with ALS-DEM is optimistic in retrieving parameters of individual trees of plantation for continuous forest inventory.

A Practical Method to Improve Precision Accuracy for Forest Aerial Photogrammetry using UAV

Masayoshi Takahashi (Forestry and Forest Products Research Institute, Japan)

Since the consumer UAVs has been rapidly advanced and integrated in recent years, Forestry sectors in Japan are also beginning to use this technology for forest management, subsidy inspections, and damage inspection. Many of these applications are based on aerial photo measurements, for example orthophotographs and 3D information. For accurate information acquisition, it is recommended to use ground reference points in the shooting area with accurate position information of them. However, since forests are located in mountainous areas and tree crowns cover most of ground surface, it is difficult to set up a ground reference points. We propose a practical method to improve the positioning accuracy for forestry by using aerial photo measurement of forests with UAV.

Poster Session 15:40 - 16:10 (16:40 – 17:10)

Room 1

Recent Forest Growth from the Re-measured Plots on the National Forest Land in Taiwan

Chao-Huan WANG (National Ilan University, Taiwan)

This study provides the basic resource information from the most recent (2009-2018) data collected by the 4th forest inventory (FI4) in Taiwan. We focus on the national forest land and interpret basic resource information such as the changes of wood volume and carbon stock. The sampling design collects information in two phases. In phase 1, a sample of points is interpreted from aerial photos, and the landscape is stratified into meaningful grouping, such as forested and non-forested area, and forest types. Phase 1 points are spaced at 500 m x 250 m grid throughout the forest area. Except for the natural hardwood lands, average dominant tree height and crown width, and crown closure have also been measured for each photo point. In phase 2, field permanent plots are spaced at 3 km x 3 km grid throughout the forest area, and most of them would be re-measured at a 5-year interval and the others at a 10-year interval. Up to now only the 5-year interval re-measured plots are available to estimate the volume and stock changes using the two 5-year intervals. The results show that the average volume stocks per ha of forests in Taiwan are still growing, the softwood forest type has high stock, and the conifer plantation has stronger growth capacity than the hardwood plantation. The man-made hardwood forest shows relatively weak growth, and the subsequent observations of its changes still needs to be paid attention continuously.

Room 2

Using Formosat-5 NDVIs to Extract Urban Greenspaces on the Urban Areas of Six Major Cities in Taiwan

Han-Ching Hsieh, Chun-Yuan Huang, Long-En Li (Taiwan Forestry Research Institute, Taiwan)

Urban greenspaces can be used to reflect quality of living environment of an urban area and has the benefits and value related to multiple ecosystem services. Based on the spatial distribution of continuous areas of high-density population defined by village administrative units, this study delimited the urban areas of six major cities in Taiwan. Aimed at the urban areas, the cloud-free multi-spectral and panchromatic Formosat-5 images from 2019 to early 2020 were chosen as experimental material. After image pre-processing and image panchromatic fusion with 2m spatial resolution, the normalized difference vegetation index (NDVI) images were established for greenspace areas extractions. The image segmentation with object-based mean shift algorithm was applied to classifying NDVI images and extracting the greenspace areas of the six urban areas respectively, and stratified random sampling points were selected for accessing the accuracy of each extraction. The results show that the overall accuracies of urban areas of six major cities are between 88% and 91%. Divided the total area of greenspace covered areas by the whole area of the urban area, the greenspace coverage rate of each urban area was obtained. Because urban greenspace coverage rate of urban areas in larger cities is an important baseline data for the inventory of urban green resources, the outcomes of this study will be beneficial to the monitoring and management of urban forests.

Room3

Applications of Google Earth Engine for Mapping and Assessing the Changes in Dry Monsoon Forest: A case study in Vavuniya District, Sri Lanka

Sharaniya Vijitharan, Nophea Sasaki, Manjunatha Venkatappa (Asian Institute of Technology, Thailand)

The monsoon forests are widely distributed in tropical South and Southeast Asia, including in Sri Lanka, where the highest extent of dry monsoon forest is found. This study aimed to map and assess the land cover changes by categories in Vavuniya district, Sri Lanka from 2001 to 2020 using phenology-based threshold classification (PBTC) on Google Earth Engine (GEE) computing platform. We focused particularly on the spatiotemporal changes in dry monsoon forests to assess the trend and annual rate of changes over the study period. Landsat 5 Thematic Mapper (TM) collections were obtained for 2001, 2006, and 2010. At the same time, we acquired Landsat 8 Operational Land Imager (OLI) imageries for 2016 and 2020 during the dry season. Our study identified and applied the minimum and maximum enhanced vegetation index (EVI) threshold values for classifying monsoon forests and other forest types. EVI thresholds ranged from 0.5027_0.776 and 0.650_0.882 for Landsat 5 TM and Landsat 8 OLI, respectively. We obtained an average overall accuracy was 87%, while the average kappa coefficient was 0.83. The producer and user accuracy of dry monsoon forest were above 80% for all maps. Although about 52.2% of land area was occupied by this forest in 2020, about 5.73% of dry monsoon forest was lost between 2001 and 2020, with an annual rate of change of -0.30% per annum. We estimated a severe reduction in dry monsoon forest area by 23% in Vavuniya North Divisional Secretariat division, with an annual rate of change of -0.01. In other divisions, the annual change rates were 0.18%, 0.003%, and 0.02% in Vavuniya, Vavuniya South, and Vengalacheddikulam, respectively. The trends of forest cover changes found in this study can be used for estimating carbon stocks and emissions, and also beneficial for conserving and sustainably managing dry monsoon forests at the district-level.

Room4

Relationship between Abundance of Native Honey Bee (*Apis cerana*) and Distance to Natural Forests in Hyuganatsu (*Citrus tamurana)* Orchards in Aya Town, Miyazaki Prefecture

Yasushi Mitsuda (University of Miyazaki, Japan)

This study aimed to examine the relationship between pollination service by native honey bee (as an ecosystem service) and distance to natural forest (as an indicator of landscape structure) in hyuganatsu (Citrus tamurana) orchards in Aya Town, Miyazaki Prefecture, Japan. In a previous study, we revealed the effects of the area of natural forests surrounding target hyuganatsu trees on the numbers of honey bee visit. The result supported our assumption that native honey bees, which visit hyuganatsu trees, came from natural forests. To further confirm this assumption, we developed a statistical model for representing the number of honey bee visit using distance to natural forests as the explanatory variable. The result of this study suggests that distance to natural forests is an important landscape factor for evaluating pollination service by native honey bee.

Room5

The Effect of Single Japanese Cedar on Field Strength Measurement at 920MHz Radio Wave

Nozomi Ikeda (Kagoshima University, Japan)

Recently, in Japan forestry workers have a lot of disaster of workplaces and it is increasing. Mobile network cannot be connected in many forest areas. That's why if accident happens, it is impossible to call emergently. It is because we need to understand the level of attenuation at radio wave. The objectives of this study are to clarify the effect of single Japanese cedar on field strength measurement at 920MHz radio wave. In other words, how is the radio wave obstructed by single tree. To measure the field strength, the distance between transmitter and receiver is constant, but the distance from tree to transmitter and receiver is variable. In term of the relationship between distance and field strength, when there has the tree, field strength become lower. When receiver or transmitter were located the tree nearer, field strength was lower. In term of the relationship between the rate of obstruction and field strength, when the rate of attenuation was larger, field strength was lower. This study shows that even if there is single tree, radio wave propagation is weak.