บทความวิจัย

CLASSIFICATION OF FORESTLAND FOR SUSTAINABLE MANAGEMENT PLANNING : A CASE STUDY OF COMMUNITY FORESTS IN NAKHON RATCHASIMA PROVINCE

Boonsuthee Jeravongpanich[1*] Patsi Prasomsin[2] Khwanchai Duangsathaporn[3]

[1*, 2, 3] Faculty of Forestry, Kasetsart University, Bangkhen, Bangkok, 10900

*E-mail: g521730001@ku.ac.th

ABSTRACT

Forestland was classified to help understand the capability of the forest area before formulating a forest management plan. A sample of 175 cases of Nakhon Ratchasima community forest (NMA_CF) projects undertaken by the Royal Forest Department was analyzed for the classification of forestland. Investigation, field checking, and geographic information system data on topographical and ecological information were utilized, namely: slope, elevation, soil, landform, and geology. The watershed classification (WSC) equation of the Moon-Chi basin and guidance under the National Forestry Policy were used in the investigation and classification process. The study revealed that the sampled forestland could be classified into two categories, 1) protected community forest (1 case) where contains WSC class 1-2 and the average slope was 35% or greater and management was for conservation and 2) productive community forest (174 cases) where contains WSC class 3-5 and the slope was less than 35% and management was for utilization and tree planting and the implementation of erosion protection measures. The forestland classification is helpful to forest managers in illustrating the important relationships and distinctions among the different land use types in the management of forest areas and in implementing the best solution to achieve the forestland objectives of the landowners. Using the two categories of NMA_CF, forest managers can formulate the necessary, integrated activities for each specific NMA_CF area, thus contributing to proper NMA_CF planning to achieve sustainable forest management.

Keywords: Forestland Classification, Community forest, Nakhon Ratchasima

INTRODUCTION

Forest classification is a key component of forest planning, as it considers land and forests and the type of land and what it is good for (Davis et al., 2001) In general, land managers need an organized system to understand the capability of the land to produce perhaps multiple goods and services, and thus provide a context for a plan. We must understand what each piece of land is capable of producing (timber, wildlife habitat, or otherwise) before we can develop alternatives for the land. Land classification serves as the basis for assessing land resources and serves as a framework for scheduling and evaluating management activities. Land classification systems should be based on professionally credible concepts and are necessary for providing policy direction and for assisting with policy implementation. Land can be classified using a number of physical or socioeconomic characteristics, including vegetation, soil, habitat, landform (physiography), and potential productivity. There are at least three organizational methods suitable for classifying land for forest planning and management processes. First, strata-based land classification groups land areas with similar attributes into strata, bins, or analytical units. Second, land classification can be based on units of land groups based on recognition of each stand or management unit by its area and other physical, economic, or ecological characteristics. Last, land classification can be based on the spatial position of groups of land as in the two previous cases and also incorporate a higher level of spatial information in the process (Bettinger et al., 2009).

For forestland classification in Thailand, the carrying capacity suggested by Pattaratuma (1992) is an effective scheme that a forest manager should consider. Carrying capacity provides information about how human needs can be satisfied by a unit of land (in earlier times, the concept related to the food needs of humans, but nowadays, it relates to much more than this), and its consists of three principles namely, land capability, land suitability, and land feasibility. Land capability is based on different characteristics of the area such as soil, slope, aspect, and the drainage system. These can affect the growth potential of the land and provide an indication of both the existing and potential situation. In addition to land capability variables, Ruangpanit (2013) stated that the classification can potentially change forest types and their growth rates. Land capability classification is a system of grouping soils

primarily on the basis of their capability to produce common cultivated crops and pasture plants without deteriorating over a long period of time (Atalay, 2016). Watershed classification and forestland zoning were examined to determine forestland classes and to understand their capability in Thailand, as these may be useful to forest managers for grouping watershed classes and assisting in facilitating future management.

Watershed classification was developed to address the problem of deforestation in catchment areas in conjunction with the Thai government setting up the National Hydrological Committee to manage national water resources and the Office of the National Environmental Board being assigned to study suitable methods for classifying watersheds. In 1992, the Watershed Classification Committee was formed to investigate watershed classification options for Thailand. Their research determined there was wide variation in the topology, geology, climate, and forest types, so the research staff decided to divide all 25 basins into five regions: Northern, Northeastern, Southern, Southeastern, and Central-Western (Figure 1).

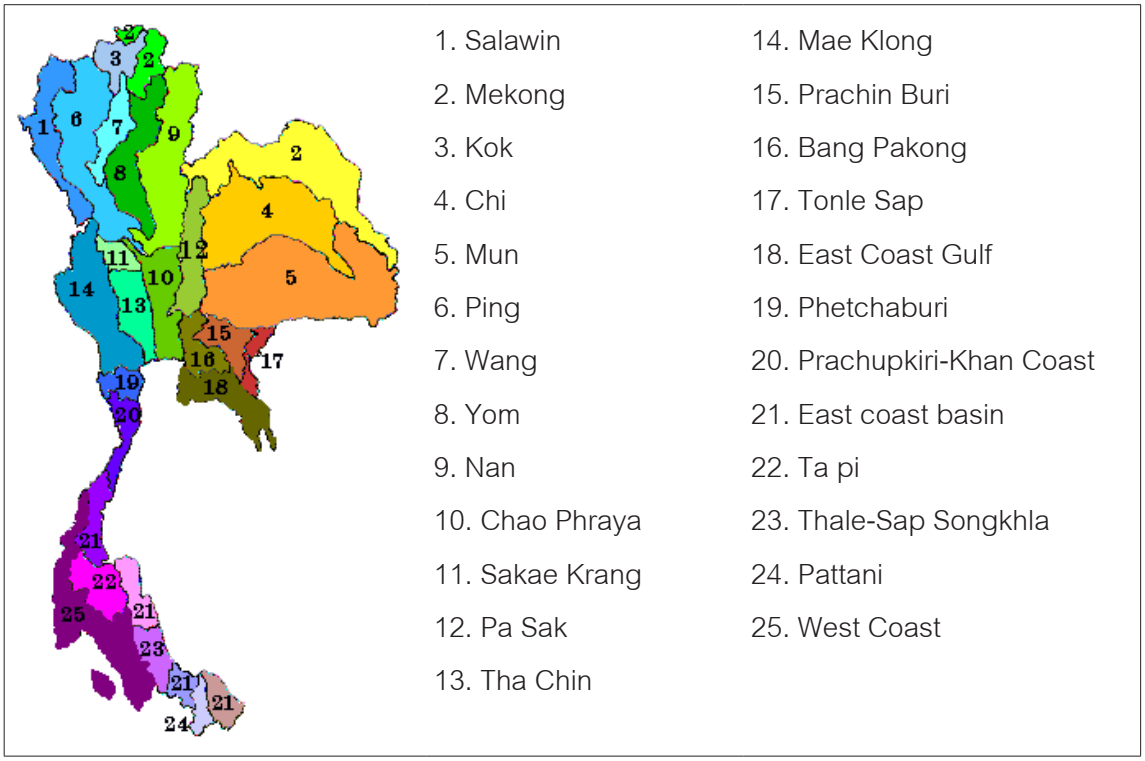

Figure 1 Major river basins of Thailand

To identify the watershed class value (WSC) of each area, the researchers agreed to utilize a multi-variable equation to predict WSC number as shown below (The cabinet of Thailand, 1988)

$$WSC = [a + b\,SLP + c\,ELV + dLF + eGE + fS] + (For) + (Min) \quad \text{..... (1)}$$

where WSC = Watershed class value

SLP = Slope as a measure of steepness of the land surface

ELV = Elevation of the area

LF = Landform as defined based on geomorphology related to recent erosional process

GE = Geology, including relationships of geological formation, geochemical weathering, etc.

S = Soil, including soil formation, physical properties related to erosion, and chemical properties related to productivity

For = Forest cover, score 1 if forested and 0 (zero) if non-forested

Min = Minerals existing in the area

and a, b, c, d, e, and f = the constant values

The cabinet of Thailand (1992) imposed political limitations on forest management by declaring other solutions to forestland zoning based on three zones described as: 1) Zone C, for protected areas such as a wildlife sanctuary, national park, watershed class 1, mangrove forest, local entity, and ancient place, where Zone C allowed for conservation programs such as prevention of soil erosion, provision of water resources, and serving as wildlife habitats; 2) Zone E, for commercial areas of four different development types: i) national forest, ii) natural forest resource, iii) community forest, and iv) natural resources, where Zone E allowed for utilizing forest resources such as timber, non-timber, mining, and fuel; and Zone A, for areas that can be used as agriculture land. The community forest project was grouped into watershed classes and decision making on activities in each class of the community forest project had to comply with the Cabinet Regulations. Guidance for the National Forestry Policy was provided in the Cabinet Regulations for all sectors regarding the processes to manage the forest resource and others natural resources over the long-term. Under the National Forestry

Policy, land with an average slope of 35% or greater was required to be managed as forest, and land tenure was not permitted to be issued according to the Land Code of Thailand (The cabinet of Thailand, 1985).

In Thailand, currently, there are around 10,000 community forest projects have been undertaken by the Royal Forest Department (RFD) in 67 province across the nation. The Community Forest Program was launched as a participatory project to prevent and solve social problems, especially rural poverty, as this was an important issue in Thai society. The aim of community forests was expanded to include the people' s wellbeing as stated in the National Economic and Social Plan no. 8 "...the people are placed at the center of development" (Office of the National Economic and Social Development Board, 2010). Initially, the community forest scheme was set up as participatory forest management that emerged from community woodlots and firewood plantations where community members could plant, maintain, and harvest trees in order to reduce household expenses (Royal Forest Department, 1987). The forestland classification of the community forest can help the people in the community to understand the capability of their forest areas and together they can formulate proper activities for implementation in the community forest. The local community can use the forestland classification information for decision-making based on the needs of the community members. In addition, the community forest operates under sustainable forest management, with the concept of engaging the local people living in and around the forest to become involved in the forest management, sharing its benefits amongst those involved in the forest management and aiming to sustain a functioning ecosystem. Moreover, community-based management is very appropriate and a crucial program that provides for a sustainable community in terms of economic, ecological, and social benefits, contributes to the well-being of the community members, addresses the social problems, and helps solve poverty. The outcome of community forest management is not only seen at the individual and community levels, but also nationally and globally, as community forest management can produce a complete forest for human needs.

The objective of this study was to classify the forestland of the 175 community forest areas in Nakhon Ratchasima province (NMA_CF) and to provide the scope of the activities for implementation in each category class.

METHODS

The materials and equipment that were integrated into the classification of NMA_CF forestland were: topographical maps, remotely sensed imagery, geographic information system (GIS) data, a personal computer, legally purchased software, and field collected data. The classification process started with collecting information regarding the 175 NMA_CFs and transferring the data into GIS features and relating the dataset of variables using the mapping software. Digital topographical maps from Royal Thai Survey Department (2006) were used for base mapping and the coordinates of the 175 NMA_CF areas were transformed to point features using the GIS software and overlaid on the base map. All the collected variables were compiled into the digital dataset for capability classification. The variables and the information of previous planning regarding the NMA_CF areas were utilized. Data preparation, GIS software solutions, and incorporating digital data based on remote sensing were based on the U.S. Department of the Interior U.S. Geological Survey (2015) in formulating the spatial dataset. Corrected data were employed for verifying the variables. According to Nakhon Ratchasima located in the Moon and Chi basins, the watershed classification scheme considered the ecological properties of the 175 NMA_CF areas based on the topography (notably the elevation, slope, landform, geology, and soil type) and the WSC equation of the Northeastern region was examined to compute the values of five variables for grouping forestland. The watershed classification in a part of the Northeastern region (the Moon and Chi basins) is based on an equation using the same variables of WSC as follows (The cabinet of Thailand, 1988):

$$WSC = [1.071 - 0.019(SLP) + 0.001(ELV) + 0.190(LF) + 0.049(GE) - 0.013(S)] + For \quad ; R^2 = 0.9925 \quad \text{..... (2)}$$

where WSC = Watershed class value

SLP = Slope as a measure of steepness of the land surface

ELV = Elevation of the area

LF = Landform as defined based on geomorphology related to recent erosional process

GE = Geology, including relationships of geological formation, geochemical weathering, etc.

S = Soil, including soil formation, physical properties related to erosion, and chemical properties related to productivity

For = Forest cover, score 1 if forested and 0 (zero) if non-forested

The watershed classes (WSC) defined based on the value computed using equation (2) for the Northeastern region are shown in the Table 1.

Table 1 Watershed classes of Moon and Chi basins

Watershed class	Value of computed WSC	Zoning categories
Class 1	< 1.55	C
Class 2	1.56 - 2.55	E
Class 3	2.56 - 3.55	E
Class 4	3.56 - 4.75	E
Class 5	> 4.75	A

The forestland zoning and the guidance from the National Forestry Policy were employed in the final classification. The method framework of the study is shown in Figure 2.

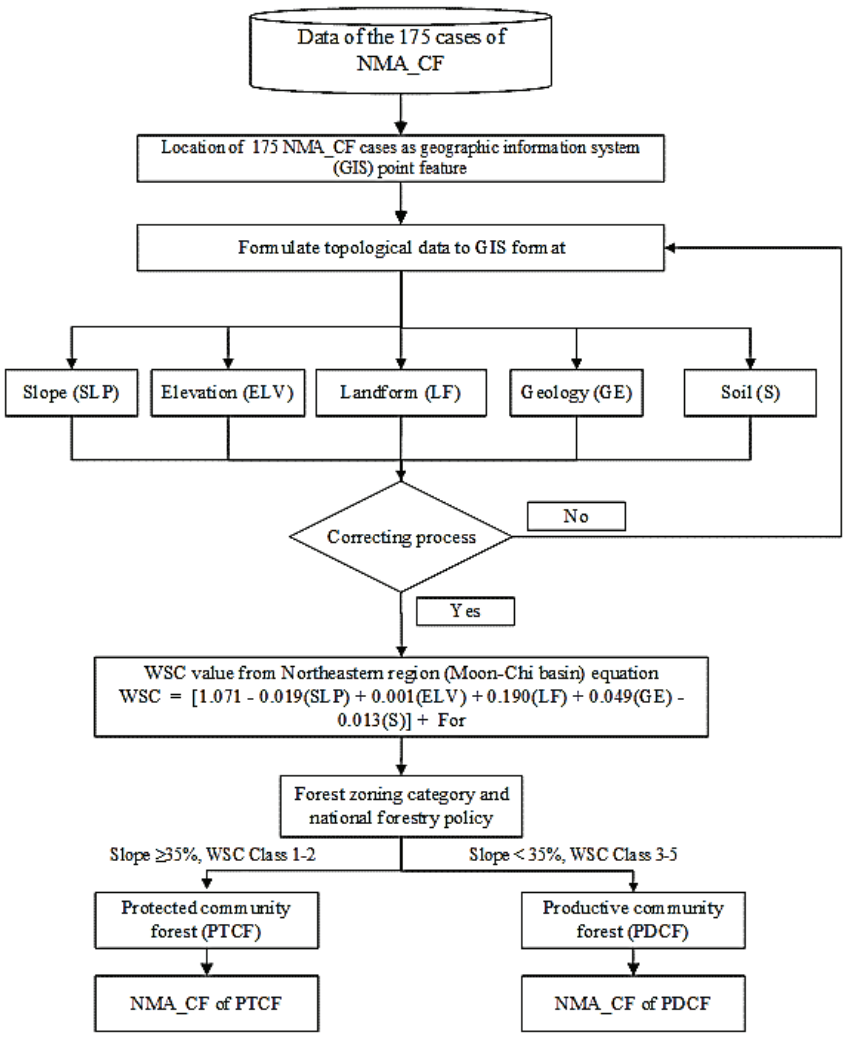

Figure 2 Framework of forestland classification of 175 NMA_CF areas

RESULTS AND DISCUSSIONS

Forestland classification of NMA_CF

The study identified that the forestland classification of NMA_CF was comprised of four capability classes, namely group I to group IV. According to the value in Table 1, the forestland classification of the 175 NMA_CF areas were grouped in relation to the watershed classification, namely classes 2, 3, 4, and 5 respectively (Table 2). The NMA_CF forestland classification is shown in Figure 3.

Table 2 Forestland classification groupings of NMA_CF areas

NMA_CF group	Watershed classification	Number of NMA_CFs (cases)
Group I	Class 2	1
Group II	Class 3	6
Group III	Class 4	70
Group IV	Class 5	98

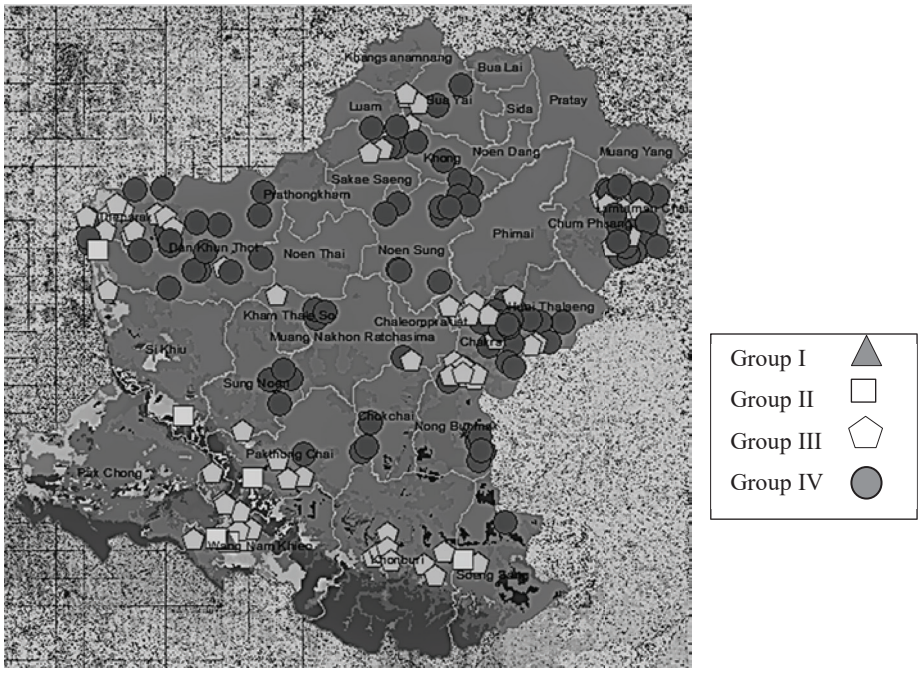

Figure 3 Location of forestland classification groups for 175 NMA_CF areas in Nakhon Ratchasima province

Group I contained the highlands located in the headwaters of catchments, with an average elevation of 455 m above mean sea level and an average slope of 39%. Group II included areas that were highland at elevations between 218 to 460 m above mean sea level and with an average slope in the range 3-18 %. Groups III and IV contained the largest number of the NMA_CF cases (168) at elevations between 86 to 409 m above mean sea level and with an average slope in the range 0-14 %. Based on the forestland zoning and the guidelines of the National Forestry Policy, the forestland on areas with an average slope of

35% or more must be forested (The cabinet of Thailand, 1988). Group I of NMA_CF had an average slope of 39% (> 35%) and groups II-IV contained NMA_CF areas located on slopes between 0 and 17.5% (lower than 35%). Therefore the four groups of NMA_CF could be aggregated into two categories, namely protected community forest (PTCF) in group I and productive community forest (PDCF) in groups II-IV as shown in Table 3.

Table 3 Forestland classification of NMA_CF

NMA_CF category	Forestland classification	Forestland activities
Protected community forest (PTCF); 1 case	Highlands, steep slope (≥ 35%) WSC class 1-2	Manage this area as prime watershed for providing water resources. Tree planting is the main activity. Activities must be implemented with erosion protection measures. Strict selection of activities, with plantations of forest tree species to address soil and water conservation measures.
Productive community forest (PDCF); 174 cases	Lower land, flat plains (slope < 35%) WSC class 3-5	Manage this area for utilization by the local community to provide livelihood for the people living around the forest. Permissible activities include agricultural cropping and grazing with moderate need for some soil conservation measures. Area zoning is needed to selecting the type of agriculture on suitable land.

Most of the NMA_CF projects (about 99%) have been established on flat land and at low elevation, with highlands or hilly areas accounting for about 1% of the 175 cases. The classification of the forestland in the NMA_CF areas places different limitations on selecting suitable forest management activities for each of the two categories-protected community forest and productive community forest. There was only 1 case in the protected community forest category, being located on an average slope of 39% at an elevation of 455 m above mean sea level. The productive community forest categories covered 174 cases of NMA_CF comprising the following groups: 1) group II (WSC class 3), 6 cases located on 3-18% slopes

and at an elevation between 218 and 460 m above mean sea level; 2) group III (WSC class 4) 70 cases located on 0-14% slopes and at an elevation between 120 and 409 m above mean sea level; and 3) group IV (WSC class 5), 98 cases located on 0-14% slopes and at an elevation between 86 and 259 m above mean sea level.

CONCLUSIONS

Through this study, the Nakhon Ratchasima NMA_CF areas were classified into four groups: group I (WSC class 2), group II (WSC class 3), group III (WSC class 4), and group IV (WSC class 5). In accordance with the Cabinet Regulations, all four groups of NMA_CF were divided into two categories of protected community forest (PTCF) and productive community forest (PDCF). Most of the community forest area in Nakhon Ratchasima (174 cases) was located on slopes lower than 35%, at low elevation, and on flat land that can be managed for improving the forestland as a productive area. There was only one case of NMA_CF on an average slope of 35% or more in the highlands that could only be managed as a protected area.

As the result of this study, the developed watershed classification can be applied usefully to classify forestland in community forests in Nakhon Ratchasima province and thereby identify the land capability of the target area at the commencement of any project. Based on the classification, forest managers can use the information in their forest management planning to achieve the goals of the forestland owner. Community forest managers can use this forest classification in the formulation of activities for implementation in community forest areas. Moreover, proper activities based on the capability of the forestland will contribute to achieving the objectives of both the forestland owners and the forest managers.

ACKNOWLEDGEMENTS

I would like to gratefully thank and express my deep indebtedness to Professor Dr. Wuthipol Hoamuangkaew (deceased), my previous thesis co – advisor, for his advice, encouragement, and valuable suggestions about the uncompromising in study. Many thanks are also recorded to Associate Professor Dr. Santi Suksard, and Mr. Pichit Lamyai helped to improve the writing format for the Thai Journal of Forestry.

Many thanks to Mr. Trira Kowphasid, the Director of the Community Forest Division, and to Mr.Somthawin Leelamanotham and Mr.Sompong Chumpangphan, forest officers in Forest Office no. 8 (Nakhon Ratchasima) for facilitating the participation scheme. Thank

you very much to Mr. Phakawat Chanthong, the forest officer of the Bureau of Community Forest who provided geographic information system expertise and helped with the spatial data analysis. My thanks are also recorded to Associate Professor Dr. Sura Pattanakiat and his team (Mr. Ithiphat Rueangkitwat and Mr. Chuti Rakasachat), Faculty of Environment and Resource Studies, Mahidol University, for providing substantial information on watershed classification.

I especially appreciate the support of Mrs. Jurirat Jeerawongpanich, my wife, for her continuing cheerfulness. Finally, I express my deep appreciation to my family who have always devoted time to support me to produce the final draft of this paper.

REFERENCES

Atalay, I. (2016). A new approach to the land capability classification: case study of Turkey. **Procedia Environmental Sciences**. 32, 264-274.

Bettinger, P., Boston, K., Siry, J.P., & Gregner, D.L. (2009). **Forest management and planning**. The United States of America: Elsevier.

Davis, L.S., Johnson, K.N., Bettinger, P.S., & Howard, T.E. (2001). **Forest management**. 4th ed. New York : McGraw-Hill Companies, Inc.

Office of the National Economic and Social Development Board. (2010). **Summary of the direction of the eleventh national development plan, Bangkok**. Retrieved December 20, 2015, from http://www.nesdb.go.th/Portals/0/news/annual_meet/53/book/BookYearend2010.pdf.

Royal Forest Department. (1987). **Annual report year 1988**. Retrieved December 20, 2015, from Bangkok.

Royal Thai Survey Department (Cartographer). (2006). **Topography Map** [Raster]

Ruangpanit, N. (2013). **Forest and Forestry in Thailand.** Bangkok : Uopen Co., Ltd.

The cabinet of Thailand. (1985). **To approve of the National Forestry Policy.**

The cabinet of Thailand. (1988). **Watershed classification of Moon-Chi basins and land use regulation in the watershed area.**

The cabinet of Thailand. (1992). **The classification of the utilization of foretland and forest resource in the National Reserved Forest.**

U.S. Department of the Interior U.S. Geological Survey. (2015). **USGS Science for a Chanaging World, EarthExplorer**. Retrieved December 20, 2015, from https://earthexplorer.usgs.gov