

CHAPTER 5

Conclusions and Recommendations

This research focused on the effects of forest fire on plant diversity, carbon sinks and nutrient accumulations in dry dipterocarp forest (DDF) with annual fire and without fire for at least 10 years at Intakin Silvicultural Research Station, Chiang Mai province.

5.1 Plant Diversity in Fire and Non-fire DDF

(1) *Plant Diversity in Overall Area of DDF*

Plant communities in DDF of this research station varied with sites according to different dominant trees and species composition. Among 63 species, five tree species including *D. obtusifolius*, *S. obtusa*, *D. tuberculatus*, *Aporosa villosa* and *Canarium subulatum*, and a climber species, *Millettia extensa*, had the frequency of 100%. The average tree density was 2,715 trees/ha (434 trees/plot). *D. obtusifolius* had the highest dominance (35.19% of all species), and IVI (18.19% of all species). The species diversity index by the Shannon-Wiener function in the forest was 3.50, whereas the forest condition was rather good, 50.86 in average.

(2) *Plant Diversity in Fire and Non-fire DDF*

Species richness of tree species in DDF with annual fire was 42 species, 36 genera, 22 families whereas DDF without fire consisted of 45 species, 38 genera, 26 families. The number of tree species was high for the families of Leguminosae, Euphorbiaceae, Rubiaceae and Dipterocarpaceae.

D. tuberculatus had the highest frequency in both DDF with and without fire, 100 and 99%. Average tree densities in these forests were 1,827 and 1,809 trees/ha, respectively. *D. tuberculatus* had the highest density, 510 trees/ha in DDF with fire and 573 trees/ha in DDF without fire. This tree species had also the highest dominance and IVI values, DDF with fire: 52.77 and 36.44% of all species, and DDF without fire: 63.45, 45.15%, respectively.

The species diversity indexes (SWI) in DDF with and without fire were 3.24 and 3.20, respectively, and FCI of 50.01 and 55.72. Most trees in DDF with and without fire followed the reverse-J-shaped distribution with plenty of individuals in the smaller size classes that indicated a good rejuvenation

5.2 Carbon and Nutrient Allocation in Tree Biomass of Fire and Non-fire DDF

(1) *Tree Biomass*

The total biomass in DDF annual fire was 106.6 Mg.ha⁻¹ divided into stem, branch, leaf and root as 68.6, 22.9, 1.9 and 13.1 Mg.ha⁻¹. *Dipterocarpus tuberculatus* had the highest biomass accumulation 51.7% (55.1 Mg.ha⁻¹), followed by *Shorea obtusa*, *Gluta usitata*, *Canarium subulatum*, *D. obtusifolius* and *Aporosa villosa* respectively.

The total biomass in DDF without fire was 128.3 Mg.ha⁻¹ divided into stem, branch, leaf and root as 82.1, 29.3, 2.0 and 15.0 Mg.ha⁻¹. *D. tuberculatus* had the highest biomass accumulation 67.4% (86.5 Mg.ha⁻¹), followed by *Shorea obtusa*, *Gluta usitata*, *Canarium subulatum*, *D. obtusifolius*, and *Aporosa villosa*, respectively.

(2) *Stored Carbon-Nutrients in Tree Biomass*

Biomass carbon stored in DDF with fire was 52.6 Mg.ha⁻¹ divided into stem, branch, leaf and root as 34.3, 11.1, 0.9 and 6.3 Mg.ha⁻¹. *D. tuberculatus* had the highest biomass accumulation (27.2 Mg.ha⁻¹), followed by *Shorea obtusa*, *Gluta usitata*, *Canarium subulatum*, *D. obtusifolius*, and *Aporosa villosa*.

Biomass nutrients accumulated in DDF with fire including, nitrogen, phosphorus, potassium, calcium and magnesium were 585.39, 82.95, 402.26, 849.09 and 193.08 kg.ha⁻¹, respectively.

The biomass carbon stored in DDF without fire was 63.4 Mg.ha⁻¹ divided into stem, branch, leaf and root as 41.1, 14.2, 1.0 and 7.2 Mg.ha⁻¹. *D. tuberculatus* had the highest biomass accumulation, followed by *Shorea obtusa*, *Gluta usitata*, *Canarium subulatum*, *D. obtusifolius*, and *Aporosa villosa* respectively.

The biomass nutrients in DDF without fire including, nitrogen, phosphorus, potassium, calcium and magnesium were 896.62, 123.45, 610.75, 1,301.62 and 292.68 kg.ha⁻¹, respectively

5.3 **Soil Properties, Stored Carbon and Nutrients, Nutrient Recycling, and Changes of Soil Moisture and Air Temperature in Fire and Non-fire DDF**

(1) *Soil Properties*

The effects of fire on soil properties were occurred in surface soil. The surface soil in DDF with fire had loamy sand whereas non-fire site was sandy loam. Other soil parameters in the surface soil in DDF with fire had loamy sand whereas non-fire site was sandy loam. Other soil parameters in surface soils of DDF with and without fire had some differences; bulk density: 1.26, 1.11 Mg.m⁻³, pH: 5.1, 5.5 (strongly acid), contents of organic matter: 25.0, 32.1 g.kg⁻¹, carbon: 14.5, 18.6 g.kg⁻¹, nitrogen: 0.8, 1.2 g.kg⁻¹, available P: 13.6, 34.9 mg.kg⁻¹, extractable K: 282.8, 359.8 mg.kg⁻¹, Ca: 385.2, 621.9 mg.kg⁻¹, Mg: 154.7, 271.5 mg.kg⁻¹ and Na: 10.6, 18.9 mg.kg⁻¹, respectively.

(2) *Carbon-Nutrient Accumulations*

The average amounts of organic matter, carbon and nitrogen within 200 cm depth soil of fire DDF were 124, 72 and 7.9 Mg.ha⁻¹, respectively whereas the higher amounts as 212, 123 and 8.0 Mg.ha⁻¹ were found for non-fire forest. Amounts of extractable P, K, Ca, Mg and Na amounts of fire site were in the order of 50; 6,421; 3,827; 2,902 and 493 kg.ha⁻¹ while those of non-fire forest were 156; 6,227; 4,287; 3,921 and 412 kg ha⁻¹, respectively.

(3) Seasonal Changes of Soil Moisture and Air Temperature

The soil moisture contents at 0-5 cm depth throughout a year under DDF without fire varied in a range of 6.1-25.9%, which were a little higher than DDF with annual fire, 4.7-21.1%. The moisture contents in surface soils during five months of dry season, December-April 2011, were low as 4.7-6.9% for DDF with annual fire and higher as 6.1-9.7% for the non-fire forest (Figure 4-10). The difference of soil moisture contents between DDF with and without fire was about 2.9% in average.

The air maximum temperature at 1.3 m above ground throughout a year under DDF with annual fire varied between 28.6-38.5 °C while the non-fire forest had a range of 27.9-38.1 °C. A little decrease of maximum temperature was implied to the effect of fire. For minimum air temperature, a range of 13.5-22.9 °C was occurred in DDF with annual fire, and 12.8-23.1 °C for non-fire forest. The minimum temperature was observed during January-February 2011, and the maximum temperature was occurred during March-April 2011. A little difference in air temperature was observed between DDF with and without fire.