CHAPTER 7

Conclusions

This research focused on the evaluation of ecological and socio-economic values of two forest plantations including the 22-year-old teak (*Tectona grandis* L.f.) and pine *Pinus kesiya* Royle ex Gordon) in the Doi Tung Development Project area, Chiang Rai province after 20 years of implementation.

7.1 Ecological Values

7.1.1 Growths and biomass of tree species in plantation forests

The tree densities of teak and successional tree species varied greatly with plots. The values were 114, 116, 84, 88 and 237 trees/plot with the mean value of 127.8 ± 62.76 trees/plot. Teak densities varied between 77 and 146 trees/plot (85.0 ± 48.73 trees/plot on average), whereas those values of the successional tree species had the greatly variation, 1-91 trees/plot. The stem girths of the 22-year-old teak varied between 51.73 ± 16.56 and 73.18 ± 20.84 cm with the mean value of 63.87 ± 7.85 cm. The heights of teak varied between 13.39 ± 1.56 and 19.40 ± 3.12 m with the mean value of 16.62 ± 3.12 m.

The tree densities of pine and successional tree species varied with plots. The values were between 75 and 101 trees/plot with the mean value of 84.0 ± 7.8 trees/plot. The densities of pine varied between 60 and 84 trees/plot. Those values of the successional tree species were in range of 2-26 trees/plot. The stem girths of the 22-year-old pine varied between 98.30 ± 17.90 and 129.50 ± 18.70 cm with the mean value of 112.29 ± 19.46 cm. The heights of pine varied between 28.0 ± 3.40 and 30.8 ± 1.40 m with the mean value of 28.30 ± 2.50 m.

The total amounts of standing biomass of teak and successional tree species in five sampling plots of the 22-year-old teak plantation varied greatly between 27.06 and $68.42 \text{ Mg plot}^{-1}$ with the mean value of **42.24±0.65** Mg plot⁻¹ (**264.0±103.42** Mg ha⁻¹). The biomass amounts of teak in these plots were 15.68, 25.60, 27.77, 47.38 and 68.15 Mg plot⁻¹ (Mean value = $36.92\pm20.90 \text{ Mg plot}^{-1}$), whereas those of succession tree species were 0.27, 0.83, 1.46, 5.84 and 18.23 Mg plot⁻¹ (Mean value = $5.33\pm36.92 \text{ Mg plot}^{-1}$).

The total amounts of standing biomass of pine and successional tree species in ten sampling plots of the 22-year-old pine plantation varied between 49.32 and 71.25 Mg plot⁻¹ with the mean value of **64.59±9.41** Mg plot⁻¹ (**403.70±58.80** Mg ha⁻¹). The biomass amounts of pine tree in these plots varied in a range of 46.26-82.22 Mg plot⁻¹ (mean value = 62.14 ± 3.05 Mg plot⁻¹), whereas those of the succession tree species varied between 0.36 and 4.98 Mg plot⁻¹ (mean value = 3.05 ± 2.21 Mg plot⁻¹).

7.1.2 Carbon storages in plantation forests

The amounts of carbon stored in biomass of all tree species in five sampling plots of the teak plantation were shown in **Table 4-1**. The total amounts in these plots varied between 13,379.38 and 33,843.62 kg plot⁻¹ with the mean value of **20,888.37**±8189.46 kg plot⁻¹ (**130.57**±51.18 Mg ha⁻¹). The mean carbon amounts allocated in stem, branch, leaf and root organs were 14,196.61; 4,140.38; 1,019.37 and 1,532.01 kg plot⁻¹, respectively.

The amounts of carbon stored in biomass of all tree species in ten sampling plots of the pine plantation were given. The total amounts in these plots varied between 24,515.0 and 41,289.85 kg plot⁻¹ with the mean value of **32,100.0** \pm 4650.0 kg plot⁻¹ (**200.63** \pm 29.09 Mg ha⁻¹). The mean carbon amounts allocated in stem, branch, leaf and root organs were calculated to 21.410.0; 4500.0; 760.0 and 5,420.0 kg plot⁻¹, respectively.

7.1.3 Water storages in plantation forests

The total water storages in plant biomass in five plots of the teak plantation varied from 31.44 to 80.50 m³ plot⁻¹ (average: 47.72 ± 20.93 m³ plot⁻¹ or 298.25 ± 103.82 m³ ha⁻¹). The average amounts of biomass water stored in stem, branch, leaf and root components were in the following order: 26.99 ± 11.69 , 14.19 ± 6.63 , 3.75 ± 1.79 , and 2.79 ± 0.91 m³ plot⁻¹. The amounts of water storage in biomass of the succession species varied between 0.26 and 43.16% of the total stand.

The total water storages in plant biomass in ten sampling plots of the pine plantation varied from 39.76 to 67.77 m³ plot⁻¹ (average: 52.34 ± 7.80 m³ plot⁻¹ or 327.10 ± 48.77 m³ ha⁻¹). In the stem, branch, leaf and root, the average amounts of water stored in biomass were in the following order: 32.30 ± 4.54 , 12.50 ± 2.28 , 2.19 ± 0.31 , and 5.35 ± 0.70 m³ plot⁻¹. It was the highest in stem, followed by branch, root and leaf. The amounts of water storage in the biomass of successional tree species were small, varied between 0.99% and 6.90% of the total storage in plant biomass.

7.2 Socio-Economics of Local Villages

The reforestation project provides various benefits to the local people, both ecological (environmental) and socio-economic values. The local people receive benefits from the plantation forests, either direct or indirect benefits. The direct benefits include either wood (timber) or non-wood (non-timber) forest products and income from employees of the project. The reforestation project in Doi Tung area can improve livelihoods of the local people as they use the timber for construction, fuel, etc., and the non-wood products as food, medicine, fiber, resin, oil, fuel, and so on.

The ecological or environmental values are considered as the indirect benefits such as carbon sequestration, and release of oxygen, hydrologic cycle and water flow regulation, prevention of soil erosion and land slide, restoring soil nutrients, improving microclimatic, recreation value, and so on. The roles of teak and pine plantations on carbon storages as well as water retention have explained in Chapter 4 and 5.

A large scale reforestation in abundant mountain area is the first priority to be done under the integrated watershed and community development project to stop migration of poverty people, who destroy the forest, it's very important to be solved the critical problems from flooding, drought and poverty of rural people in Thailand.