5. Discussion

Rainfall in 1989 was well distributed , eventhough there was a short dry spell during the last week of June. It did not negatively affect the growth of upland rice due to high water holding capacity of soil. Rain of 318 mm or 21 % in May, the first month of rainy season, resulted in high erosivity index. Erosivity index of 182.7 m-t/ha or 27.2% per annum was recorded in this month. Therefore, good ground cover in the beginning of the rainy season was very important in dissipating erosive power of rain and retarding the flow of runoff. This was achieved by providing an intermediary impact-absorbing layer of mulch from the preceding year residue or from other sources like grass strips or Leuceana hedge rows. In addition, plant canopy from early planting dissipated erosive power of rain and protected the soil from the erosive rain.

Amount of residue from the preceding year was quite low, particularly from the relay cropping systems of corn/lablab and corn/red kidney bean. Normally corn was harvested in late August and followed by lablab or red kidney bean. The residue of corn partly decayed by the end of rainy season due to high moisture content. Furthermore, it was destroyed by some animals such as rats, moles, ants and termites, etc. Therefore, at the time prior to upland rice planting only 1.8 t/ha of residue was recorded from cropping system of corn/lablab and corn/red kidney bean. Normally, such systems gave more than 10 t/ha of dry matter at the time of harvesting (TAWLD, 1985).

Upland rice grew slowly especially in the first two months after planting. After this stage upland rice was able to compete with weed. The critical aspects are weed management and fertility management. Competing weeds ideally need to be removed by the third week after the crop has been seeded and certainly by the fifth week otherwise permanent damage to crop yield may occur. Two or more weed controls need to be effective and economic within the limited time available.

Estimated soil loss from USLE model was almost double of the values measured by staking technique. Eventhough, the "C" value was replaced by the onsite measurement and LS-subfactor was modified by using McCool equation. The reason behind this might be the soil in the highlands of Northern Thailand differ from empirical data gathered in midwestern United States. Normally, soil in agricultural area on hilly land of northern Thailand was deep, high in organic matter content and well drained. This resulted in higher infiltration of water into the soil. Reduction of runoff decrease soil surface movement. The important Great Soil Groups found on hilly areas are Haplustalfs, Paleustults, Haplaustults and Palehumults (Therawong, 1985). Higher estimation of soil loss was also reported by Suddhapreda et al. (1988) whose work was conducted on Pak Chong clay loam (Oxic Paleustults) with 25 % slope. The areas utilized for shifting cultivation were predicted to give the highest soil loss of 1208 t/ha/yr.

Soil loss was not significant different among planting date because of high erosivity index occured on the first month of rainy season and the initial growth rate of upland rice was very low. The significant difference in soil loss among treatments was due to the effects of cropping factor in USLE-model. The C-value was 0.54 from no-mulching while an average of 0.38 was obtained from mulched plots (Table 20). It means that, if all variables of USLE are fixed, mulching the soil with crop residues can reduce soil erosion by 30 percent. The C-value can be reduced through the effectiveness of plant canopy and mulch. Therefore, an improved variety to produce good ground cover during vegetative phase and maintaining good ground surface cover, should be developed. Plant spacings should be closed enough to favor weed control, soil erosion control and yield. Mulching should be encouraged to improve crop emergence, reduce erosion and increase infiltration.

The strips of corn/red kidney bean inherited high value of LS-factor. Therefore, higher estimates of soil loss was found compared to other mulching treatments.

Hall et al. (1985) suggested that soil loss tolerance, ranging from 2.2 to 11.2 t/ha, depending on soil types. Measured and modeled soil loss from the experiment were higher than the tolerable level (Table 1). Therefore, current soil loss exceeds the highest tolerable rates about 20 to 50 times. If this rates continues to occur, whole top soil layers would be washed away by water run-off within only a few years.

The average soil loss was high even in treatments where crop residues were used for mulching. However, Inthapan and Boonchee (1988) showed significantly highest soil loss rate of 116 t/ha/yr from traditional farming system. Generally, residue measured from preceding crops was only 2 t/ha. It might not be enough to cover soil on the steep lands from high erosive power of rain. TAWLD (1985) suggested that maintaining soil fertility and minimizing erosion on upland areas require at least 10 t/ha of residue. Soil surface disturbance during land preparation period is also the practices that accelerate soil erosion. Therefore, such practices should be minimized.