Evaluations of sediment loss and nutrient condition in various land use types in the low mountainous area of Northern Vietnam.

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1. INTRODUCTION

Soil erosion and associated changes in soil production is one of the leading environmental concerns around the world. Water supply and storage reservoirs, freshwater and coastal environments, agriculture and urban productivity can be negatively impacted by soil erosion. Approximately 10 million ha of cropland are lost due to soil erosion (Pimentel, 2006). Declining of soil production is also occurred related to soil erosion and nutrient loss. Soil erosion can also relate to local socio-economic activity because local economic and human activity can control vegetation types, species, and ground surface conditions. Thus, vegetation overstory and understory covers related to land use types are considered the most important factors for the soil erosions followed by precipitation patterns and topography (Thornes, 1990). Integration of soil erosion processes at given land use types can also affect soil nutrient conditions. Hence, the relationships between the soil erosion and soil nutrient loss in various land use types from forested areas to agricultural land have not been examined. The objectives of this study were (1) investigated soil erosion conditions in various land use types, (2) identified the characteristics of soil nutrient and carbon accumulations; and (3) examined the relationships between soil erosion and nutrient conditions with respect to land use types.

2. STUDY AREA AND METHOD

This study was conducted in Xuanmai town in the northwest of Hanoi capital, Vietnam (latitude 20°54'00''North and longitude 105°35'00''East; Fig. 1). Mean annual precipitation and temperature around study area was 2268.4mm and 22.7°C, respectively. For examining soil erosion and soil production, we selected representative 10 land use types including forest and agricultural land around Xuanmai town. Spatial distribution of these 10 land use types was examined using the latest Landsat image (taken in 2007). For each land use types, we selected three plots (1m x 1m) for investigating vegetation biomass, litter cover, soil erosion, overstory vegetation condition, and soil physical and chemical properties. We also measured high of soil pedestal for presentation soil erosion feature (Sidle et al., 2000). For soil physical and chemical properties, we measured soil hardness, soil bulk density, water contents, soil water repellency, soil C/N ration, soil organic content. For soil surface condition, we sampled all litter and vegetation in 1 x 1 m plot. Since litter and ground cover condition may be associated with solar radiation input (light condition) to ground surface, we also measured canopy openness using fish eye lens.

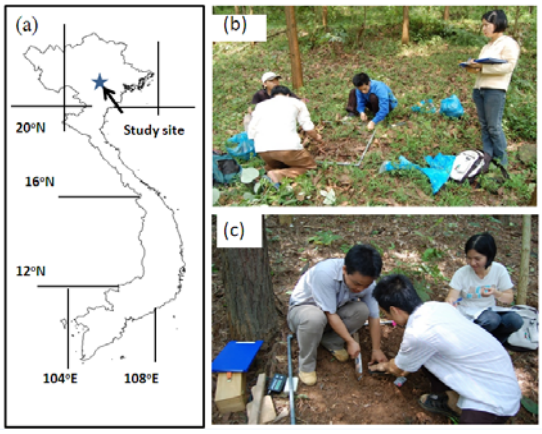

Fig. 1. Outline of study site

3. RESULTS AND DISCUSSION

Dominant overstory vegetation in this area was Acacia mangium, Pinus massoniana, Acacia sp,

Eucalyptus and some of native forest. Agriculture crops were cassava and lemon grass. Shrub land was also occurred in abandoned land after plantation. Dry biomass in mature forest (except pine forest) and agriculture land were higher than in landscape plantation and bare land. Highest dry mass was occurred shrub land use type (373.4 g m^{-2}). Mean litter dry mass of 1020.5 g m^{-2} at shrubs land was significantly higher than 259.6 g m^{-2}, 266.0 g m^{-2} and 0 g m^{-2} at native trees, cassava and bare land, respectively (Fig. 2)

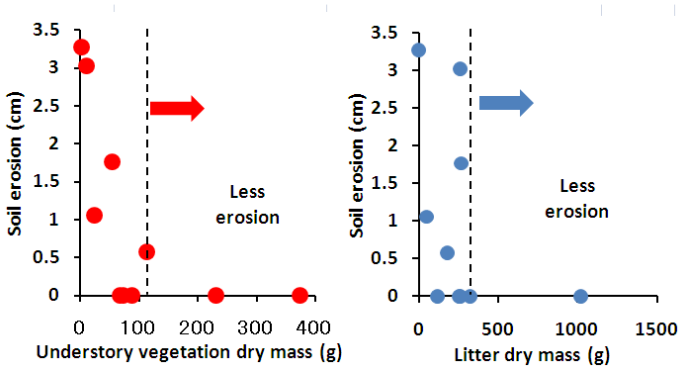

Fig. 2. Relationship of soil erosion and understory vegetation/litter

Significant differences about bulk density among land use types were observed. Bulk densities were higher in lemon grass (1.3 g cm^{-3}), landscape plantation (1.2 g cm^{-3}) and cassava (1.2 g cm^{-3}). Bulk density tended to be higher in Eucalyptus forest. The soils revealed a very high percentage of silt and clay fractions, over 70% of total, and a low sand fraction. Sand contents were higher in Lemon grass and bare land, as compared to soils from Acacia forest, native tree, shrub and cassava. Thus, lemon grass and bare land can be affected by more soil erosion than the other land use types.

The height of soil pedestals due to soil erosion varied from 0 to 3 cm. Mean soil pedestals high was 1.0 cm among all land use types. Highest soil pedestal was occurred at bare land and pine forest (3.3 cm and 3.0cm). We did not observed soil erosional features in native trees forest, young Acacia forest, Eucalyptus forest, shrub and Lemon grass

Soil organic carbon (SOC) and total nitrogen (TN) contents in surface layers differed significantly across land use types (Table 1). The result showed that land use affected contents of soil organic carbon, total nitrogen. Ranged of SOC and TN was 0.79 to 5.17% and 0.07 to 0.29%, respectively. The mean C: N ratios ranged from 10.61 and 19.08 with 16.23 in mean with 2.22 of standard deviation. Although vegetation biomass significantly related to soil erosion feature, such physical processes may not directly affect the availability of soil total C and N in our study sites. Because litter is quickly decomposed in the tropical environment, soil carbon and nutrient are rapidly produced than the soil erosion and transport processes in our study sites.

Table 1. Chemical properties of soil

	Pinus massoniana	Acacia mangium	Native tree	Acacia spp	Eucalyptus	Cassava	Shrub	Lemon grass	Bare land	Roystonea regia
Total Carbon (%)	3.18	4.41	3.41	3.24	4.79	1.92	5.17	2.48	2.39	0.79
Total nitrogen (%)	0.19	0.26	0.20	0.19	0.29	0.12	0.27	0.16	0.14	0.07
C/N ratio	16.65	17.00	17.11	16.53	16.44	15.73	19.08	15.48	17.70	10.61

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