

## CHAPTER 1

### INTRODUCTION

Highland-conventional cultivation have caused serious problem of degraded soil productivity for several decades. Inappropriate land uses and poor fertilizer management on sloping land may cause massive loss of plant nutrients with surface runoff and soil erosion. This may lead to low crop productivity due to poor efficiencies of fertilizer-use and plant nutrient uptake, leading to decreased crop yields, low income and poor economic problem. Therefore, increasing fertilizer use efficiency and soil nutrient availability are important to improve crop productivity on sloping highland. The efficient plant nutrient management should be applied with soil and water conservation practices in order to have a sustainable highland farming system.

Many strategies have been used for soil and water conservation on sloping highland for many decades, but most of them have not been broadly adopted under local condition due to impractical and low cost of benefit return. Panomtaranichagul and Narubarn (2008) recommended that sustainable highland rainfed agriculture should be an integration of many conservative cultural practices such as water harvest, anti-soil erosion and multiple cropping (IWAM). Particularly combinations of cultivated furrow with bio-degradable mulching material and alley cropping system was the best method for reducing soil erosion, harvesting rain water, increasing plant nutrient availability and fertilizer use efficiency when compared to the other types of

single conservative cultural practices. However, applications of mulching material in the best IWAM seem to be impractical when biomass of plant residue is limited. Therefore, contour furrow cultivation, the second best method was the selected cultural practice for improving fertilizer use efficiency in this study.

In general, most of cultivated soil in mountainous area of northern Thailand is acid soil due to acidic parent material with high amount of iron (Fe) and aluminum (Al) content, and severe soil erosion on steep slope land also causes nutrient loss through sediment transported substantially. These may limit soil nutrients availability and soil fertility. Most of long-term use of cultivated land has been affected by residual accumulation of phosphorus fertilizer (Wild, 1988), which is mainly unavailable under acid soil condition, the highest value of available phosphorus was obtain at optimum soil reaction (pH 5-7). Lime had been used to reduce soil acidity for a half century. The other benefits of liming were improved soil physical condition and biological activities (Manna et al., 2007). Another major factor that related to soil phosphorus availability is soil organic matter which can improve crop yield and soil physical properties (water holding capacity, aeration porosity and bulk density) in the long run (Edwards and Lofty, 1982).

Recently, zinc was concern as an important micronutrient that promotes crop growth, production of biomass and human health (Salgueiro et al., 2000; Kaya and Higgs, 2002). In general, Zn-deficiency is found in intensive cultivated soil. Foliar Zn spray is an option to solve Zn deficiency when application Zn on soil was not sufficient.

To build up a sustainable agricultural system on sloping land, several strategies of soil management and cultural practices must be considered. In this study, the

integrated water harvest, anti-soil erosion and multiple cropping (IWAM) technique was used as contour furrow cultivation, with foliar zinc spraying, liming, phosphorus fertilizer (organic and inorganic) applications. In order to increase fertilizer use efficiency, soil phosphorus availability and crop production, to achieve the sustainable rainfed agriculture on sloping land.

### **OBJECTIVES**

This thesis aims to improve sustainable crop production on sloping highland using lime, fertilizers, micronutrient and contour furrow cultivation. The study objectives are as follows.

- i) To study the effects of liming, fertilizers and zinc applications on phosphorus availability including crop growth and yields, under both conventional contour planting and contour furrow cultivation.
- ii) To compare the effects of liming, organic and inorganic fertilizer applications, and foliar zinc spray on available phosphorus, crop growth and yield under conventional planting and furrow cultivation.
- iii) To find out the most suitable practice to build up a sustainable highland rainfed agricultural system.