CHAPTER 1

INTRODUCTION

Laos is a landlocked country with borders to Thailand on the west, Myanmar in the northwest, China in the north, Vietnam on the east and Cambodia in the south. Its location is in Southeast Asia, between latitudes of 12 and 23 ^{o}N and longitudes of 100 and 108 ^{o}W. The size of the country is 236,800 km^2, consisting of 18 different provinces. It has a population of 5, 5 million people in 2005 (national statistic center 2005).

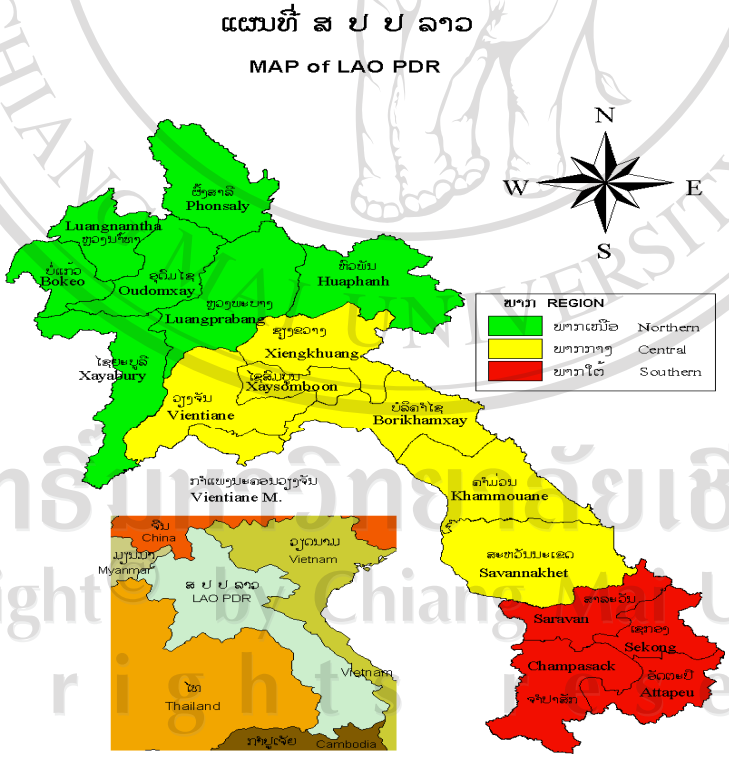

Figure 1.1 Map of Laos.

Laos is currently in the midst of a rubber planting boom. Strong market demand from China for latex and investor interest from China, Vietnam, and Thailand has caused the rapid increase in rubber planting. However, there is little institutional support or understanding about how current investor interest can be best channeled to maximize potential returns to the national economy and as well as ensure socially and economically just smallholder rubber production.

Farmer in northern Laos is starting to planted during the last 5 years and the number of rubber plantations is still increasing. Rubber is a very valuable tree and gives the farmer a good income. One problem is that it is a long-term investment running 7-10 years and that rubber is established in monocultures where intercropping is possible only during 1-3 years, depending on spacing. Another problem is the most quality of seedling come from China, it was transported by truck and it took for 2-3 days to farmers. So, percent survival of seedlings were quite low and farmers lack of technique to support. The plantation are established by farmers that depend on shifting cultivation practices for their food supply, with the result that more land continuously had to be cleared for food production to replace land planted with rubber. Upland farms have generally poor soil condition especially low phosphorus (P), and small farmers could hardly reach beyond break-even in their production. They increasingly depend on exogenous farm inputs to maintain same level of crop yield overtime. Research on Rubber tree - annual crops integration, despite the long years it has been espoused by the Lao-Swedish Upland Agriculture and Forestry Research Project (LSUAFRP) rarely claimed to have found the best technique that can sufficiently meet the benefit needs of a typical farm household on a sustainable basis. If ever there were past research breakthroughs of such good technique, these

were rarely translated into readily useable information materials that could benefit small farmers.

To close this information gap on the economic viability and technical sustainability of combining rubber tree and crops production for food and cash, there is a need to generate empirical data. This may help program and policy planners, field practitioners and small farmers rationalize their cropping options. By using bio-technology modeling as Arbuscular Mycorrhizal (AM) fungi tool for solving analysis; nutrients and material flow dynamics in a close farming system can easily be determined. Besides, serving as a showcase of different technology "mix", it will also provide first hand data for policy decision support system.

As AM fungi are the predominant mycorrhizal fungi type in dry tropical soils and associate with a wide range of plant species, they have a potential to benefit the growth of both tree and crop species in agroforestry systems. *M. denticulata* have shown high-mycorrhizal fungi dependency and respond to inoculation. Similarly, field crop such as cowpea are know to be obligately dependent on AM fungi, and inoculation using several AM fungi inoculants has been highly beneficial to crop yields in a range of soil. However these responses vary widely according to the host species, the AM fungi inoculation used, soil fertility and the levels of indigenous population of AM fungi inoculants are selected.

The importance of maintaining active populations of AM fungi in agroforesty soils in order to sustain crop productivity has also been demonstrated. More recently Jumnian (2008) have shown that maize yields were better and mycorrhizal fungi colonization higher in maize crops cultivated after other mycorrhizal crops, than the maize, cultivated after non-mycorrhizal crops. AM fungi inoculum in the soil

normally occurs as spores, mycorrhizal roots and mycelial networks (Miller, 2000) attributed early infection of maize seedlings and increased final grain yield to the key role AM mycelial network play in enhancing phosphorus absorption in young plants. Although most sensitive to disturbance, AM mycelial networks are primarily responsible for the paid colonization of new roots, and have been shown to retain their capacity to colonize roots after long periods of drought typical of tropical regions (Brundrett and Abbott 1994).

AM fungi associations are found in a broad range of habitats, including the agroforestry system. AM fungi reproductive structures are in the form of external spores, which are formed either singly or in small masses. These spores, plus hyphal fragments, and root segments represent propagules which can be dispersed and utilized as inoculum for new host plant colonization. The primary vectors for dispersal of mycorrhizal inoculum are wind and animals. Arbuscular mycorrhizal fungi have been demonstrated to be wind- blown up to 2 km (Warner et al., 1978). A wide range of animals are known to disperse mycorrhizal fungal propagules, and generally, any animals that move soil can cause the migration of mycorrhizal fungi.

It is well established that most of the plants characteristic of shrub steppe habitat are associated with arbuscular mycorrhizal fungi. AM fungi associations are widespread among plant families and very few families are non mycotrophy appears to be restricted to families such as the AM fungi involved are species of the endogonaceae.

AM fungi are a main component of the soil edaphon in most agroecosystems. These obligate mutualistic symbionts colonize the roots of the majority of crop plants. AM fungi can efficiently absorb mineral nutrients by their extended hyphal network,

especially from nutrient - poor soils, and deliver them to their host plants in exchange for carbohydrates.

The general objective of this study is to find out arbuscular mycorrhizal fungi related to rubber plantation in low soil nutrient in the northern province of Lao PDR This study also evaluate AM fungi on growth of rubber seedling in difference levels of phosphorus application and a suitable source AM fungi on growth of rubber seedlings.

Figure 1.2 Rubber plantation in smallholder in Phonxay district, Luangprabang and Luang Numtha provinces, Laos PDR.

Objectives

1. To determine the extent of colonization of AM fungi on tree crops root and to determine the distribution and abundance of AM fungi in soil in the root zone major tree crops in agro forestry system in Northern Lao PDR
2. To assess benefit of AM fungi on growth of rubber seedlings in a phosphorus deficiency soil.
3. To evaluate method for producing AM fungi inoculums for rubber seedling production.