CHAPTER 1

Introduction

1.1 Background

Montane forest ecosystems are usually found at elevations above 1,000 m above mean sea level (Santisuk, 2006) and covers Thailand’s most important water catchments. Such ecosystem types have been greatly modified by various types of land-use, particularly and shifting cultivation (Delang, 2002). Since the last century, the non-Thai hill people have illegally settled in mountain chains of the Northern Thailand and consequently altered the natural montane vegetation (Santisuk, 2006). Although most mountainous areas in northern Thailand are national parks (36% of all national parks), wildlife sanctuaries (47% of all wildlife sanctuaries), or other types of protected area (Department of National Parks, Wildlife and Plant Conservation, 2016). Most of the natural vegetation cover has been converted into grasslands or open secondary forests, due to logging, forest fires and social and economic factors (Schmidt-Vogt, 1999; Luukanen, 2001; Laurance, 2007; Frois *et al*., 2008).

Therefore, forest restoration is urgently required for this most important watersheds in the Thailand, to prevent run-off and soil erosion (Santisuk, 2006), and to recreate an ecosystem that can function effectively (Stanturf *et al*., 2014). In previous forest restoration and reforestation projects, launched by the government sector, *Pinus kesiya* was commonly planted on abandoned areas in northern Thailand (Santisuk, 2006) due to its fast-growing characteristic (Kiianmaa, 2005). Another species that has been planted widely is *Leucaena leucocephala*, because it helps to improve soil fertility and survives well during droughts (Frois *et al*., 2008). The use of pioneer species, either exotic or native species in reforestation projects, is mainly to reduce the growth of weeds and prevent soil erosion.

A technique with higher diversity is called the ‘framework species method’ which has been tested for restoring montane forests in northern Thailand over the past 20 years.

This technique employs a mixture of 20-30 native tree species, to accelerate natural regeneration. It results in a high level of biodiversity recovery in less than 10 years after planting (Elliott *et al.*, 2013). Although practitioners and local communities can implement restoration appropriately, fires in the dry season are a major problem. Fire destroys young seedlings and reduces growth. A single fire can eliminate most plants in a restoration plot, thus deflecting the successional pathway.

Fires are infrequent in montane forest ecosystems. Consequently, tree species in such ecosystems lack adaptations to fires (Cerda and Robichaud, 2009). Fire disturbance affects ecosystem regeneration: it destroys the soil seed bank (Nieuwstadt *et al.*, 2001; Lentile *et al.*, 2007), and encourages non-forest species to establish after the fire (Setterfield, 2002; Lentile *et al.*, 2007). Furthermore, in forest restoration projects, fire obstructs an ecosystems recovery, by burning the planted saplings (Lawes *et al.*, 2011a). Although, some species grow back after fire (resilience), repeated fires kill small trees and thus prevent recruitment of adult trees (Lawes *et al.*, 2011a).

In fire-prone ecosystems, trees have resilient characteristics that include thick bark (Pinard *et al.*, 1999; Hoffmann *et al.*, 2003), the ability to resprout (Kauffman, 1991) and/or a high growth rate (Hoffmann *et al.*, 2003). To restore montane forest ecosystems that are less adapted to fire, native tree species with fire resilient characteristics must be selected.

Climate change is increasing the risk of more frequent and more intense fires, especially where increasing temperature is accompanied by lower precipitation or longer dry seasons (Burton *et al.*, 2010). To prepare for this unpredictable situation, native tree species that survive after a fire should be identified and promoted in forest restoration. These native tree species not only restore a forest but also resilient ecosystem, to cope with unpredictable future fires, increase an ability to absorb changes, and to hold stability and return to the equilibrium state after disturbance (Holling, 1973). There are only a few publications on the effects of fire on native tree species in the tropics (Elliott *et al.*, 2003, Marod *et al.*, 2002). No report has been found on the minimum size of native trees that are likely to survive after a fire in the montane forest ecosystem in northern Thailand.

This study addressed 3 main research questions:

1) How much does size of native trees affect their survival after a fire?

2) How much does size of native trees affect their resprouting ability after a fire?

3) What are the most suitable fire-resilient native tree species to plant for restoring montane forest ecosystems in fire-prone areas?

1.2 Hypotheses

1) Post fire survival increases with increasing tree size.

2) Post fire resprouting ability increases with increasing tree size.

1.3 Research Objectives

1) To quantity the effects of tree size on their survival after fire.

2) To quantity the effects of tree size on reprouting ability after fire.

3) To identify potential tree species candidates to be used for restoring montane forest ecosystems in fire-prone areas.

1.4 Usefulness of the research

1) This study suggests a minimum size of trees which will likely survive better after burning. Therefore, this knowledge can be used to determine optimum size of seedlings when no further plot maintenance is needed, also optimum length of time to implement fire prevention.

2) This study provides a better understanding of relationship between tree size and resprouting ability after fire disturbance (fire resilience).

3) This study provides a list of potential tree species for restoring montane forest ecosystem in fire-prone area.