CULTIVATING EXOTIC TREES: EXAMPLES FROM ROYAL PROJECT FOUNDATION IN THE ANGKHANG HIGHLANDS OF THAILAND

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Abstract

There are many different views on the introduction of exotic species in upland ecosystems. Some argue that many of these species are more productive and useful, while others feel they change the ecosystem and disturb indigenous species. This paper looks at the work of the Angkhang Highland Reforestation Project, which is part of the Royal Project Foundation. The project aims to study the growth and introduction of exotic species in Northern Thailand. The main objectives of the project are to protect and conserve valuable watersheds in the North and support the development of hilltribe communities that live in these areas. This paper describes some of the main achievements of the project and demonstrates that introduction of exotic species should not be always be seen as problematic.

Introduction

Thailand has a total area of about 513,115 km\(^2\) and is generally divided into four main topographical regions: North, Northeast, Central Plains, and South. The Royal Forest Department estimates that forests area covers almost 26 percent of the country's total area, and the majority of forest area is concentrated mainly in the North (Royal Forest Department 1996). The North is particularly mountainous, and the five highest mountains in Thailand are located in the area. It is also where many of the country's major watersheds are located. Thus, proper watershed management is crucial, not only for local forest conversation, but also for the country.

Technically speaking, watershed management in Thailand has a rather short history. In 1959, the Faculty of Forestry of Kasetsart University had a few courses on watershed management in the undergraduate curriculum of the Department of Conservation. Development of the academic staff was started during the 1960s by sending junior lecturers to study in the United States. This was followed by the establishment of the Watershed Research Station in Huay Kogma in Chiang Mai Province. In 1967, the Department of Horticulture of Kasetsart University began a Highland Fruit Tree Research Project at Doi Pui adjacent to Huay Kogma. The aim was to select proper fruit trees for high-elevation sites. The name of this project was changed to the Highland Agriculture Project two years latter in order to provide broader opportunities for researchers studying a variety of topics.

In 1969, His Majesty the King visited hilltribe villages and the Highland Agriculture Project. The visit afforded him with invaluable insights into the hilltribes' life and problems which affected not only the local watersheds, but also the security of the nation. At this time, the northern borders were unstable due to Vietnam/American War and Chinese rebel forces using the area as a base of activity. Because of this, many of the hilltribes had no other alternative than to grow opium. In order to assist the hilltribes, promote forest conservation and watershed management, and to support the sustainable development of the area, His Majesty the King initiated the "Royal Project for the Development of the Thai Highlanders" in 1969. The project brought together volunteers, government officials, and foreign experts to support the development of these hill areas. In 1992, the project name was changed by royal decree to "The Royal Project Foundation" since 1992 (Royal Project Foundation 1998). Today (1999), the project has established nearly 40 field stations throughout the North and won various awards including the 1988 Ramon Magsaysay Award for International Understanding and the 1988 Thai Expo Award for a Standard Thai Goods for Exports.

Angkhang Highland Reforestation Project

This paper focuses on the work of one of the Royal Projects which has taken place in Angkhang highlands located in Fang District, Chiang Mai. The Highland Reforestation Project also known as the main forestry project of the Royal Project Foundation was initiated in 1981 at Angkhang. Its elevation ranges from 1,200 to
1,800 meters above sea level with an average slope of about 35-55 percent. The original vegetation type was classified as hill evergreen forest. After deforestation from shifting cultivation and logging, pioneer species (such as, *Eupatorium adenophorum*, *Imperata cylindrical*, *Artemisia pallens*, *Melastoma malabathricum*, and *Pteridium aquilinum*) quickly invaded. Annual forest fires seem to be the main factor for promoting such vegetation types. Major soils include reddish brown lateritic and red brown earth with soil pH of 5.2 and relatively high clay and organic matter content.

The amount of annual rainfall is 1,745 mm, 87 percent falling from May to October (the monsoon period). Table 1 shows the monthly distribution of various climatic data.

### Table 1: Climatic data of the Royal Agricultural Angkhang Station, Chiang Mai (1979-1993)

<table>
<thead>
<tr>
<th>Month</th>
<th>Rainfall, mm</th>
<th>Temp. °C</th>
<th>R.H, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>January</td>
<td>15.2</td>
<td>21.8</td>
<td>3.6</td>
</tr>
<tr>
<td>February</td>
<td>14.5</td>
<td>24.4</td>
<td>4.4</td>
</tr>
<tr>
<td>March</td>
<td>6.6</td>
<td>27.6</td>
<td>8</td>
</tr>
<tr>
<td>April</td>
<td>78.2</td>
<td>28.9</td>
<td>11.6</td>
</tr>
<tr>
<td>May</td>
<td>214.6</td>
<td>27.4</td>
<td>15.1</td>
</tr>
<tr>
<td>June</td>
<td>206.8</td>
<td>25.2</td>
<td>17.3</td>
</tr>
<tr>
<td>July</td>
<td>268.1</td>
<td>24.8</td>
<td>16.8</td>
</tr>
<tr>
<td>August</td>
<td>317.1</td>
<td>24.4</td>
<td>15</td>
</tr>
</tbody>
</table>

**Tree Introduction to Angkhang**

The main focus of the project was to establish forest plantations of various exotic trees and bamboo to research improved reforestation schemes as well as demonstrate the importance of multi-purpose plantations. The project was financially supported by the Vocational Assistance Commission for Retire Servicemen (VACRS) of Taiwan and technical support was provided by Kasetsart University Faculty of Forestry (KUFF), the National Taiwan University (NTU), and Taiwan Forestry Research Institute (TFRI). The main objectives of the project were to:

- Investigate the silviculture of exotic/man-made forests in the Angkhang highlands;
- Provide wood and other forest products to local people for their basic needs;
- Study the effects of tree species on soil and water conservation efforts; and
- Transfer knowledge and experiences gained to other highland areas which have similar conditions to Angkhang in order to support sustainable forest management.

The project focused on four activities: seedling production for forest plantation and extension; plantation establishment and management; income generation from the plantations; and research and training on forest plantation (Thaitutsa 1996). In order to make the project more beneficial to local People and forest conservation efforts, the Project was divided into three phases each lasting four years:

- Phase 1 (1981-1984): Exotic species trials
- Phase 2 (1985-1988): Comprehensive plantation establishment and management

Table 2 shows some of the main achievements and activities of the project. All exotic trees introduced to Angkhang were broad-leaved species because there was no previous information on exotic species for high elevations. Therefore, seeds of ten species introduced from Taiwan to Angkhang in late 1981 were *Acacia confusa*, *Aleurites montana*, *Alnus formosana*, *Chamaecyparis obtusa*, *Cinnamomum camphora*, *Cryptomeria japonica*, *Cunningharmia lanceolata*, *Fraxinus griffithii*, *Liquidambar formosana*, and *Zelkova serrata*. Root cuttings of *Paulownia taiwaniana* were introduced in 1983.

**Table 2: Yearly achievements and activities**

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity and Achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>Tree introduction from Taiwan, ROC</td>
</tr>
<tr>
<td>1982</td>
<td>Plantation establishment at Angkhang</td>
</tr>
</tbody>
</table>
| 1983 | Establishment of exotic tree nursery at Angkhang  
Introduction of Paulownia taiwaniana root cuttings |
| 1986 | Bamboo introduction |
| 1989 | Utilization of pruned woods for mushroom cultivation |
| 1990 | Bamboo shoot harvesting |
| 1991 | Establishment the Highland Agroforestry Project |
| 1992 | Start the Training and Extension Program |
| 1993 | Utilization of pruned and thinned woods for kilned charcoal and handicrafts |
| 1995 | Establishment Villagers Woodlot Project |
| 1998 | Large-scale plantation of bamboo (Dendrocalamus latiflorus) for shoot culm production |

During phase 1, planting stocks were produced at a lowland nursery of the Royal Forest Department (RFD) and most seeds, especially during the first ten years, were imported from Taiwan for reproductive propagation. Some other activities included: vegetative propagation; root cutting for *Paulownia taiwaniana*; culm and rhizome cuttings for bamboo; and tissue culture for *Liquidambar formosana*, *Paulownia taiwaniana* and some bamboo species. From 1982 to 1998, the total plantation area was about 120 hectares, and the amount of seedlings produced annually was about 80,000 -100,000.

In 1982, trees were planted at spacing of 2.0 x 2.5 m and were consequently pruned in 1989. The pruned limbs were used for mushroom cultivation, mainly Shitake (*Lentinus edodes*). In 1986, bamboo was added in order to produce edible shoots and culms for supporting fruit trees. More than 60 species of 13 genera of bamboo are native to Thailand and all are of sympodial type. Thus, this was the first introduction of monopodial bamboo to Thailand. There were six sympodial and four monopodial bamboo species, including: *Bambusa beecheyama* var. *pubescens*, *Bambusa dolicholata*, *Bambusa edulis*, *Bambusa oldhamii*, *Dendrocalamus latiflorus*, *Phyllostachys bambusoides*, *Phyllostachys lithophila*, *Phyllostachys makinoi*, and *Phyllostachys pubescens*.

In 1993, the trees were thinned, 12 years after planting. The by-products were used for charcoal making, wood carvings, and other handicrafts. In a similar manner, bamboo shoots and culms were harvested in 1990. Knowledge and experiences gained from the first 10 years of experiments on tree and bamboo species included: sharing of experiences with other researchers working on highland agroforestry systems (1991); national and regional training on highland forestry development (1992); technology transfer and support to local highlanders through the Villagers Woodlot Project (1995); and the establishment of a commercial bamboo plantation (1998).
Performances of Exotic Trees at Angkhang

The results of the project show that not all exotic trees and bamboo were able to grow successfully at Angkhang. Some species had low survival and growth rates, but some species showed superior performances in comparison to native species. Phenotypic performances of tree species could be categorized as follows:

- **Good performance**: *Paulownia taiwaniana*, *Acacia confusa*, *Liquidambar formosana* and *Cinnamomum camphora*
- **Medium performance**: *Cunninghamia lanceolata*, *Fraxinus griffithii*, and *Cryptomeria japonica*
- **Poor performance**: *Alnus formosana*, *Chamaecyparis obtusa*, *Aleurites montana* and *Zelkova serrata*

It should be noted that *Acacia confusa* grew relatively slow during the first few years, but showed superior performance after five years of growth. For *Paulownia taiwaniana*, early pruning up to a specific height of clearbole is required.

In a manner similar to exotic trees, bamboo species can be ranked accordingly:

- **Good performance**: *Dendrocalamus latiflorus*, *Bambusa oldhamii*, *Phyllostachys makinoi* and *Phyllostachys lithophila*
- **Medium performance**: *Phyllostachys bambusoides*, *Bambusa edulis*, *Bambusa dolicholata*, *Bambusa beecheyama* var. *pubescens*
- **Poor performance**: *Phyllostachys pubescens*

Several combinations of forest and agricultural crops were tested in agroforestry systems at Angkhang. Based on their growth and development performances, *Paulownia taiwaniana* and *Dendrocalamus latiflorus* were treated as primary crops combined with wheat, barley, linen, red bean, tarro, sweet corn, coffee, and ginger. Proper combinations to be recommended are *Paulownia taiwaniana* and wheat, *Paulownia taiwaniana* and barley, *Paulownia taiwaniana* and linen. For wider spacing, a combination between *Paulownia taiwaniana* and *Dendrocalamus latiflorus* is also recommended.

Based on the experiences at Angkhang, the following uses are suggested for specific species:

- Firewood and charcoal: *Acacia confusa*
- Mushroom cultivation: *Liquidambar formosana* and *Acacia confusa*
- Musical instruments: *Paulownia taiwaniana*
- Jewelry boxes: *Paulownia taiwaniana*
- Vineer: *Paulownia taiwaniana*
- Meeting-room panel: *Cunninghamia lanceolata* and *Paulownia taiwaniana*
- Wood carving: *Cinnamomum camphora* and *Liquidambar formosana*
- General construction: All good-performance species except *Paulownia taiwaniana*
- Soil and water conservation: *Acacia confusa* and *Paulownia taiwaniana*
- Agroforestry systems: *Paulownia taiwaniana*
- Bamboo shoots: *Bambusa oldhamii*, *Dendrocalamus latiflorus* and *Phyllostachys makinoi*
- Culm utilization: *Dendrocalamus latiflorus*
- Culm for fruit-tree supporting: *Phyllostachys makinoi* and *Phyllostachys lithaphila*
Conclusions

While many feel that there should be an emphasis on natural regeneration and use of indigenous species, exotic and foreign species should not be discounted. As the research in Angkhang Royal Project showed, exotic species sometime out perform indigenous species. Thus, a mix of both types of species is recommended in reforestation projects. Proper research and scientific experiments can provide extension officials with the proper information for introducing appropriate species that can assist in forest conservation and watershed management, as well as be used by local people for a variety of purposes. This emphasizes the conclusions of Zobel et al. (1987- that "exotic forestry has special and sometimes unusual advantages and problems".

Literature Cited


