Report on Rubber Suitability Zoning in the Central Development Zone, Na Mo District, Oudomsay Province

Land Management Component
Soils Survey and Land Classification Centre

Lao-Swedish Upland Agriculture and Forestry Research Program
October 2005
LSUAFRP Field Report No. 05/12

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References

1. Alton, Bluhm & Sannikone (GTZ) May, 2005: Para Rubber in Northern Laos; The Case Study in Luang Namtha


3. LSUAFRP, March 2005: Na Mo Central Development Zone Agro-ecological Zoning and Agro- ecosystems Analysis

4. FAO, Optimum Crop Requirements (Land Evaluation Part III)
1 Introduction and Background

1.1 Introduction

Na Mo District is a focal area for rubber production, and an area of approximately 65 hectares was planted in 7 villages in 2004. District plans were to expand the area by a further 260 hectares in the same seven villages in 2005. The planned areas in each of the 7 villages had not been decided at the time of the AEA exercise in October 2004, although three main nursery areas had been established in the villages of Na Thong, Phou Thong and Huay Sang. It was also mooted that the planting of a further 6,000 hectares was under consideration in the coming years by arrangement with Chinese companies. A summary of 2004 rubber planting achievements and 2005 plans disaggregated by district agro-ecological zones is provided in the table below.

<table>
<thead>
<tr>
<th>Productive Agro-ecological Zone – (AEA Zone 1)</th>
<th>Areas Planted 2004</th>
<th>Nursery Areas Planted 2004</th>
<th>Plans 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas Planted 2004</td>
<td>Nursery Areas Planted 2004</td>
<td>Plans 2005</td>
<td></td>
</tr>
<tr>
<td>Villages</td>
<td>Area (ha)</td>
<td>Villages</td>
<td>Area (ha)</td>
</tr>
<tr>
<td>Pang Dou</td>
<td>7</td>
<td>Na Thong</td>
<td>5.00</td>
</tr>
<tr>
<td>Pang Thong</td>
<td>12</td>
<td>Phou Thong</td>
<td>29.03</td>
</tr>
<tr>
<td>Kok Fart</td>
<td>14</td>
<td>Huay Sang</td>
<td>1.0</td>
</tr>
<tr>
<td>Na Mo Neua</td>
<td>10</td>
<td>Na Mo Neua</td>
<td>Not decided</td>
</tr>
<tr>
<td>Na Hom</td>
<td>17.5</td>
<td>Na Hom</td>
<td>Not decided</td>
</tr>
<tr>
<td>Huay Sang</td>
<td>4</td>
<td>Huay Sang</td>
<td>Not decided</td>
</tr>
<tr>
<td>Sub Zone 1</td>
<td>Total 62.97</td>
<td>35.03 ha</td>
<td>(??)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mountainous Multiple Use Forest Zone - (AEA Zone 2)</th>
<th>Areas Planted 2004</th>
<th>Nursery Areas Planted 2004</th>
<th>Plans 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas Planted 2004</td>
<td>Nursery Areas Planted 2004</td>
<td>Plans 2005</td>
<td></td>
</tr>
<tr>
<td>Mixay</td>
<td>2.2</td>
<td>None</td>
<td>Nil</td>
</tr>
<tr>
<td>Sub Zone 2</td>
<td>Total 2.2</td>
<td>??</td>
<td>(??)</td>
</tr>
</tbody>
</table>

Total 65.17 ha 35.03 ha 260 ha

Five of the above villages, Pang Dou, Pang Thong, Kok Fart, Na Mo Neua and Mixay are target villages of LSUAFRP, and the project is providing support to rubber trials, integrated with fruit trees and annual crops in Pang Thong, Pang Dou, and Na Mo Neua.

1.2 Important Background Information

1.2.1 Issue Emerging from AEA in the Central Development Zone

During the CDZ AEA the concern about inadequately planned rubber planting was raised and the District representatives indicated they would welcome assistance in designating suitable areas for planting rubber in the CDZ. Agro-ecological zoning for
the Central Development Zone (CDZ) of Na Mo was undertaken in March 2005, during which the boundary of the CDZ and the village boundaries of the 32 villages within this zone, were delineated and mapped in the GIS. This village management area mapping is a valuable tool to assist the district with planning extension and development activities, including rubber.

1.2.2 GTZ Rubber Study in Northern Provinces

2. A study on rubber, (Alton, Bluhm and Sannikone, 2005), was undertaken with GTZ funding in early 2005 and the findings of the study were presented in May 2005 to a wide audience of development and research organizations.

One finding of the GTZ study was:

“A review about elevational constraints to economically productive rubber production strongly suggests that planting rubber between 700 to 900 masl carries high risk to the farmer. Elevation is of course linked to latitude and many authors point out the risks and low returns from rubber at extreme latitudes. In the rush to (plant) rubber these risks and their documented history have been ignored”.

GTZ Study recommendation:

“We strongly recommend that the relevant GOL agencies build understanding of the risks of planting rubber at higher elevations. Furthermore a zone between 700 to 900 masl ought to be designated; if rubber is planted in these elevations villagers should be assisted with regard to varietal selection and possibly some type of insurance mechanism”.

1.3 Proposed Land Management Component Research Activity

Given the presence of the LSUAFRP in the area where rubber planting is occurring, and in recognition of the importance of the findings and recommendation of the GTZ rubber study, it was opportune that the component assist with the designation of the elevation zones within areas in Na Mo District in which rubber planting is proposed. This information would be of value to the district agencies in planning the development of rubber expansion in the District. Farmers in villagers within various elevation zones could be provided with useful information regarding areas in which rubber planting would be risky and less risky.

1.4 Objectives of the Rubber Suitability Zoning Pilot

The objectives of the rubber suitability zoning exercise were as follows:

- To provide elevation maps and rubber crop requirements information to district agencies to assist with decision making and planning of rubber expansion
- To use the elevation maps as tools for informing farmers about the relative risks of planting rubber in different designated elevation zones
• To help avert long term problems with future village rubber productivity by concentrating expansion in the less risky zones and villages

2 Rubber Suitability Zoning Pilot Test – Na Mo District

The pilot test on rubber suitability zoning was undertaken in the Central Development Zone (CDZ) of Na Mo District. The Land Management Component developed a procedure in conjunction with the GIS Unit of the Information Services Division of NAFRI. Preparation of the GIS maps to facilitate the zoning was undertaken by the GIS Unit, after which the rationale and procedure was presented to representatives of LSUAFRP components at a meeting in NAFRI including, Land Management, the GIS Unit, Farming Systems, the Socio-economic Unit, and the Director of NAFReC, Luang Prabang. After reaching agreement on the procedure at NAFRI, the second phase of the research was undertaken in Na Mo during the AEA Results and Feedback Workshop for the CDZ.

2.1 Methods and Procedures for Rubber Suitability Zoning

The methods and procedures developed by the Land Management Component are as follows:

2.1.1 Methodology

The methodology works from the finding provided in the GTZ rubber study that:

In northern mountainous environments, an elevation zone of 500 to 700 masl is a more favourable rubber planting zone, an elevation zone of 700 to 900 masl is a zone of higher risk, and elevation zones below 500 masl are preferable.

In addition, the most important crop requirements for rubber as presented in FAO Optimum Crop Requirements (Land Evaluation Part III) are considered.

• The activity makes use of physical and spatial information available in the GIS to map the elevation zones within the Central Development Zone of Na Mo District
• Within the elevation zones, other bio-physical and ecological parameters such as present land use, forest categories, and slope are applied to determine and “exclude” unfavourable rubber areas
• The potential areas are mapped and overlaid on the CDZ and village boundaries to provide a recognizable spatial picture of “potential rubber areas” in villages within the CDZ
• Other parameters such as soil properties, particularly physical properties are then examined “on the ground” within the “potential rubber areas” to determine the “less risk free areas”
• District staff and villagers are engaged in the work on the ground in selected LSUAFRP target villages with a view to testing the procedure, acquainting them with the zoning procedure, and to raise awareness of the potential risks.
2.1.2 Zoning Procedure to Define Suitable Rubber Areas

1. GIS Assisted Steps

Step 1: Produce maps the CDZ boundary and the village boundaries within the CDZ

Step 2: Identify two elevation zones; Zone 1, 500 to 700 masl and Zone 2, 700 to 900 masl, within the CDZ over which other physical parameters can be overlaid

Step 3: Identify land areas within each elevation zone that should be further considered, ie, areas <36% slope. Exclude areas >36% slope (Source: Slope Map)

Step 4: Identify forest and agricultural land areas within each elevation zone that should be excluded, including the following categories; “mixed deciduous”, “bamboo”, and “paddy land” (Source: Present Land Use Map, 2000).

Step 5: Identify land areas within each elevation zone that should be further considered, including the following categories: “unstocked forest”, and “ray” (Source: Present Land Use Map, 2000)

Step 6: Analyse the above factors (elevation, slope, forest areas) to determine the remaining areas within each elevation zone which can be classed as “initial potential rubber areas”

Step 7: Prepare enlarged hard copy maps (A3 size) of each of these physical parameters to use as tools for further field level enquiries and verification at village level

Step 8: Prepare village topographic maps at the same scale (size) as the physical maps, ie, A3, to use when conducting further field level enquiries and verification at village level

Step 9: Prepare large scale topographic maps (1:10,000) to use for comparison, defining and sketching the areas of rubber suitability.

Step 10: Prepare, if available, indigenous soil classification information for selected villages

2. Field Steps – Conducted with Villagers Leaders and Informants

Introduction: Explain rubber crop requirements: climate, slope and soils to villagers

Step 1: Overlay “initial potential rubber area” map on village boundary transparency map to indicate “potential rubber areas” within the village boundary.

Step 2: Identify/verify forest areas with villagers and draw on a village forest plastic overlay map

Step 3: Identify soil types and areas and draw on a village soils plastic overlay map
Step 4: Identify/verify fallow (*pa lao on*) and upland cultivation (*hay*) areas and draw on a village plastic overlay map

Step 5: Identify/verify paddy areas and draw on a village plastic overlay map

Step 6: Overlay the forest, soils, fallow/hay, and paddy area maps on the “initial potential rubber area” map to determine which areas are “suitable” and which areas should be “excluded”

Step 7: Draw a village “rubber suitability” map on a transparency

Step 8: Mark rubber fields already planted on plastic overlay map and overlay on the “rubber suitability” map to see if these plantings lie within the suitable rubber areas determined from the overlays.

Step 9: Discuss the findings with villagers and reach agreement on the areas suitable for rubber within the village management areas; discuss the implications with villagers and DAFES staff if existing rubber plantings are located in “unsuitable areas”

2.2 Preparations for Field Visit to Rubber Growing Villages

2.2.1 Explanation of Procedures

Mr Phaythoune Pilakorn, the Head of the NAFRI GIS Unit, made a presentation on procedures for defining potential rubber growing areas within the CDZ. This presentation included

- An explanation of the GIS procedures used
- An explanation of the various map parameters used to produce the potential rubber zone maps
- A brief summary of the critical crop requirements for rubber
- The procedures used in the field to verify the potential areas with villagers

The critical crop requirements for rubber that were presented to staff and later explained to villagers are presented in Appendix 1

2.2.2 Formation of Field Teams

A multi-disciplinary group of LSUAFRP staff from NAFRI and agency representatives from the District undertook the field activity in Pangthong and Pang Dou villages. The work teams were as follows:

<table>
<thead>
<tr>
<th>No.</th>
<th>Pang Dou</th>
<th>Agency</th>
<th>Pang Thong</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ms Pouwa</td>
<td>DAFES</td>
<td>Mr Khamsao</td>
<td>DAFEO</td>
</tr>
<tr>
<td>2</td>
<td>Mr Ten</td>
<td>Khet Na Mo</td>
<td>Mr Thongsy</td>
<td>DAFEO</td>
</tr>
<tr>
<td>3</td>
<td>Mr Syvanh</td>
<td>Planning</td>
<td>Mr Bounson</td>
<td>FS Research</td>
</tr>
<tr>
<td>4</td>
<td>Mr Khamsao</td>
<td>Khet Na Thong</td>
<td>Ms Bouaphorn</td>
<td>LWU</td>
</tr>
<tr>
<td>5</td>
<td>Mr Khamhak</td>
<td>Khet Pouli</td>
<td>Mr Khamse</td>
<td>D/Governor</td>
</tr>
<tr>
<td>6</td>
<td>Mr Khampou</td>
<td>LMC – SSLCC</td>
<td>Mr Bountieng</td>
<td>LMC Head, VTN</td>
</tr>
<tr>
<td>7</td>
<td>Mr Oudong</td>
<td>FS Component</td>
<td>Mr Somsak</td>
<td>LMC – LUP Unit</td>
</tr>
</tbody>
</table>
The field steps were explained to the work groups and “trialed” in the office, prior to the visits to the villages. This included the steps, the base maps to use, the overlay maps that had to be produced, the information required from village representatives particularly with regard to current land use, forest areas and soils, and the location of rubber plantings within the villages. Arrangements were made for the village committees, other knowledgeable villagers and rubber planters to attend the village discussions.

3 Field Activities

In each village the purpose of the visit, the activities to be undertaken and the information that the work groups wished to gather from villagers regarding land use areas, distribution of soil types, and location of rubber plantings was explained, after which the field steps were put into practice.

The “village potential rubber suitability area” map produced from the GIS analyses was used as a base map over which plastic overlays were used to distinguish and sketch the following:

- Village forest areas (excluded)
- Village soil types areas (to identify soils preferred by villagers for rubber)
- Village fallow areas (pá lao) & current swidden (areas with potential for rubber)
- Village rubber planting areas (to identify areas in which villagers have planted rubber)

When discussing village soils, reference was made to indigenous soils terminology provided in the indigenous soil classification reports prepared by the Socio-economic Unit and the Land Management Component.

The end result was a map that indicated areas where rubber was already planted and where there was potential for more rubber planting in elevation zones from 500-700 masl and 700-900 masl, after forest areas, land steeper than 36%, and areas with unsuitable soils had been excluded. The work was accomplished in less than one day, including the production of sketch maps of suitable areas in each village. The rubber zone maps have since been digitized and will be made available to the district agency staff (DAFEO).

Appendix 1 presents the GIS maps used to define “potential rubber zones” in village management areas in the CDZ.

Appendix 2 presents the maps produced from discussions with villagers, the final map indicating where there is potential for rubber planting after unsuitable areas have been excluded.
4 Conclusions

The pilot rubber zoning exercise demonstrated that:

1. “Indicative potential” rubber growing areas within Development Zone boundaries and village management area boundaries can be indicated on maps using elevation, slope and land use information from the GIS.

2. Enlarged village topographic, terrain, and potential rubber area maps can be used to discuss and confirm with villagers the “potential rubber growing areas” within village boundaries.

3. Villager knowledge of soil types within village management areas when combined with the soil requirements for rubber can be used to confirm or verify the “actual village areas” where it would be most appropriate to grow rubber, and conversely, the village areas where there are higher risks associated with marginal soil types (areas that should be avoided).

4. The potential rubber zone maps produced for this exercise would be useful tools for District Authorities to plan future rubber expansion in the Central Development Zone, both when dealing with rubber companies from China, and also when responding to requests for assistance from villagers.

5. Restricting future plantings to the potential rubber zones would minimize risks to farmers, particularly during the early years of rubber development when crop husbandry and management problems are most likely to occur.

6. Larger areas of similar elevation and terrain exist in the Southern Development Zone (SDZ) and these areas would be more appropriate than Khet Pouli, an area being considered for rubber planting, because it is a higher elevation area. Delineating village boundaries in areas in the SDZ and overlaying these on “potential rubber zones” as was done for the CDZ, would provide District Authorities with a useful tool for considering rubber planting in that zone.

7. In regard to the Pangthong village case study example presented in Appendix 2 a number of observations can be made:
   - The village protected and use forest areas are not being encroached upon for rubber planting.
   - All rubber planting to date has been undertaken in areas previously used for annual cropping (pa lao on and hay).
   - Most of the rubber planting to date is taking place in areas in the 700-900 masl zone, which is considered a higher risk zone.
   - The rubber planting to date has been on the more appropriate soil types.
   - Some plantings are located on land with slopes in excess of 36%, however rubber trees are planted along contoured bench terraces and inter-planted with annual and fruit tree crops to reduce the impacts of soil erosion.
Appendix 1. GIS Maps Used to Define Potential Rubber Suitability Zones

1. CDZ and Village Boundaries

2. 500 to 700 masl Elevation Zone

3. 700-900 masl Elevation Zone

4. Land Use Map: Forest categories

5. Land Use Map: Fallow-Hay

6. Slope Map: Areas > & < 36% Slope

7. Potential Rubber Planting Areas: 500-700 masl Elevation Zone
Appendix 2: Rubber Suitability Zoning Field Maps, Pangthong Village

1. Village Soils Map

2. Village Existing Land Use Map

3. Village Existing Rubber Planting Area Map
Appendix 2: Rubber Suitability Zoning after Discussions with Villagers
Pangthong Village - (Contd)

4. Potential Rubber Area Map (from GIS)

5. Potential and Existing Rubber Plantings Map
(Combining GIS and village plantings)
Appendix 3: Crop Requirements Summary-Rubber (Hevea brasiliensis)

1. Climate

- Temperature range: 22 to 35 degrees C
- Optimum Growth Conditions: 27 and 28 degrees C
- Annual rainfall: 1,250 mm – 4000 mm
- All months should have > 100 mm of rain
- Low drought tolerance
- Excess rain and marked dry seasons reduce yields
- Rubber is sensitive to wind damage, particularly if soils are shallow

2. Soil

**Physical Properties**

- Ideal soils are deep > 1.0 meters
- Well aerated
- Well structured
- Adequate water holding capacity (50% clay content)
- Well drained – ground water table of 4.0 to 6.0 meters below the surface
- With poor drainage the roots atrophy (shrive; waste away)
- Clay textures to medium textures are most suitable
- Hardpans, stoniness restrict root growth (no gravels < 2.0 meters from the surface)
- Soils subject to erosion need soil conservation techniques or measures
- pH range: 4.0 – 7.0; optimum pH: 5.0 – 6.0
- At pH > 6.5 growth is retarded and applying lime is deleterious (harmfull)
- Salinity: At EC < 0.2 dS/m – no yield reduction; 50% yield reduction at 1 dS/m; 100% yield reduction at 6 dS/m

**Nutrient Requirements**

- Rubber can grow adequately on impoverished soils
- Rubber is responsive to a good nutrient supply and a balanced manuring program
- Production is not hampered at all at a cation exchange capacity (CEC) of 4 cmol (+)/Kg of soil
- Top soil organic matter content should be > 2%
- Rubber needs N, P, K and Mg for optimum growth until tapping
- Avoid an excess of N; this increases vegetative growth and risk of tree trunk breakage
- Mature rubber trees have a low yield response to added fertilizer but a balanced supply is essential
- Nutrient removal (kg/ha/growing cycle) to produce 1.5 ton/ha of dry rubber:
  
<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>40</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>10</td>
</tr>
<tr>
<td>K₂O</td>
<td>25</td>
</tr>
</tbody>
</table>
• Fertilizer application (kg/ha/growing cycle) to produce 1.5 ton/ha

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>P&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;5&lt;/sub&gt;</td>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td>K&lt;sub&gt;2&lt;/sub&gt;O</td>
<td>0</td>
<td>35</td>
</tr>
</tbody>
</table>

**Mineral Toxicity Symptoms**

Boron: Faint interveinal mottled yellowing on the leaves followed by severe marginal and tip scorch

Manganese: Dull greenish-brown leaves and occasionally interveinal scorch

**Mineral Deficiency Symptoms**

Copper: Defoliation and death of apical growing points

Magnesium: Chlorosis in interveinal leaf areas spreading inwards from leaf margins

Manganese: Paling of leaf with bands of green tissue outlining midrib and vein (<50 ppm in leaf)

Molybdenum: Very pale scorch around leaf margins, particularly at leaf tip (in most acid soils)

Potassium: Marginal and tip chlorosis followed by marginal necrosis

Zinc: Lamina becomes reduced in breadth and is often twisted, and there is general chlorosis of the leaf with midrib and main veins remaining dark green

3. Yields

Rainfed: Good commercial yield: 1-2 ton dry rubber/ha
Appendix 4: Rubber Plantings, LSUAFRP Villages, 2004-05

<table>
<thead>
<tr>
<th>Year</th>
<th>Pangthong</th>
<th>Pangdou</th>
<th>Na Mo Neua</th>
<th>Na Mo Tai</th>
<th>Kok Fart</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fam.</td>
<td>Ha</td>
<td>Fam.</td>
<td>Ha</td>
<td>Fam.</td>
</tr>
<tr>
<td>2004</td>
<td>9</td>
<td>5.45</td>
<td>26</td>
<td>7.15</td>
<td>4</td>
</tr>
<tr>
<td>2005</td>
<td>49</td>
<td>36.00</td>
<td>3</td>
<td>1.75</td>
<td>3</td>
</tr>
<tr>
<td>Totals</td>
<td>58</td>
<td>41.45</td>
<td>29</td>
<td>8.90</td>
<td>7</td>
</tr>
</tbody>
</table>

Total All Villages:
- Families: 104
- Area: 66.24 ha (approx)

Note:
1. The majority of plantings are with district assistance
2. The areas are approximate, derived from 625 trees/ha
3. The villagers in Pang Dou reported substantial mortalities among the 2004 plantings