Project
Afforestation in Ha Tinh, Quang Binh and Quang Tri provinces

Sivilcultural solutions in Vietnam
and its application to the project

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Sivilcultural solutions currently existing in Vietnam and options

During 40 years Forestry Sector of Vietnam has developed and submitted to the Government many policies for forest protection and development. Law for forest protection and development, policies for land and forest allocation, regulations for management of 3 forest types have strengthened the development of forestry sector and helps the sector to aware its role in the economic life and in the social community as well.

Beside the system of policies, a system of sivilcultural techniques also has been developed. More than 100 technical criteria, procedures and norms have been developed focusing on different types of forest, on technical activities for forest use and development.
Three mentioned norms have strongly effected to different kinds of natural forest as well as to plantations within the project area. Recommendations for concretization of norms, for development of under-norm technical criteria to be applied for the project have been made.

1. Species to be planted

This part focuses on the purpose to summarize the lists of species to be planted which were recommended to be selected and selected in National Afforestation Programme and in other projects. Special discussion concentrates to species selected and proposed by the project. The system of main species and indigenous species for test planting has been considered.

Beside normal criteria for the species structure, they pay special attention to multi purpose species and 5 species have been proposed following this direction. Motivation for farmers to plant and protect forests is considered reasonably from the economic view. The economic issue can not be neglected during the land allocation and during the process of transferring forests to the farmers as well. And this will negatively effect to the environment protection, to sustainable production.

2. Relating issues

These are issues such as land use planning, forest garden, fruit garden, test program for selection of indigenous species. These are aspects which assist the project in the technical field and have the role to make sivilcultural solutions to be more effective within the project area. Beside main objectives of the project, this report also includes 2 species in the annexes.

Sivilcultural solutions in Vietnam to be applied for the German project "Afforestation in Ha Tinh, Quang Binh and Quang Tri"

By Nguyen Ba Chat

Within a half of the century (1943 – 1993) Vietnam has lost 5 Mio. ha of natural forest. Remaining 9.3 ha are also damaged seriously. Forest area per person in Vietnam is low (0.2 ha/person while the figure of South-East Asia is 0.4 ha/person and of the world is 0.62 ha/person). Forest area is reduced and the forest cover amounts to only 28% which is lower than the safe level (43%). Loss of forest results in many problems such as negative effect to the environment, flood, soil erosion, low productivity. Needs for the fuel wood of the community are also not met. The reasons of decreasing of the forest quality and quantity are uncontrolled harvesting, swiddening, cultivation changing (plant
food and industrial species), forest fire, poison from soil reclaiming activities... The annual population growth of Vietnam is approximately 2% (equivalent 1.4 Mio. per year) and this is a strong pressure for the Vietnamese forest concerning the needs for fuel wood and for food. In the whole country about 200,000 ha are planted every year and nearly 150,000 ha are lost.

In the last time, with efforts of the Vietnamese Government and with many support from the international community, from projects as PAM, German, Sweden ... more than 1 Mio. is afforested by the Vietnamese people. Especially, the 327 program from time to time has changed the picture of bare land areas in the mountainous and midland areas as well as in the coastal area of Vietnam. The green color has came back and the forest cover was increased. Therefore, protection capacity of many areas is strengthened contributing to develop the agricultural production.

The process of forest planting, rehabilitation and using by the Forestry Sector does not stand outside the general orbit of the country development. In many cases, management, organisation, technical activities as well as level of people’s knowledge and relationship between benefit of the collective, of community and of the individual have important impact to the forest situation.

After nearly 40 years from the first day of the Vietnamese Forestry Sector, the technical staff of the sector has been improved more and more. They have learned lot of experiences from other countries and have developed a copious technical system and sivilcultural technology. In some periods, the sivilcultural solutions somehow can contribute to the forest development. However, they also have negative impacts. The project areas (Ha Tinh, Quang Binh and Quang Tri) are also effected by the way of management and by the technical impact as well.

Many technical measures were applied, many documents were issued and it seems that everything was settled (norm for planing Pinus merkusii, norm for planting Acacia auriculiformis issued in 1996). Besides, there are still many problems for discussions. One of these problems is the sustainable forest management and forest rehabilitation and development, planting indigenous species on the site which was impacted. One more problem is transferring the state forestry to the forestry sector which is developed by both people and the Government.

The report includes following parts:

1. Sivilcultural measures currently existing in Vietnam and options
2. Species to be planted in Vietnam and in the project area
3. Other relating issues

1. Sivilcultural measures currently existing in Vietnam and options
1.1 General about the development process of systems of sivilcultural techniques

After 1954 due to the necessity of development for different economic sectors in the country, the forest resource - wood had significantly contributed to the restoration of the country and the forest was harvested. Therefore, it needs to be reestablished and technical measures for making impact to the forest from time to time have been formalized. Following the development of the country, the Forestry Sector also develops continually. And consequently, in order to meet practical requirements the technical system also has to be improved. Procedures, norms have been developed and issued by authorities according to 2 following methods:

- Through studies and experiments technical criteria are developed and tested on specified scale. Then they are issued by the authorized levels.
- A group of experts are assigned to develop technical procedures and norms. They collect materials and elaborate these norms which are approved then by a Science Council. Finally, authorized levels issue it.

During 40 years the Forestry Sector has developed more than 100 technical procedures, norms and guidelines focusing on the people who use and establish forest. This is big figure but not enough. System of sivilcultural techniques developed has significant contribution to natural forest planting and production. In the same time they also meet technical requirements of different economic components. Especially, from the time the land and forest are allocated to farmers and different economic components the system of sivilcultural techniques has many positive contributions. Although there are many things have to be adjusted and changed, the system of sivilcultural techniques has developed its effects efficiently.

1.2 System of sivilcultural procedures and norms

Developed sivilcultural measures aim to affect to the 2 main objectives that is the land without forest and with forest. Its goal is to have high production efficiency, to protect environment and improve the economic life of the people. With the theory and knowledge learned from the countries which have developed forestry, through experimental surveys, system of technical procedures and norms have been created according to each development period of the Forestry Sector in Vietnam.

In order to include the forest to the management system, forests were classified in 3 types: production forest, protection forest and special use forest. Step by step 87 protection and special use forest stands were determined, contributing to protect the natural forest in important areas. Based on this forest classification, technical regulations were developed appropriately. Technical issues are mentioned in the following main regulations:

The system of technical procedures and norms contributes to assist technical organising and management to achieve good results. These are procedures, norms and criteria concerning forest using and planting (soil selection, seed collection, preservation
and treatment, nursery production, protection from diseases and insects, planting, tending, thinning, harvesting). Mostly, silvicultural aspects were regulated completely on different levels. Following are main procedures and norms which have strong effect to different types of forest:

1. Harvesting procedures of bamboos. No. 603 QD/LN issued by the General Department of Forest in 1963
2. Temporary guidelines for maintenance of timber forest No. 16/QD dated January 07, 1970
3. Technical procedures for planting Styrax tonkinensis forest QTN 6-71
4. Technical procedures for planting Manglietia glauca forest QTN 7-71
5. Technical procedures for planting Pinus forest QTN 8-71
6. Technical procedures for planting Eucalyptus forest QTN 9-71
7. Technical procedure for planting Liquidambar formosana forest QTN 20-80
8. Technical norm for planting Eucalyptus and Acacia mangium forests QPN 8-89
9. Technical norm for planting, tending and protection of Bruguiera gymnorrhiza forest QPN 7-84
10. Technical norm for planting and protection of Melaleuca leucadendrom forest QPN 9-86
11. Technical norm for planting Tectona grandis forest
12. Temporary norm for solutions of silvicultural techniques to be applied for production forest QPN 10-88, 1988
13. Technical norm for planting Canarium olcosum, QPN 11-88
14. Technical procedures for planting Dendrocalamus
15. Technical procedures for thinning Pinus merkuzii, QPN 18-86
16. Technical procedures for thinning Styrax tonkinensis forest, QPN 22-82
17. Technical procedures for thinning Maglietia glauca forest QTN 21-82
18. Technical procedures for collecting resin of Pinus kesya QTN 21-82
19. Technical procedures for establishment of protection forest in watershed area QPN 13-91
20. Technical norm for establishment of seed forest and garden QPN 15-93
21. Norm of silvicultural measures to be applied for production timber and bamboo forest QPN 14-92
22. Temporary norm of technique for planting Acacia auriculiformis QPN 19-96
23. Temporary norm of technique for planting Pinus merkusii QPN 20-96
24. Species used for afforestation and forestry development in forest area No. 680 QD/LN Aug. 15, 1986

Beside above mentioned procedures and norms there are other procedures and norms concerning silvicultural field such as prevention diseases and insects, harvesting, multiplication. Although the system of law documents relating the system of silvicultural techniques does not deal with all the silvicultural objectives, but basically, in each period it assists forestry institutions to implement planting plans and plans for forest using as well. More or less the system of procedures and norms is the necessary guidelines which contributes to plant 1.04 Mio. ha of forest and to protect about 9 Mio. ha of natural forest in the whole country.
Basically, procedures and norms (official or temporary) have defined the necessary technical steps for forest establishment and effect direction to different forest objects. However, these procedures and norms were created in different periods according to practical needs and level of the science and technical development. Therefore, there are still many issues which should be added by systematical studies and experiments according to strategy orientation. Practically, many points from the procedures and norms were not tested on necessary levels and they show many problems during the implementation. Thus, considering technical issues relating to the project, we do not criticize unpractical points. The important thing is analysing shortcomings in order to find out the solutions for appropriate adjustment and changing and to apply it efficiently for the project area.

Three provinces (Ha Tinh, Quang Binh and Quang Tri) are included in to the project area. These provinces have all the typical characters of Vietnamese biophysical conditions, especially in the field of forestry. All three provinces have forest, sea, high mountain and rice field. There are rivers such as Ca, Rao Cai, Gianh, Kien Giang, Ben Hai, Thach Han and big lake Ke Go with the basin area of 1.879.000 ha including 420.000 ha of protection forest (Forest statistic in 1993). Besides, there is an area of protection forest in 300 km along the coast. Natural objects, especially forest, are very diversified. Therefore, most of the procedures and norms are applied in the 3 provinces. We will deal with main solutions for forest and forest land in the project area through applying main procedures and norms.

1.3 Impact of the sivilcultural measures

We do not describe and criticize the application of technical regulations relating sivilcultural field in the whole country. This report only clarifies the effect level of the technical measures on different forest objects, especially necessary and adequate conditions for measures to become effective (focusing on the project area).

Natural forest in the 3 provinces amounts to 170.564 ha and this is production forest. Forest in this area has been harvested and the procedure for wood harvesting, 1963 was applied. The annual productivity was 60.000 – 100.000 m$^3$. This document was applied for natural forest after 1960. The procedure defines the minimum diameter for harvesting based on wood groups (mechano-physical specification). The basis of the procedure is selection harvesting according to the diameter.

In 1988 the norm concerning sivilcultural solutions applied for production forest (QPN 10-1988) was extended and it includes also sivilcultural fields such as forest planting, enrichment, regeneration, rehabilitation and protection.

In 1993 bamboo forest was included as additional part to this norm and some sentences and articles were changed. Norm and procedures were developed and added in 2 periods. However, there are many unclearly and limited points in the norm. It is stipulated "harvest and ensure the rehabilitation capacity". But in reality, regenerated forest is rehabilitated in the direction of the quality decreasing. Species with economic
value, traditional species with high value for use were harvested totally. And post-
harvesting technical steps are not followed strictly.

Forest was harvested continuously from big diameter to small one until there is no more
wood for cutting. Many areas lost its rehabilitation ability and became poor forest. There
are also other uncontrolled forces involved in the forest harvesting. Harvesting
measures have negatively affected to the forest. Aside from this, management activities
are not good with unclear division of responsibilities. Therefore, not only the forest
structure was broken, but mostly forest became poor and degraded (forest in Northern
provinces, in Central Vietnam, in South-East Vietnam and a part of Tay Nguyen). That
is one of reasons which makes the forest to be degraded and poor and the forest area
to be smaller and smaller.

Some articles of the norm and procedure are not appropriate with management
practice, with social law and general knowledge of the community. Therefore, its
advantages can not become active. Due to the generality of the norm, many aspects
were applied in the way that it is difficult to control it. For example, when the forest
harvesting is limited, they apply the article for forest tending in order to harvest under
another meaning. Looking at the green colour of the forest, many people think
(intentionally and unintentionally) that the forest productivity and recourse as well as its
structure are still ensured. But in reality, it is obviously degraded and many forest areas
have lost the harvesting capacity for the next rotations. This problem is also common in
the three project provinces. Applying the norm of sivilcultural solutions do not show the
forest reserve and development. Besides, there are also other social reasons and
natural forest is reduced obviously in both quality and quantity. Precious wood such as
Cindora, Peltophorum, Michelia tonkinensis, Vatica, Tarrietia are more and more rare.
Mostly, these species were harvested totally. There are different economic components
(state, collective) involving in this harvesting. Statistic data shows the development
process of forest recourse within the project area.

Percentage of poor and restored forest in Ha Tinh  38.7%
Quang Binh  52.9%
Quang Tri  65.5%

This figure shows that the percentage of forest which lost production ability (harvesting
and rehabilitation) in Quang Binh and Quang Tri is very high. According to the statistic
data, the percentage of natural forest (rich and medium) in Ha Tinh is satisfying.
However, it includes also slopping areas, areas with difficult topography which are very
difficult for harvesting.

Forest was degraded, forest area for harvesting is reduced, forest reserve is low,
productivity is also reduced, diversity of wood is reduced – this is the consequence of
uncontrolled process of forest using and applying of norms.
### Table 1. Forest situation in the project area (Statistic data in 1993)

<table>
<thead>
<tr>
<th>Type of forest</th>
<th>Ha Tinh</th>
<th>Quang Binh</th>
<th>Quang Tri</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ha)</td>
<td>Product.</td>
<td>%-m³/ha</td>
</tr>
<tr>
<td>Natural forest</td>
<td>164,515</td>
<td>100</td>
<td>22,334</td>
</tr>
<tr>
<td>Product. forest</td>
<td>99,648</td>
<td>27.3 / 192.6</td>
<td>27.3 / 192.6</td>
</tr>
<tr>
<td>Rich forest</td>
<td>30,772</td>
<td>30.9 / 115.8</td>
<td>47,867</td>
</tr>
<tr>
<td>Medium forest</td>
<td>36,876</td>
<td>36.8 / 68.4</td>
<td>39,813</td>
</tr>
<tr>
<td>Poor forest</td>
<td>1,955</td>
<td>1.9 / 24.6</td>
<td>16,438</td>
</tr>
<tr>
<td>Restoring forest</td>
<td>2,441</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bamboo</td>
<td>64,867</td>
<td>82,943</td>
<td>51,360</td>
</tr>
<tr>
<td>Protection forest</td>
<td>635</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood &amp; bamboo</td>
<td>151,810</td>
<td>255,195</td>
<td>19,498</td>
</tr>
<tr>
<td>Bare land</td>
<td>151,297</td>
<td>200,441</td>
<td>18,967</td>
</tr>
<tr>
<td>Affor. bare land</td>
<td>151,297</td>
<td>200,441</td>
<td>18,967</td>
</tr>
</tbody>
</table>

Survey on forest after harvesting (April 1998) in Huong Son, Huong Khe enterprises, Ha Tinh province and Truong Son, Ba Ren in Quang Binh shows the reduces in forest quantity and quality. For the harvesting rotation 20 – 25 years the diameter of wood to be harvested is reduced. Diversity of wood is also poorer and poorer. Mostly, there is no big Vatica, Tarrietia javanica, Peltophorum trees. Although harvesting activities were done according to designation approved by authorized levels, forest will develop in down direction as in the North if the old management is remaining. How to acknowledge the application of sivilcultural solutions in the project area and the reason of quality and quantity reducing. Above, we mentioned the application of tending article for harvesting. The norm includes a tending measure which is very appropriate in theory. However, it is not applied in the practice due to the high investment. That is the problem we have to consider and make additions.

Forest has became poor which is difficult for rehabilitation. Forest structure is broken and it affected to the regeneration capacity of the forest. Growth of creepers, trees with diseases and insects, with large canopy are the big hamper for regeneration and
restoring process after harvesting. Cleaning step after harvesting as well as other steps are also neglected.

In order to see the effect of harvesting situation to the forest structure and productivity, we would like to introduce a survey on forest harvesting in Huong Son. Huong Son forest is assessed as the place where they protect forest reserve in the best way. Our comment do not intend to criticize any organization or individual. We only want to clarify that technical solutions should somehow be developed and applied with supporting of policies in order to protect forest reserve and improve the forest. Huong Son enterprise has the largest area in Ha Tinh province. Before it managed about 60,000 ha and annual harvesting is 40,000 m$^3$.

At present the enterprise manages 42,097 ha natural forest including:

Rich forest: 23,225 ha making up 55% with average reserve of 209 m$^3$/ha

Medium forest: 7,006.9 ha making up 16.6% with average reserve of 127.5 m$^3$/ha

Poor forest: 7,441 ha making up 17.7% with average reserve of 70.2 m$^3$/ha

Restoring forest: 1,277 ha making up 3% with average reserve of 38.4 m$^3$/ha

Plantation: 551.5 ha

Bare land: 1.699 ha

(Dada from FIPI, October 1997)

According to general regulations there is no figure for comparison between the percentage of poor and rich forest during it development progress. If compare to statistic data by FIPI in 1993, there are differences between reserve of different types of forest and this is not real changes of forests, it may be just the influence of data collection. In one study of PhD Tran Xuan Thiep (his composition) published in 1996 (National Library, Library of Forestry Science) the author commended: Practically, issued and applied process and norms for forest harvesting leaded to selection cutting according to diameter. Data on structure, regeneration, area shows that the forest is not able to restore. The conclusion is:

After harvesting Huong Son forest has changed in structure:

- Compositions of valuable species have decreased: Erythrophloeum fordii is reduced from 3.8% of forests type IV to 0.7% and 0.65%; Michelia, Cinnamomum tonkinensis, Bassia pasquieri, Castanopsis indica, Chukrasia species and other valuable species also are reduced in its composition as Erythrophloeum fordii. At the same time species of low value such as Gironniera subaequalis, Syzygium species, Symplocos species were increased.
**Decreasing of forest fund:**

Area of rich forest was reduced while area of poor forest was increased.

Forest quality also became worse: high value species became less and low value species became more.

In 1960 – 1970 forests from group IIIA3 and higher groups were harvested, IIIA2 was remained. In 1985 – 1990 IIIA2 was harvested with 90 m³/ha. Until 1985 there are 22,600 ha from total 55,600 ha forests in Huong Son which do not have capacity to produce big timber.

Harvesting process has misused forest fund. According to the norm 14-92 harvesting is allowed up to 40% of forest reserve. The harvesting designation was 25%, but in practice, due to damages, cut amount is calculated up to 40 – 45%. Forest IIIA3 has the reserve of 150 m³/ha. With the harvesting intensity of 25% (38 m³/ha) and growing rate of 2.3% (equivalent 2.5 m³/ha per year) 15 years are needed for restoring. For the harvesting of 40 – 45% 20-25 years are needed for restoring while they harvested it after only 12 – 15 years. Following is the example in sub-enterprise Nga Doi of Huong Son enterprise:

<table>
<thead>
<tr>
<th>Forest status</th>
<th>Factor observed before harvesting</th>
<th>After harvesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trees</td>
<td>430</td>
<td>365</td>
</tr>
<tr>
<td>Cut trees (15%)</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>M (m³/ha)</td>
<td>232.7</td>
<td>149.3</td>
</tr>
<tr>
<td>Cutting intensity</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Average D (cm)</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>Average H (cm)</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Number of trees with D&gt;40cm/ha</td>
<td>remaining after harvesting</td>
<td>32 (54.5 m³)</td>
</tr>
</tbody>
</table>

Big timber amounts to 75% (175 m³/ha). Harvesting amount is 36% and damages are 15%. It makes the total of 51% (89 m³) and the remaining forest fund is 86 m³ which is equivalent forest of group IIIA2. Annual growing rate is 2% and it needs 30 years for restoring the forest fund. However, the rotation in practice is only 15 – 20 years. The designation for harvesting is only 25%, but cut amount is exceeding by 1.5 – 2.0 times. On the other hand, there are uncontrolled harvesting.
Practice shows that procedures and norm have strict regulations. However, sivilcultural measures are not followed due to different reasons. Forest compositions are not improved, density is reduced by and by, species allocation in natural forest was bad and became more differentiated.

Aside from this, management activities as well as technical monitoring are not understood rightly. In many areas social reasons make the situation more serious.

Above mentioned situation shows that although Huong Son has experienced management staff and its application of technical procedures and norm is assessed well, but Huong Son forest has been degraded after harvesting.

Legality and strictness of the norm QPN 14-92 was mentioned as above. However, there are many important issues which were mentioned very generally. For example: Article 15: Rotation for selection harvesting should ensure the time for forest rehabilitation in order to reach before the next harvesting the reserve that is not lower than before harvesting. In Huong Son, regulations concerning rotation and forest fund were followed. On September 1, 1991 the Forestry Sector has issued a Temporary Regulation QD 364/LSCN on wood and bamboo harvesting with many details. However, concerning the important point there is only a sentence "measure, count and define the wood amount to be harvested of each plot." The Instruction No. 7 LS/CNR dated May 14, 1993 defines: "Selection of trees to be cut: according to the allowed intensity (QPN 14-92) and the maximum amount to be harvested is 45% of the forest fund. However, concerning the rotation it makes only general regulation as in Article 15 and the addition is "following the process". What is another process?

There is no other norm beside the 14-92 norm because while the new norm was issued, the old one does not have its effect any more. There are norm and regulations as well as Instruction for harvesting designation, but that is not enough. The Instruction No. 3LS/CNR dated February 08, 1994 defines the objects available for harvesting as following:

- For the South:
  - Green broad leaves forest with the reserve of 120 m$^3$/ha, number of trees with D>30cm amounts to more than 30% of the total quantity
  - Dry diptocarp forest with the reserve more than 90 m$^3$/ha

- For the North:
  - Green broad leaves forest with the reserve > 80 m$^3$/ha
  - Production forest for pit prop with the reserve 60 m$^3$/ha

If we analyze harvesting objects, harvesting amount, growing ability of the forest after harvesting, harvesting rotation of different specified areas, we can see that the changing of forest status is even worse than Huong Son.

QPN 14-92 also defines harvesting techniques, but only few organizations apply these techniques.
There are many regulations, instructions concerning natural forest. However, these
documents are not synchronous and there is no concretization by technical indicators
for each region, each implementation step. Despite of many instruction documents and
appraisal regulations, the over-harvesting of forest fund can not be prevented in
practice. In these instructions they mentioned only technical measures but not
investment policies for sivilcultural steps. In big projects for the forest rehabilitation they
concentrate only to afforestation or enrichment may take some attention, but very small.
Natural forest owners concentrate only on how they can take the forest products without
control and monitor by different organizations. Sivilcultural solutions for protection and
development of natural forest do not have enough attention. At the same time there is a
lack of policies for efficient investment and management. Although there are special
department in the Ministry, provincial department and sections which are responsible for
this matter, but specified regulations on responsibility and investment are not
appropriate. Therefore, many right opinions on technical economy are not applied. One
more problem is training and payment policy for staff in order to support them to fulfill
their tasks.

In order to overcome shortcomings of the forest harvesting and to improve poor forest,
Technical procedure for forest rehabilitation was developed. Technical instructions of
this procedure are very good. However, due to inappropriate management knowledge of
different levels, the procedure was not applied as required. This procedure was
forgotten and then canceled. It is replaced with another norms which is more general
and covers a large range of production forest in a large area with various vegetation
compositions, forest structures, topographical types, soil types, climate conditions and
cultivation traditions and levels (swidden cultivation, undeveloped economy of the
population which lives near to the forest). Besides, there is a policy for macro
management that all the land and forests as well as mountains area managed by the
Government.

These are 2 basic documents concerning techniques for forest using, protection and
development. The norm does not define regions for applications and appropriate
technical procedures should be developed for regions with specified biophysical
conditions and forest status. On the other hand, feasibility of the norm is limited due to
its scientific basis. Mostly, norms were developed by a group of experts based on some
observations and Eastern or Western logic. It was not systematically tested for
consideration of its feasibility. The norm was changed 2 times and what is the basis for
these changes? During development of norms, costs for assessment tests are not
supported by donors. Therefore, technical and relating conditions were not ensured.
Besides, there are other reasons which can limit its application in to practice.

The system of technical procedures and norm for forest planting and rehabilitation
includes: technical procedures for planting Styrac tonkinnensis (QTN 6-71), Mangilietia
insignis (QTN 7-71), Pinus (QTN 8-71), Eucalyptus (QTN 9-71), Liquidambar formosana
(QTN 2-80). Above mentioned procedures define the steps such as seed collection,
seedling production, soil selection and preparation, planting and tending until canopy
closure. These procedures were developed in order to plant species for wood
production. However, not all procedures are clear. Mangilietia insignis which is planted according to the procedure, does not produce big wood as expected while Pinus merkusii produces wood. A serie of surveys on Pinus merkusii (plastic tube, tube content, nutrient, seedling criteria, soil, thinning..) concentrates only to wood production while fuel wood from Pinus merkusii during thinning has very low value. From 1980 many procedures for planting each species were developed (Eucaliptus calmandulensis, Acacia mangium, Dipterocarpus alatus, mangroves, Melaleuca). These procedures are the basis for forest enterprises and corporations to apply during forest planting. This is also the technical basis for PAM project, 327 program. Thinning procedures for some species (Pinus merkusii, Styrac tonkinnensis, Mangilietia) were also developed in 80th years. In 90th years 2 norms for planting Pinus merkussi and Acacia auriculiformis were developed. These norms are relating to species to be planted in the project area. In this part, we summarize the application of these norms in Vietnam in general and in the 3 project provinces.

Technical process for planting Pinus merkusii:

Pinus merkusii is considered as the species which mainly produces resin and is planted on poor soil in Quang Ninh, Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Hue, Thua Thien ... The norms has been developed with many detailed regulations. Attention was paid to soil classification based on the soil thickness (from 20cm to 50cm), on indicating vegetation (Dicranopsis linearis; Rhodomyrtus tomentosa, Melastoma dodencandrun, bushes), on pH (3.5 - 5.5). There are 5 soil types and it is recommended to plant Pinus only on the soil from types I, II and III for resin production. Besides, there are some criteria on N, P, K and slopping (<20°). Concerning seed collection it is regulated that seeds are collected only from seed garden with high productivity. However, there is no such seed garden in Vietnam (Article 12, Technical norm for planting Pinus merkusii QPN 18-96). For the purpose of resin production Pinus merkusii should be planted with graft (Article 20, 21, 22, 23, 24). In practice, selection and grafting activities are experimented but not applied widely in production. This shows that sometimes experts who develop norms and procedures do not base on practical surveys in order to create norms which can be used in the practical production. Another example is article concerning mixed planting (Article 26): Mixed planting with Acacia or other indigenous broad leaves species is carried out in bands or patches. Mixed planting in lines is applied with the ratio 4:1: 4 Pinus lines and 1 line of indigenous broad leaves species. These regulations are also very general. Which species from indigenous broad leaves species and which Acacia species (A. mangium, A. auriculiformis, A. crassirpa) we can use? And what is the differences between the soil in North-East Vietnam and North of Central Vietnam? In practice until June 1998 there is no summarized study on indigenous broad leaves species in order to indicate specified species to be planted mixed in Pinus forest. And the mixed planting measure with ratio 4:1 also was not tested. The planting density defined by the norm also should be considered through practical afforestation. There are 2 densities to be applied: 1.600 - 2.000 trees/ha and 400 - 600 trees/ha for plantation with grafts. How tending activities will be carried out with this low density?
Can we apply mixed planting in the Pinus forest with the purpose of resin production? In the Article 45 it is said that thinning activities is carried out according to articles 39 and 40 while these articles regulate planting time and technique.

According to the regulation on Pinus density for 327 program, the density for Pinus is only 500 - 600 trees/ha, remaining is supplementary species such as Acacia auriculiformis. Arrangement of mixed planting is different in 3 provinces: it is planted in lines with the ratio 4 Acacia : 3 Pinus in Quang Tri, in Quang Binh they planted mixed species around the plot and the ratio for Ha Tinh is 1:1. The German project tests mixed planting applying the ratio 7:3.

Pinus merkusii has important role in the species structure in the project area because the soil conditions, economic value and successful of Pinus planting in many areas can ensure the success of the project. The acceptance of farmers is also different in the 3 provinces. Pinus is species of poverty cancellation in Ha Tinh, in Quang Binh farmer's acceptance is less and in Quang Tri Pinus has no attention. Therefore, the question is what is the position of Pinus merkusii in the species structure of the project?

According to the experience of Ha Tinh when Pinus forest reaches to 7 - 10 years it should be thinned 50% (700 - 1,000 trees) and resin is took totally in 3 years. Resin productivity can reach to 1.2 - 1.5 tons per ha and its price is 4,000 VND per kg. There are 4 - 6 Mio. ha to be harvested every year. The investment is not so much. At present Ha Tinh has 16,000 ha Pinus merkusii with different ages. Most of these areas were transferred to farmers to protect and harvest its products. Pinus forest of the Long Dai Forestry corporation also were transferred and protected. Despite of hostile whether conditions in 1998 summer, there is no forest fire as the farmers have received forest and protect it themselves.

Pinus merkusii was studied in many fields from seed selection, seedling production, planting, thinning to tending. In last years they paid attention to the planting Pinus with resin production purpose. Pinus merkusii production in Trieu Hai forest enterprise is good sample.

However, there are some problems to which we have to pay attention as following:

- How long is the consumption of Pinus resin? Does it ensure the incoming for the farmers?
- What is the incoming of farmers from the forest between the time of planting and the time for total harvesting of resin (thinning)?
- What are the techniques for Pinus merkusii with resin production purpose in each step from seed selection to planting?
- What about the planting density, soil, mixed planting measure (species, procedure), forest fire, disease and insects?

For the time being the project can have some options: which species can be used for mixed planting and what is the ratio? Acacia auriculiformis can be selected as it was
planted in practice. I have found out one broad leaves species in the project area which can survive on the site conditions appropriate to Pinus merkusii. In other area Pinus merkusii is mixed planted with Castanopsis and Dipteracarpus, but the mixed ratio is occasional. I have met Pinus kesiya mixed planted with this broad leaves species as above. And I want to recommend it for test planting in the project area. One question that the project has to clarify is the ratio and method for mixed planting of Pinus merkusii with Acacia auriculiformis.

When Mr. Nguyen Luyen applied the ration 7/3 for mixed planting of Pinus merkusii and Acacia auriculiformis, Mr. Nguyen Khac Ninh criticized that Acacia will dominate over Pinus. Mr. Ninh takes the experiment of the Institute of Agriculture and Forestry for the sample. The experiment is carried out on Luot mountain. The ratio applied is 1 Acacia : 1 Pinus according to lines or 3 Pinus : 2 Acacia according to density. It is obvious that in the same conditions Acacia grows faster than Pinus massoniana. Mr. Ninh informs that Pinus massoniana grows faster than Pinus merkusii.

Following is the observation results of experiment for planting Pinus merkusii and Acacia auriculiformis in narrow bands: 5 Pinus lines : 3 Acacia lines; distance between trees is 2m and between lines is 2m:

Table 1: Growth of Pinus merkusii and Acacia auriculiformis
Dong Ha, Quang Tri (planted in 1984 and observed in 1987)

<table>
<thead>
<tr>
<th>Age</th>
<th>Pinus merkusii</th>
<th></th>
<th>Acacia auriculiformis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D 1.3 (cm)</td>
<td>H (m)</td>
<td>D 1.3 (cm)</td>
<td>H (m)</td>
</tr>
<tr>
<td>3</td>
<td>2.82</td>
<td>2.37</td>
<td>2.54</td>
<td>2.75</td>
</tr>
<tr>
<td>4</td>
<td>4.13</td>
<td>3.70</td>
<td>3.88</td>
<td>4.82</td>
</tr>
<tr>
<td>5</td>
<td>5.42</td>
<td>4.57</td>
<td>6.17</td>
<td>6.14</td>
</tr>
<tr>
<td>6</td>
<td>6.93</td>
<td>5.50</td>
<td>6.47</td>
<td>7.47</td>
</tr>
<tr>
<td>7</td>
<td>8.17</td>
<td>6.50</td>
<td>7.59</td>
<td>9.98</td>
</tr>
<tr>
<td>8</td>
<td>9.05</td>
<td>7.63</td>
<td>9.11</td>
<td>11.21</td>
</tr>
<tr>
<td>9</td>
<td>9.95</td>
<td>8.63</td>
<td>10.2</td>
<td>12.4</td>
</tr>
<tr>
<td>10</td>
<td>10.67</td>
<td>9.37</td>
<td>11.3</td>
<td>13.7</td>
</tr>
<tr>
<td>11</td>
<td>11.23</td>
<td>10.03</td>
<td>12.4</td>
<td>14.9</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>10.50</td>
<td>13.5</td>
<td>16.1</td>
</tr>
<tr>
<td>13</td>
<td>12.62</td>
<td>10.97</td>
<td>14.5</td>
<td>17.3</td>
</tr>
<tr>
<td>14</td>
<td>13.17</td>
<td>11.3</td>
<td>15</td>
<td>18.6</td>
</tr>
</tbody>
</table>
In the 4th year Acacia is higher than Pinus merkusii, in the 6th year Acacia dominates over Pinus, but its effect to Pinus growth is not very obvious.

This is a factor for consideration in order to define the appropriate distance, density and method for mixed planting.

Value of the mixed planting is easily to be recognized during wood production, but how we can assess it through resin production (quality and quantity). All these questions are in front. What will be the impact of mixed planting if other species are used? What will be the comparison and options?

Acacia auriculiformis and norm for its planting:

Acacia auriculiformis is planted in the project area for about 15 years. This is the practice from which we can gain experience for the project. In Quang Tri Acacia auriculiformis became a kind of good. VIJACHIP buys Acacia boards with attractive price. But it is necessary to consider its productivity on specified site types in the project area. In Quang Binh and Ha Tinh Acacia does not become the good yet as in Quang Tri. What is the role of Acacia in provision of inputs for fabrics which produces boards in the 3 provinces for 5 – 7 next years? That is the important point for farmers when they select species for planting on the land they received. The factors that limit options for selections of species to be planted are limited number of species planted in the project area, lack of information, plan for seedling production. On the other hand, the farmers are not used to plant forest trees as to industrial trees that they have planted for a long time. Acacia auriculiformis is studied in Vietnam early (1981). The study is relating to planting techniques, technique for creating forest, find out and select the origin. A technical norm for planting Acacia (QPN 19-96) was issued for 2 purposes: wood production and protection. Before the norm was issued there are about 70,000 ha Acacia from different origins planted in Vietnam in different ecological regions. They provide high harvesting productivity. The norm focuses on the provision of material for production of different kinds of boards and paper production with the 7 year rotation. Minimum productivity in average is 10m³/ha per year. Many other procedures and norms were also developed based on individual experiments and on production experiences in some regions. There are many points in the norms that are not proved in the practice.

Questions rose are soil type, fertilizer, soil preparation, density and productivity. Which origin can be appropriate for specified site type in order to have required productivity? Mixed planting method is also one issue. These issues were mentioned in surveys. However, they are not added.

1.4 Some issues relating to silvicultural solutions and recommendations

Although there is an open space in the norm, but it is necessary to define main technical specifications. All the above mentioned issues are very difficult for organizations to apply. Due to lack of financial supporting, lack of information update by technical staff it
is also difficult to make process suitable with local conditions. In practice, PAM project and 327 program are implemented in different regions, but the issues concerning productivity, quality and economy are not fully mentioned. The survival of forest reaches 80%. However, projects can not assess survival rate after 5 – 6 years as they are implemented in the first half of the shortest rotation. Main part concerning seedling production, initial planting meet practical requirements. However, it needs some additions. In 327 program Acacia auricuriformis is planted mixed with other species. Articles 19, 23 and 30 of the norm No. 19-96 define: “The best method for mixed planting is plant in bands or patches. Mixed planting in lines is also possible. Acacia density in bands or patches is 1,600 – 2,500 trees/ha. Maximum density applied by 327 program is 1,600 that is the minimum density of the norm.

This factor shows that localities and afforestation projects do not consider articles of norm as the standards. How does this application affect to the afforestation targets? This is not assessed yet. However, we can see that application of 19-96 in specified cases has big and important changes which is the density of initial planting. Productivity of Acacia forest in some areas does not reach figure required by the norm.

There should be local or project procedures to concretize the application of 19-96 norm based on summarizing experiences gained from 327 program and PAM project as well as from demonstration models of the project, especially for mixed planting. Results of surveys on Acacia origins are very important to ensure high efficiency of the project and benefit for the farmers.

Above mentioned is 3 sivilcultural solutions relating to the project implementation. Therefore, they have only little meaning for other areas.

Recommendations:

- From the system of procedures and norms, norms applied for the project are important. Therefore, they should be concretized to become appropriate for the project objectives.
- There are many procedures and norms relating to the project implementation and each locality also develops temporary documents. The project should consider, select and apply appropriately.
- The project has to assess the afforestation situation (Acacia auriculiformis, Pinus merkusii, Cuninghamia) in the project area. This assessment will be the basis for application of technical procedures and norms in the project area.
- Develop technical guidelines appropriate to project objectives and management activities of the project.
- Regulations in procedures and norms define only technical aspects, but do not consider conditions for applying (social) which is relating to policies for forest management and development.
- Above mentioned issues are very important and its application will be the contribution of the project in the technical field to forest development in the project area and in Vietnam.
The project should pay attention to the selection and efficient application of silvicultural solutions because many regulations of the norm are on macro level.

2. Species to be planted in the project area

2.1 General about the species planted in Vietnam

Species structure has been developed since 1983. Ministry of Forestry has issued it and made additions to it through the Decision 680QD/LN (annex 2). Workshops on species structure for North-East, North-West Vietnam, Central Vietnam and North of the Central Vietnam (1985 – 1987), national workshops in Hue (1994), in Pleiku (1996), in Phu Ninh (1996) financed by international organizations have provided many useful informations and discussions.

Workshop 327 in Hoa Binh suggested 104 species (Annex 3)

The group for assessing species to be planted in 327 program proposed 72 species (Annex 4)

Species structure of PAM project is not very diversified. When the indigenous species are allowed to plant in 327 program, localities have planted various species on different levels, areas, with various measures and densities. However, within 2 – 3 years there is not sufficient information for assessing growing rate, but only survival rate.

According to the Decision 680 QD/LN species structure was defined based on 5 indicators. However, in reality number of indicators is not sufficient as mentioned. This structure is applied for different site regions or for North of Central Vietnam which has different site types. Especially, it is not simple to include indigenous broad leaves species in to the project area. The project aims to support farmers to plant successful on forest land in order to have products. The selection activity tries to reduce risks. Therefore, test planting in practical production is needed. The objective of the project as well as of technical authorities is to select indigenous broad leaves species for planting in the project area. Thus, we should accept risks if necessary and carry out the test planting in specified area in order to select appropriate indigenous species for the future. If all the projects/programs intents to avoid difficulties and risks, then planting indigenous species will be only beautiful idea for ever.

2.2 Biophysical and social conditions in the project area

The objective of the project is to contribute to afforestation and soil protection program within the area of 3 provinces Ha Tinh, Quang Binh and Quang Tri through supporting farmers in efficient soil using, sustainable environment protection, creating new jobs and improving economic life of farmers. Detailed targets are:
• New planting of 21,000 ha
• Support project communes in 10 districts from 3 provinces to develop village plans in the first 3 years of the project implementation

(Decision 435/TTg dated June 26, 1997 concerning approval of the project by Vice Prime Minister Tran Duc Luong)

The project has developed a plan for planting 21,000 ha in 46 communes of 10 districts in 3 provinces.

Criteria for selection of participating areas focus on the aim of the project:

• Selected communes are in the same region
• There are ecological problems such as erosion
• There are adequate labour and land fund
• Bare land covers high percentage and forest cover is low
• Project measures play important role

The project is implemented within the area from 16°12 to 18°46 of North latitude, the East side is neighboring the sea, the West side is 35 – 45 km inland. Some project sub-areas (communes, districts) are located in distance form each other. Although 7 project districts neighbor the sea, but communes are not located in the area of flying sand, only a part of project area is located in the interior sand area.

Geographical area of the project is not large and there are no big changes for temperature and humidity. However, climate conditions of each sub-area have its specific characteristics. Ngang mountain pass separates Ha Tinh and Quang Binh (Ky Anh and Quang Trach), raining in Ky Trinh is also different. Lao wind in Son Mai, Son Tho, Cam Tuyen and Cam Hieu communes is different from other communes of the project area.

Table 3. Climate conditions in some project places

<table>
<thead>
<tr>
<th>Month</th>
<th>Ky Anh Temperat. (°C)</th>
<th>Raining (mm)</th>
<th>Dong Hoi Temperat. (°C)</th>
<th>Raining (mm)</th>
<th>Quang Tri Temperat. (°C)</th>
<th>Raining (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17.5</td>
<td>130.2</td>
<td>19.0</td>
<td>62.4</td>
<td>19.4</td>
<td>156.5</td>
</tr>
<tr>
<td>2</td>
<td>18.2</td>
<td>86.5</td>
<td>19.3</td>
<td>43.4</td>
<td>20.4</td>
<td>66.2</td>
</tr>
<tr>
<td>3</td>
<td>20.7</td>
<td>72.1</td>
<td>21.7</td>
<td>43.8</td>
<td>22.6</td>
<td>65.7</td>
</tr>
<tr>
<td>4</td>
<td>24.4</td>
<td>76.4</td>
<td>24.9</td>
<td>56.1</td>
<td>25.6</td>
<td>57.6</td>
</tr>
</tbody>
</table>
Differences of climate indicators have effect to species selection and they are relating to site conditions, productivity as well as to other technical details.

According to geographical and topographical 3 regions were classified: midland hills (Duc Tho, Huong Son), hill neighboring the sea (Ky Anh, Bo Trach, Quang Trach). Topography is high and slopping (100 – 200 m) from Huong Son and become lower to Le Thuy, in Quang Tri area the land is lower and more event.

Soil conditions also change from Feralite with thickness of 30 – 50 cm in midland hills (Huong Son, Duc Tho, Cam Lo) to sandy clay with thinner soil layer. Within each sub-area (commune) the topography is also changed in thickness of soil layer, soil fertility (humus, N, P, K) as well as the physical and chemical compositions of the soil. These factors are clearly analyzed in materials concerning site matching. Through observation of indicating vegetation we also can see the differences in site matching conditions.

Socio-economic conditions in project areas also are diversified in:

- Cultivation conditions and traditions
- Transportation and cultural conditions, population density
- Development of economic types in the area: agriculture, forestry, agricultural and forestry product processing, services, handicrafts...

Biophysical conditions have direct effect to surviving, growth and development of the forest. Cultivation traditions, level of technical application have impact to the success of species selection.

**2.3 Requirements relating to species selection**
Wood production and non-wood products are the common purpose of afforestation programs. Especially, in rural areas afforestation programs create jobs for farmers and contribute to improve the rural economic life. And a certain thing is that forest will develop its protection function. Forest trees can be harvested only after a long term. Therefore, species with only wood products are not attractive as multipurpose species which provides also by-products such as fruits, oil, resin, medicine material... The question is to select species which meets above requirements and also following requirements:

- Ecological characteristics of species should be appropriate to soil conditions
- Species selected should suitable with the project objectives
- Species selected should be multi purpose, provide products in the short term and permanently
- Forest products can be materials for handicrafts

2.4 Species planted and proposed for the project area

Feasibility study of the project has selected species for afforestation and for fruit garden as well:

- Forest species: Acacia mangium, Cassia siamea, Casuarina equisetifolia, Pinus hainai, Canarium album, Cinamomum
- Fruit species: orange, lemon, litchii, pepper, coffea

Project APM 4063 has selected Eucalyptus, Pinus merkusii, Acacia auriculiformis, Casuarina equisetifolia for afforestation.

For 327 program:

- In Ha Tinh they have selected Pinus merkusii, Acacia auriculiformis, Canarium nigrum, Calaphyllum soulattri Burm, Vatica tonkinensis, Mangletia glauca for afforestation. But for bare land in Ky Anh, Duc Tho and Huong Son they planted only Pinus merkusii and Acacia auriculiformis. Planting Canarium album is only limited.
- In Quang Binh they have planted Acacia auriculiformis, Cassia siamea, Acacia mangium, Casuarina equisetifolia, Tarictia javanica, Endospermum sinensis, Canarium, Peltophorum tonkinensis, Vitis pentagona. In the areas with the same conditions as in German project they planted only Pinus merkusii and Acacia auriculiformis. Casuarina equisetifolia and Acacia auriculiformis are planted in flying sand areas.
- Quang Tri has selected Acacia auriculiformis, Cassia siamea, Acacia mangium, Tarictia javanica, Techtona grandis, Vernicia montana, Hevea brasiliensis, Pinus merkusii. In 1998 they following species were added: Madhuca parquieri, Liquidambar formosana, Peltophorum dasyrhachis, Alstonia scholaris, Lisea sp., Cinamomum sp. On the same soil as in the German project they planted mainly Acacia auriculiformis, Cassia siamea, Pinus merkusii.
Following is the proposal for species to be planted by experts of the Institute of Forestry and of the National Project Management Unit:

<table>
<thead>
<tr>
<th>Site type</th>
<th>Species priority</th>
<th>Project area</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cacarium</td>
<td>Cassia siamea Ha Tinh</td>
</tr>
<tr>
<td></td>
<td>Tarictia havanica Canarium Quang Binh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Madhuca pasqui.  Lisea sp. Quang Tri, Ha Tinh, Q.Binh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cassia siamea    Pinus+Acacia Quang Tri</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cassia siamea    Mangium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pinus merkusii   Acacia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accia auriculif. Casuarina equisetifolia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mangium</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Ha Tinh, Q. B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quang Tri</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Quang Tri</td>
<td></td>
</tr>
</tbody>
</table>

The criteria for site classification are:

- Indicating vegetation
- Thickness of soil layer
- Slopping

After studying biophysical conditions of the project area and the project objectives Mr. Nguyen Luyen proposed indigenous species to be planted in the project area as following:

<table>
<thead>
<tr>
<th>Species</th>
<th>Region</th>
<th>Height of the land</th>
<th>Ecological requirements</th>
<th>Soil requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tarrietia javanica</td>
<td>Low land</td>
<td>&lt; 100m</td>
<td>Prefers light, occupies higher level.</td>
<td>Deep and thick soil layer</td>
</tr>
<tr>
<td>Cassia siamea</td>
<td>Planted in many areas</td>
<td>Fast growing</td>
<td></td>
<td>Alluvial deposits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Normal growing on exhausted soil.</td>
</tr>
<tr>
<td>Litsea sp.</td>
<td>Quang Tri, Da Nang</td>
<td>250 m – 1,000m</td>
<td>Likes shade, occupies middle level</td>
<td>Deep and moist soil</td>
</tr>
</tbody>
</table>
Canarium nigrum From central area to the North <500m Fast growing, likes light Likes humus.


Sindora tonkinensis North of Central VN 300 – 700 m Likes shade in small age. Good soil.

Melia azedarach Provinces Likes light in small age Many soil types

In the proposal for test of mixed planting in the project area, Mr. Tran Quang Viet has suggested 4 models:

- **Mixed planting of Camellia oleosa with Acacia species (Ac. auriculiformis, Ac. mangium, Ac. crassirpa) in bands: 4 Camellia oleosa lines and 3 Acacia lines. Camellia density in the band is 800 – 1,100 trees/ha (distance 2.5m x 3m or 3m x 3m) and Acacia density is 1,666 trees/ha (2m x 3m)**
- **Pinus, Acacia and Camellia oleosa mixed planted in the bands: 4 Camellia lines – 1 Pinus line – 1 Acacia line. Distance for Pinus is 2 x 3m and for Camellia is 3m x 3m.**
- **Mixed planting of Paulownia with Tarrietia javanica or Litsea sp.: 4 Paulownia lines – 1 Tarrietia or Litsea line. Distance for Paulownia is 3m x 3m, for Tarrietia is 4m and for Litsea is 3m. There will be 825 Paulownia trees and 206 Tarrietia or Litsea per ha.**
- **Mixed planting of Casuarina equisetifolia and Acacia crassirpa, Eucalyptus in coastal area: density is 2,500 trees/ha.**

PAM project selected species to be planted based on the list of species in the Decision 680 QD/LN dated August 15, 1986. 327 program also based on this Decision and some other species were added by localities. Decision 680 QD/LN selected species for planting based on 5 criteria as following:

1. Appropriate to the production objectives of the region, area
2. Appropriate to the ecological situation and site conditions of the area for planting or development
3. The technical process or guidelines are existing, or at least have experience in planting, the species has been developed in practical production with success
4. Seed recourse is ensured and meet the quality and quantity requirements
5. Productivity and economic efficiency are receivable

According to these 5 criteria species to be planted are classified in 2 groups: group of proved species and of potential species.
We can use this list for species selection. However, a list with too many species is very difficult to consider and to find the solution.

According to the Decision 680 QD/LN, basically the North of Central Vietnam includes Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue with following species:

- **Group of species proved for planting:**

  1. Eucalyptus camaldulensis
  2. Eucalyptus citriodora
  3. Eucalyptus exerta
  4. Styrax tonkinensis
  5. Dalbergia hupeana
  6. Protium serratum
  7. Cajamus cajan
  8. Salmalia malabarica
  9. Acacia auriculiformis
  10. Erythrophlorum fordii
  11. Calamus tetradaetrylus
  12. Dendrocalamus sp.
  13. Artocarpus intergrifolius
  14. Manggletia insignis
  15. Cassia siamea
  16. Casuarina equisetifolia
  17. Cinamomum cassia
  18. Pinus merkusii
  19. Canarium nigrum
  20. Bambusa arundinacea
  21. Dendrocalamus membranaceus
  22. Bruguiera gymnorrhiza
  23. Khaya senegalensis

- **Group of species potential for planting:**

  1. Calophyllum soulattri
  2. Michelia hypolampra
  3. Chukrasia tabularis
  4. Liquidambar formosana
  5. Pinus kesya

Area proposed for afforestation in the North of Central Vietnam is very large including from coastal area to bare land and land with characteristic of forest land (after swidden or poor forest). From the above list, there are only Eucalyptus camaldulensis, Acacia auriculiformis, Dendrocalamus, Cinamomum, Pinus merkusii, Casuarina equisetifolia, Chukrasia tabularis have been planted and successful assessed in each area. And only
25% of these species have been received by the practical production. Other species were planted also, but the results have not been assessed.

Valuable indigenous broad leaves species were planted as test in some provinces of the region, but they are not proved. Some species, which are easy to plant, such as Styrax tonkinensis are not appropriate for the region as they are not suitable with economic and other objectives of the region. Some species that have wood of good quality such as Tarrietia javanica, Michelia, Erythrophlocum fordii are not planted as they require good soil conditions. Sometimes afforestation direction depends on the implementation of policies. Plans, policies and norms are on macro level and the species selection which is mainly carried out for long term development, is limited by many factors. For some species they defined the economic purpose only 30 years after planting (Pinus merkusii). For other species as Acacia auriculiformis, the economic purpose was defined by and by. However, this purpose definition is limited only for some areas. Pinus merkusii was acknowledged not long time ago and only in Quang Binh. In Vinh Chap and Vinh Linh farmers do accept it not so highly and there is the same situation with Acacia auriculiformis in Le Thuy.

There are some species which are potential to develop on different site types and in different measures (block planting, mixed planting) such as Calamus tetradartylus, Dendrocalamus membranaceus. These are short term species and their products are materials for handicrafts and other processing activities.

In the project area they pay attention also to other species such as Michelia sp., Endospermum chinensis.. These are fast growing species which is valuable and needed for wood processing industry. These species require good soil.

2.5 Discussions and recommendation

Species structure proposed and planted by programs, projects shows that:

- The number of proposed species is too much
- Potential species were not defined yet, especially for each province in order to study its economic and protection value and define silvicultural measures for its development.
- Proposals, especially development aims and potential are not carefully considered by different levels.
- Some species proposed for planting and mixed planting models still are tested (Michelia sp.) or not distributed in the region (Paulownia fortunei). Paulownia fortunei was took from other region and it is not clear whether it is suitable for the project area or not. Besides, mixed planting in lines for Casuarina equisetifolia, Acacia auriculiformis and Eucalyptus was proposed without basis.

Following is species selected by the project:

1. Pinus merkusii
2. Acacia auriculiformis
3. Cassia siamea
4. Casuarina equisetifolia
5. Acacia mangium

and other potential broad leaves species:

1. Canarium album
2. Camellia oleosa
3. Cinamomum cassia
4. Tarrietia javanica
5. Endospernum chinensis

Acacia mangium, Acacia and Acacia crassirpa also require the same site type as Acacia auriculiformis while Acacia requires better soil. In the project area they focus not only on the purpose of greening bare land, but also on the economic purpose. Therefore, it is very important to consider the product using capacity and its consumption.

Proposals for planting Tarrietia javanica, Litsea sp., Aquilaria crassa, Sindora siamensis, Calophyllum soulattri in the project area are very difficult to apply even in Huong Son, Ky Thuong (Ky Anh), Cam Chinh (Cam Lo) because these species require strict soil and ecological conditions. Tarrietia javanica, aquilaria crassa, Sindora siamensis are long term species and there is no convincing conclusion yet on Litsea sp. although 327 program has implemented test planting. Therefore, in the proposal for above 5 species we should concentrate to site conditions, but not put them in difficult and unsuitable conditions because we urgently need indigenous species.

Cassia siamea was planted and is in afforestation plan of Quang Tri. I wonder about its growth on Quang Tri site conditions and I am afraid that it can not reach expected size and provide expected products as mentioned in Table 4, Annex 10.

We do not have another opinion against theory for species selection of the decision 680 QD/LN. Farmers need to harvest forest product as soon as possible. Therefore, this issue should be considered while transfer land or forest to them and select species to be planted. However, species selection should ensure sustainability of the forest, ensure the environment protection and erosion prevention as well as water recourse protection. Pinus merkusii meets some of above mentioned requirements. However, its production rotation is too long. On the other hand, we have experience relating to forest fire and diseases on 30,000 ha Pinus which was pure planted. Following mixed forest of Pinus kesya and broad leaves species in Mang Den, Kontum and Da Lat, we can consider the establishment of mixed Pinus stands in the future with one level or two levels. This issue should take some time for consider and test.
In the project area, mostly soil is degraded and not appropriate to multipurpose indigenous broad leaves species. Species selection should also follow main criteria as mentioned above and two following points:

1. Suitability with ecological conditions
2. Multipurpose and short term species; permanent market for product consumption

Most of farmers who received land and participate in afforestation are poor people. Population is growing and the life needs are increasing as well. It is difficult that the farmers can wait for 10 – 15 years to harvest only 1 time. At present we can see that Quang Tri has harvested forest in order to collect materials and sell it to VIJACHIP. However, investment for reforestation is not assessed yet and there should be a direction for policy development. It is necessary to create motivation to make farmer’s benefit closer to forest production. Farmers should not sell their agricultural products (rice, maize, peanut) as well as forest products before harvesting time. If they have to do that, the value of their products will be reduced. However, there is no other solution because they have to force their daily life.

I think that beside main species such as Acacia auriculiformis, Pinus merkusii, Casuarina equisetifolia, Acacia mangium, Cassia siamea we can develop multipurpose indigenous broad leaves species in the project area. It is should be discussed and find out the solution.

Beside 5 species proposed in the feasibility project, we can include to test mixed planting species as Chukrasia, and Schima wallichii.

Following is species to which we should pay attention:

1. Canarium album is a species growing on good forest soil. In small age it likes shade, but in the age of 2-3 years it can grow in light. Canarium album can be planted on the soil with thickness more than 30cm and can be mixed planted with Acacia auriculiformis. Planting density for Canarium album is 50 – 100 trees/ha. Canarium produces resin, fruit and wood as well. All its products have good consumption market. Canarium is long-term species and can meet protection and other requirements. We already have technique for nursery production. However, if the planting density is high, Canarium can get disease in the first period. Canarium produces fruit in the age of 6 – 7 years. Canarium grows slowly on poor soil and cattle like to eat Canarium very much. However, if technique of forest garden is applied, the success is definite. For the small area (<2 ha per household) 100 – 150 trees is enough in order to have possibility for careful tending.

2. Catanosis bossi or Castanopsis indica is one of 20 Castanopsis species distributed in North and Central midland and mountainous provinces. I have met Castanopsis forest in Do Luong, Yen Thanh (Mr. Tho’s household in Dong Thanh commune, Yen Thanh, Nghe An). In 1987 Mr. Tho has received 126 ha of bare land which was covered by bushes. Mr. Tho protected this area and until 1994
fern, Aporosa microcalyx, Castanopsis and Ormosia b alansea have restored from bushes. At present restored forest has the height of 7.8 m with the density of 800 – 1,300 trees/ha. Castanopsis indica occupies 30 – 40% and 10% of Castanopsis have produced fruits with the average productivity 200 – 250 kg/ha/year. Castanopsis indica is also planted and restored in many area (Nghi Xuan, Ha Tinh). At present there is also an area of Castanopsis indica in the project area (Doi 9, Mr. Y’s household in Bac Trach commune, Bo Trach) that grows on poor soil. This species is distributed very widely in Vietnam. There are many Castanopsis species that produce fruits in Vietnam and their fruits have different tastes. One Castanopsis species survives and develops on poor site in Quang Binh. This is a Castanopsis which can be restored and planted on poor soil (Hiep Hoa, Yen The, Bac Giang have many experiences on planting this species). There are some models of this species in the project area which can be developed. Especially, this is a species that can be mixed planted with Pinus merkusii. We can provide further measures and techniques on planting this species.

3. Camelia oleosa is a species which produces food oil. Mr. X’s in Vinh Chap has long-term Camelia garden and every year he produces food oil for the household. Camelia is planted on many places in Vinh Linh (Vinh Hoa, Vinh Nam). In Le Thuy, they planted Camelia in Mai Thuy commune. In Cam Lo, Cam Thanh many households plant Camelia and produce oil for themselves. This factor shows that Camelia is potential to be planted in the project area. Camelia is appropriate for many soil types and it can be planted on all the soil types of the project area. Camelia is a species with medium size. This species was mentioned in the feasibility project. At present in the 5 Mio. ha program Camelia is a species which they pay attention. However, we should consider the scale for planting it (test or develop widely). In order to select high productivity seeds, it is preferred to select seeds existing in the locality. We have had experience in planting Camelia from the period before 1975. Therefore, we can avoid shortcomings and select appropriate solutions. Camelia grows slowly, but its has deep root system and can produce fruit after 4 years, these fruits can be harvested from the 6th year. At present we already have the guidelines for planting Camelia.

4. Dendocalamus species is developed widely in Thanh Hoa, Nghe An and in some last years in Hoa Binh, Phu Tho and some provinces of the central region. Sustainability of Dendocalamus depends on planting measures. This is short term species, its using value and products are higher than Castanopsis indica. Its productivity is also higher. Beside materials for paper and chopstick production, Dendocalamus also provides inputs for production of other valuable bamboo goods. Technique of Dendocalamus planting is easy. Its shoot is also an attractive food. Dendocalamus can protect soil and prevent erosion very well. Therefore, we can select Dendocalamus to plant on the food of the plot. Spread Dendocalamus also is not difficult. At present Dendocalamus is planted on some places in Quang Binh and Ha Tinh, but they do not pay adequate attention to seed sources and planting technique. Therefore, the results are not promising.
5. *Calamus tetradartylus* is planted scattered in delta areas, even in inland sandy areas such as Cam Duong, Cam Xuyen and on many places in the region as Ky Anh and other places. *Calamus tetradartylus* can be planted on the food of the plot together with *Dendocalamus* to establish protection fence and to prevent soil erosion. Especially in areas with lakes and dams, *Calamus tetradartylus* is able to keep mud away.

Above are 5 species I proposed for planting in the project area. An important point is to apply results of site matching, especially of village land use plans. Considering the theory and practices concerning this matter we can see that there are many issues in 6 village land use plans which should be concretized, especially the suitability of plans with technical measures.

Above are multipurpose species which can be planted in the project area and which is appropriate for ecological conditions as well as management and organization method of the project. Besides, considering site matching conditions as well as protection and economic purposes, following species also can be selected:

- **Peltophorum tonkinensis** is a timber species of Leguminosae family. *Peltophorum* wood is durable and is classified in group III. *Peltophorum* is a light preferable species, fast growing and ecological regions appropriate for it are wide. Normally, this species regenerates in area after swidden cultivation. *Peltophorum* can grow on poor soil with thin and shallow soil layer. *Peltophorum* has deep root system, large and thick canopy in raining season. *Peltophorum* seeds are always available. Experiences for nursery production and planting of *Peltophorum* were gained. *Peltophorum* can be planted on soil types existing in the project area, excluding inland sandy area. *Peltophorum* can be planted in patches, groups of 5 – 7 trees or narrow bands with 2 – 3 lines mixed planted with *Acacia auriculiformis*.

- **Erythrophleum fordii** is valuable timber species which is widely distributed and has soil protection function. *Erythrophleum* can grow on poor soil. In practice it was planted on bare land covered with *Acacia auriculiformis* in Ba Vi, Ha Tay; in Phi La, Lang Son. However, *Erythrophleum* on poor soil grows worse than on better soil. It can be planted in patches or in narrow bands under bands of *Acacia auriculiformis*.

- **Ormosia balansea** is big timber, distributed widely from Northern provinces to South provinces. This species is very popular in secondary forests. *Ormosia balansea* regenerates through shoots and seeds very well, can restore after swidden cultivation. This is potential species for forest rehabilitation, can survive and grow on poor soil. However, in the first period it needs shade. Therefore, *Ormosia* can be sowed with seeds under Pinus or *Acacia* forests. *Ormosia* is planted with seeds sowing, but not seedlings because root system of *Ormosia* seedling is easily to be effected and slowly grows. *Ormosia* also can be sowed in groves with 5 – 7 holes in triangle, distance applied between trees is 3 –4 m. Each hole is sowed with 3 – 4 seeds. We can provide additional techniques if the experiment is needed.
• Cinamomum ilieoiolides is a big timber which is distributed from Northern provinces to Tay Nguyen. Cinamomum survives in mixed forest with broad leaves species. Cinamomum wood is good quality and its root has high content of oil. In the first period Cinamomum is trungtinh and in post period it totally prefers light. Cinamomum can grow on poor soil. In Phu Tho farmers planted Cinamomum on poor soil of Phu Ninh and Thanh Ba in big patches.
• Schima walichii is a species with good wood which can survive on poor soil (Schima walicii, khaocai, trin...). Schima walichii is distributed in the height under 1,500m. Some Northern provinces has planted Schima walichii very successfully.
• Liquidambar formosana is a broad leaves species which is able to be planted on bare land.
• Madhuca pasquieri is also indigenous broad leaves species which can survive on poor soil in the project area. Madhuca provides good wood, its seeds produce oil and its flowers contains honey for bee raising.
• Gleditschia australis survives on poor soil. Its fruit is material for cleaning. This is multipurpose species.

There are many other broad leaves species which has high value wood, can be planted on bare land and perform protection function. However, it planting should follow necessary technical requirements. There is still no technical procedure for planting these species yet. Sometimes even technical cadre has never met them. Therefore, we can not plant it widely. However, in small test models with 1 - 2 ha we can reach some results if we have a full time expert to monitor it. In practice, many people have planted above species as the test. But they did not have adequate conditions to for long term monitoring and these species are not attractive for them. Therefore, all these work have only the beginning and never finish. With the project support and responsibilities of other local sectors, research institutions need financial and personnel support for implementation of long term test planting in 10 - 15 years. Mostly, all the species in the list have been studied in individual aspects and periods. However, these studies are not continuous, not systematical and there is a lack of studying direction, many important points were neglected. Nursery production is the first step and has attention from many people while planting, tending activities were neglected during studies. And the consequence is that we do not have a completed technical system for planting even only 1 species. Problems concerning productivity, sustainability were not considered. On the other hand, technical as well as management system is still controlled by old thinking. Requests for financial support for forest protection after canopy closure have been mentioned by many authorized levels although the forest has been allocated to farmers. Shortcomings should be overcame during application of technical measures: how to apply the agro-forestry approach in the conditions of degraded soil of the project area and at the same time focus on the system of multipurpose species as mentioned above.

3. Other issues
3.1 Land use planning and ownership

Provision of land tenure certificate ensures the right for land use of the farmers who received land. In the area where land was allocated to the farmers, many questions were raised and need the solution. Understanding about the right to own the products is also different in different areas.

Farmers received land and deposit accounts. Many people think that they have total ownership as the rights mentioned in the Laws on forest protection and development as well as according to Instruction 02. However, it is needed to clarify the division of products harvested on allocated land. In the approving document of Project Feasibility study no. 435/TTg dated June 16, 1997 (Article 3) it was regulated: "The main objective of the project is support for afforestation. At the same time it is necessary to develop and submit to the Government a policy for fund returning through products." What will be this policy? At least there should be 8 years for the products to be harvested and whether no need to clarify this policy at the moment?

3.2 Protection and production forest

In the above Decision it was only decided "new planting of 21,000 ha". Quantity of protection and production forest is not clear. In the Project Feasibility Study it is stated that the project will plant 9,820 ha protection forest and 9,000 ha production forest. However, these figures are only estimated. During a short trip (May 15 – 22) to some project fields we recognized that all the project areas are located not in the national protection region. According to the criteria for classification, that is not critical region. In the point b, Article 10 of the regulations on management and using of protection forest it is stated: "Households receiving forest have the obligations and rights as regulated in the regulation on management of production forest and are under the technical management of the forest management board." However, in planning practice of some communes and in technical designation there is no difference between protection and production forests.

I think that reestablishment of forest on bare land in the project communes is important issue. Although no one of project areas is located in critical region, but protection on local scale (protect water recourse of small lakes for any cultivation area) is also very important. For project areas where the forest was lost, afforestation will have protection function. As the soil has been degraded in different levels and is under the safe bound, then even in 1 production rotation (10 – 12 years) the soil and ecological conditions can not restore significantly. Therefore, we should consider the project forest as protection forest in the meaning of soil protection and improvement, but not simply as production forest in order to have appropriate policy for harvesting. This results can be achieved only if we select species and planting methods which allows the frequent and permanent harvesting. We can see that even agricultural soil with frequent fertilizing, but which is harvested every year, becomes degraded and can not be restored. It is worse for the situation of degraded slopping land in the project area.
3.3 As mentioned above, macro procedures and norms propose species and techniques which is not very appropriate for the project conditions. Therefore, surveys and assessments of experts in relating fields are needed in order to make additions for technical requirements and make the project management more efficient.

3.4 In the steering and designing concept of the project they have already focused on mixed plantation. However, the agro-forestry measures do not occupy appropriate attention.

3.5 Forest and fruit gardens: Support through loan for establishment of forest and fruit gardens is the important components in order to reach the project targets to plant 21,000 ha. The proposal of the project Feasibility Study is suitable with the traditions, cultivation and economic capacities of the households located in the project area. This is the contribution to the project success.

3.6 Demonstration models and test planting for species selection: The project supports forest planting. This is also the activity of many other projects. If the project also finances for tests, for models in order to select a system of indigenous species for forest rehabilitation, this will be an important contribution to natural and forest recourses conservation.

4. Conclusion

According to 5 main requirements of the project and under the guide of the Chief Technical Advisor I have studied relating issues and carried out the field surveys. The results are showed in the report. As this is a big and complicated issue and there are many people are involved in its study, there may be some opinions which is the same as of other people or which is subjective. These problems will definitely be clarified or clarified by and by in the workshop and there will be specified solutions concerning sivilcultural technique during the project implementation.

In order to contribute to the success of the project, we think that there are 2 main technical issues which is:

- Select a group of multipurpose indigenous species with short term for harvesting and permanent harvesting, appropriate for the site conditions of the area
- Select an appropriate agro-forestry system, establish forest garden as an active support

Issues relating policies are proposed by policy experts.

We are willing to contribute and will continue to contribute our experiences to the project and we hope that we will have adequate conditions for implementation of mentioned above proposals in order to ensure the success of the project.
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Terms of reference
for Sivilcultural Expert

Coordinating with policy expert and expert in protection forest under the direct guide of the Chief Technical Advisor, the sivilcultural expert has following tasks:

1. Collect and select sivilcultural measures existing in Vietnam
2. Assess the impact to natural and protection forest existing
3. Propose measures for replacement focusing on indigenous species and community forestry
4. Explain the effect of official and unofficial forest using right to the structure and composition of the natural forest and plantations
5. Coordinate the practice and problems which can be raised during afforestation
6. Write the summarizing report (not more than 40 pages)
7. Cooperate with the head of group and 2 other experts to complete 3 reports

Using Ormosia balansea Drake in forest rehabilitation and plantations of 5 Mio. ha program

By PhD. Nguyen Ba Chat
Forestry Science Institute

Ormosia balansea belongs to Leguminosae family. This is one of 9 Ormosia species in Vietnam that is big timber. 327 program has established more than 950,000 ha of forest during 5 last years. More than 70 indigenous and imported species have been planted in the whole country. PAM project also contributed to create significant forest area. Ormosia balansea is indigenous species, big timber, widely distributed and can naturally regenerate in different situations of forest rehabilitation. However, this species was not tested in above mentioned projects. 5 Mio. ha program requires a species structure with high productivity and efficiency in order to provide wood and to strengthen protection functions. Technical procedures, norms and guidelines concerning forest rehabilitation and natural regeneration focus only on general specification and theoretical characteristic. Vegetation status of species was not clear and was mentioned very generally (species of high level, purpose regenerated species...). Although in forest
classifications (by Thai Van Trung, Tran Ngoc Phuong) they have mentioned forest types and statuses in different soil and climate conditions, but uncontrolled actions have changed rules and even forest areas. There is still no specified regulations because researching and testing documents as well as experiences are not updated. We have studied some aspects for Ormosia balansea and have specified results. We want to introduce technical material relating Ormosia balansea in order to contribute to supplement the sivilcultural measures in relating procedures and norms.

1. Identifying characteristics of Ormosia balansea
   Ormosia balansea is a big timber. The height reaches up to 30 – 35 m, diameter reaches 80 – 100 cm. Ormosia balansea has double leaves in the form of feather. It has 3 couple of folioles. The foliole has the length of 10 – 12 cm, the width of 4 – 7 cm. There are fine hairs on the upper side of the leave which have the rust color. Ormosia balansea trunk is straight, bark is silver grey. Its branches separate highly. Ormosia balansea canopy has the form of the umbrella and is green for whole the year. Ormosia balansea fruits are flat. Young fruits are green and ripen fruits are brown. Each fruit has one seed which is flat, has hard coat and is light red. 1 kg contains 750 – 1,300 seeds.

2. Use value
   Ormosia balansea wood has light yellow heart which is difficult to distinguish. The wood is firm, hard and has fine grain. Its proportion is 0.428. Ormosia balansea wood is used for housing, furniture making. It also is used for boards production and production of paper powder. Ormosia balansea has a developing root system which grows deeply. The species survives for a long term and is very suitable for establishment of protection forest, for soil improvement. The species regenerates well with shoots, root and seeds. It is appropriate for forest rehabilitation.

3. Natural distribution
   Ormosia balansea usually grows mixed with other broad leaves species in secondary forest rehabilitated after swidden. The species is widely distributed from Tay Nguyen to the Northern provinces (Ha Tinh, Nghe An, Thanh Hoa, Phu Tho, Tuyen Quang, Ha Giang, Son La), and also in the Southern provinces. However, it occupies more than 5% in Northern provinces. Ormosia balansea is distributed according to the following biophysical conditions:

   Height: 1,500m
   Annual rainfall: 1,300 – 2,500 mm
   Dry season lasts for: 3 – 4 months
   Average temperature in 20.4 – 24.6 °C
   Average highest temperature: 25.5 – 27.9 °C
   Average lowest temperature: 17.4 °C – 21.7 °C
Soil: red, yellow or red-yellow soil, red humus

4. Regeneration
Ormosia balansea is green for whole the year. It can produce fruits in the age of 15 – 17 years. The flowers open in April – May. Fruits ripe in November – December. Seeds have a hard coat and is able to survive for a long time in the earth. Therefore, it is easy to preserve Ormosia balansea seeds. 1 kg contains 800 – 1,300 seeds.

Ormosia balansea regenerates very strongly. Different forest status from restoring forest to forest after swidden show that Ormosia balansea can regenerate in different ages. Especially, in restored forest after swidden, shoot regeneration is very strong. In many areas they implemented the forest rehabilitation for 5 – 6 years and have established young forest with allowed density. Table 1 show the number of Ormosia balansea trees regenerated in different forest statuses:

Table 1:

<table>
<thead>
<tr>
<th>Province</th>
<th>Forest</th>
<th>Height (cm)</th>
<th>Num. of trees/ha</th>
<th>Nu. of big trees/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;20</td>
<td>21-50</td>
<td>51 - 150</td>
</tr>
<tr>
<td>Quang Ninh</td>
<td>0.4</td>
<td>11</td>
<td>55</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>0.5-0.6</td>
<td>25</td>
<td>41</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>0.7</td>
<td>13</td>
<td>61</td>
<td>18</td>
</tr>
<tr>
<td>Yen Bai</td>
<td>0.4</td>
<td>16</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>0.5-0.6</td>
<td>31</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>0.7</td>
<td>17</td>
<td>39</td>
<td>7</td>
</tr>
<tr>
<td>Nghe An</td>
<td>0.4</td>
<td>9</td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>0.5-0.6</td>
<td>31</td>
<td>17</td>
<td>19</td>
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<td></td>
<td>0.7</td>
<td>15</td>
<td>13</td>
<td>15</td>
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<tr>
<td>Ha Tinh</td>
<td>0.4</td>
<td>12</td>
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<td></td>
<td>0.5-0.6</td>
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<td>0.7</td>
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</tbody>
</table>
We can recognize that in the forest with less trees and low forest cover, the number of regenerated Ormosia balansea is increasing. However, during the process of height changing there is a big elimination due to many reasons. Shoot regenerated trees from 1 – 4 years are eliminated 50 – 60% of the total. Number of regenerated Ormosia balansea trees amounts to 20 – 35% of regenerated species.

Number of regenerated Ormosia balansea is high. Therefore, during forest rehabilitation and tending it is necessary to pay attention to the appropriate quantity in the composition of the forest stand.

Ormosia balansea regenerates not only in poor, medium forests, but also on the soil after many time of swidden cultivation as in following provinces:

- Tien Phu, Phong Chau, Phu Tho: the farmers have tended and rehabilitated 31 ha from the 1989. That was mixed Livistona and timber forest which has been totally harvested, then they planted cassava for 2-3 years and after that it was fallow. At present, this area is covered with forest which has H= 11 – 13 m, D = 8 – 9m and there are 1,100 – 1,300 trees different species, 47% from which are Ormosia balansea. Remaining species are Engeldhartia sp., Lithocarpus cornea, Aporosa microcalyx, Eugenia brachiala, Quecus platycalyx, Symplocos laurina. On the surface soil, vegetation of lower level develops. There is a layer of rotten vegetation on the soil. Average reserve of this forest is 60 – 65m$^3$/ha, while the neighboring Eucalyptus forest has the reserve only 50 - 55 m$^3$/ha and soil is not improved.

- In Giang Son commune, Do Luong, Nghe An they also have a rehabilitation area after swidden since 1991. At present there are 61 ha of rehabilitated forest in which Ormosia balansea occupies 27 – 31%. Other species are Castanopsis sinensis, Lithocarpus cornea. Holarrheuna species, Liquidambar formosana ...

- Rehabilitation models with regenerated Ormosia balansea is very common in different localities. This is a species which has the seed preserved for a long time in the soil and can regenerate strongly form shoot and root. If we carry of the rehabilitation on soil after swidden with Ormosia balansea shoots, Alchornea trewioides an teguot, only after 5 –6 years we can have young forest stand. As the swidden cultivation has lasted for a long time, the soil was degraded, so the young forest stand we have through rehabilitation can be used only for protection function or production of small wood (pit props, fuelwood, boards).

In the first stage Ormosia balansea grows slowly. However, from the 3rd year its growth can be compared with the growth of Canarium, Manglietia glauca.

1. Discussions and proposals

Ormosia balansea is widely distributed in different ecological conditions. There are numerous Ormosia balansea seeds. The species strongly regenerates and fast grows. Especially in the areas after swidden cultivation the rehabilitation capacity is very high. Ormosia balansea survives for along time, its root system develops in both depth and
width. Ormosia balansea canopy is green and thick for whole the year, its leaves can be rotten fast. The tree can protect and improve soil fertility. Ormosia balansea wood has many uses. The first, we propose to pay attention to tending activities during forest rehabilitation and to using purpose (economic, protection) as recommended in norms and procedures.

Support by the sector is required in order to complete the techniques for planting and rehabilitating Ormosia balansea, to establish appropriate models and contribute to the species structure one valuable species.

Table 2: Growth of planted Ormosia balansea (Cau Hai, Phu Tho)

<table>
<thead>
<tr>
<th>Age</th>
<th>D 1,3 (cm)</th>
<th>zD (cm)</th>
<th>H (m)</th>
<th>zH (m)</th>
<th>V (m3)</th>
<th>M 900 trees/ha (m3)</th>
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<tbody>
<tr>
<td>2</td>
<td>1.1</td>
<td></td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.5</td>
<td>0.4</td>
<td>3.2</td>
<td>1.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2.1</td>
<td>0.6</td>
<td>4.6</td>
<td>1.4</td>
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<td></td>
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<tr>
<td>5</td>
<td>2.9</td>
<td>0.8</td>
<td>5.6</td>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>4.1</td>
<td>1.2</td>
<td>6.8</td>
<td>1.2</td>
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<td></td>
</tr>
<tr>
<td>7</td>
<td>5.1</td>
<td>1</td>
<td>8</td>
<td>1.2</td>
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<td></td>
</tr>
<tr>
<td>8</td>
<td>6.3</td>
<td>1.2</td>
<td>9.9</td>
<td>1.9</td>
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<tr>
<td>9</td>
<td>7</td>
<td>0.7</td>
<td>12</td>
<td>2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>7.9</td>
<td>0.9</td>
<td>14</td>
<td>2</td>
<td>0.0250</td>
<td>22.5</td>
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<tr>
<td>11</td>
<td>9</td>
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<td>15.6</td>
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<td>12</td>
<td>10.1</td>
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</tr>
<tr>
<td>13</td>
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<td>16.5</td>
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<tr>
<td>14</td>
<td>12.5</td>
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<td>15</td>
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<td>17</td>
<td>15.5</td>
<td>0.9</td>
<td>20.7</td>
<td>0.7</td>
<td>0.1728</td>
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</tr>
</tbody>
</table>
In the ages from 6th – 16th year Ormosia balansea grows fast in D with increase of 1cm per year. H increases fast from the 3rd – 16th year. After 20th year H and D continue to increase. However, the speed is reduced. It is obvious that Ormosia balansea has the fast growth.

During the implementation of 327 program some provinces have test planted Ormosia balansea in some areas, but the efficiency is not high. Ormosia balansea strongly regenerates from shoots, root and seeds. However, the elimination is also very high. As quality of the seedling used is low and the tending activities carried out are not according to the ecological requirements, results achieved are not as expected. In the first stage Ormosia balansea grows slowly while the vegetation grows faster than 2 – 3 times. Therefore, vegetation has dominated planted trees. Model for planting Ormosia balansea is existing now in Cau Hai, Phu Tho as introduced in Table 2.

During regeneration and rehabilitation process we can use Ormosia balansea for filling up planting. We can sow directly 3 – 4 seeds in to one hole or can plant with seedling which has H=30 – 35cm. Some Northern provinces have experience in nursery production, but not in planting forest.

### Indigenous species to be planted for establishment of forest garden and greening bare land

Decision 327 by the Government and the policy for land and forest allocation are the important change for the forestry sector. Mostly, the areas covered with forest are located far from villages. Therefore, the need for land and forest allocation in these areas is not pressing as in midlands where the population density is very high, the need for land and fuel wood is increasing. Forest in midland was seriously damaged and there are many bare land areas. In last some decades they planted Eucalyptus, Acacia, Pinus species. These species more or less provided fuel wood, wood and contributed to greening bare areas. Most of plantation is planted with above species. In the condition of block plantation and on those sites we did not have adequate conditions to select appropriate indigenous species in order to improve economic efficiency.
In some areas managed by households, species structure has been changed from agricultural cultivation (rice, maize, potato, cassava, normal fruit trees). However, species structure on slopping land has not been changed yet, excluding areas with special soil and climate conditions where farmers have planted valuable species such as Cinamomum, Illicium, Anacardium occidentale. Farmers are looking for the fast and efficient production such as planting Eucalyptus which can be harvested after 7 –8 years. They also planted Toona sureni, Vernicia montana to use for essential needs. Forest species of Vietnam are very rich and we can select a group of multipurpose species (2, 3 purposes) which has high economic value for farming and forest garden owners. In practice, farmers have selected some high value species based on their experiences. We want to introduce these species in this reports.

1. Canarium nirum is widely distributed in Vietnam. It has originated from natural forest. Canarium nigrum produces both fruits and wood. In some half-mountain half-plain areas farmers have planted Canarium nigrum for fruit harvesting. Canarium nigrum produces fruits after 7 – 10 years. In August - September Canarium fruits are ripe and this is the time for sowing, for seedling production. March (spring season) or falling is the time for planting. In bare areas holes should be big and the fertilizing before planting should be done with big amount of fertilizer. Possible size of the hole is 60 cm x 60cm x 60cm

2. Canarium album has the same value as Canarium nigrum. Besides, it produces resin. This is a big timber, produces big amount of woods. Canarium album easily gets insects in small ages.

3. Castanopsis: there are about 50 castanopsis species from which 12 -15 species have fruits. These species are distributed widely in different regions. Castanopsis can be planted on poor soil. Castanopsis brevispinula has good fruits, its wood is white and the size of trees is medium. This Castanopsis is distributed in Lai Chau. Castanopsis boisii and camus (Yen The, Ha Bac) have the leaves with shining upper side and light pink under side. Their fruits taste very well. Farmers plant these species around the forest garden. Castanopsis ceratacantha is planted in Dien Bien, Tuan Giao. It fruits can be ate. Castanopsis hickel and camus are distributed in Tuyen Quang, Yen Bai, Thanh Hoa, Phu Tho, Nghe An and have eatable fruits. Castanopsis tessellata is planted in Son La, Yen Bai, Vinh Phu, Tuyen Quang, Thanh Hoa, Hoa Binh and has big and good fruit. Castanca Mollissina is distributed in Trung Khanh, Cao Bang and has big fruits. Castanopsis quantrinensis is planted in Quang Ninh, Quang Binh and has eatable fruits.

There are various Castanopsis species which are distributed in many regions. It is very easy to select them to include in to forest garden. Castanopsis has flowers for bee raising, eatable fruit and some species can produce wood for construction or fuelwood. Castanopsis can regenerate from shoot. It can be planted through sowing seeds or with seedlings. In some areas farmers already have experience in its planting and protection.
4. Garcinia multiplora is distributed in Phu Tho, Thanh Hoa, Yen Bai, Son Tay. Its fruits are eatable and its seeds produce oil. Garcinia is easy to plant. The fruits are ripen in October – December.

5. Bassia pasquieri is a big timber with good wood. It is distributed in Ha Tay, Bac Thai, Quang Binh, Ha Bac, Lang Son, Thanh Hoa, Nghe An. Bassia flowers are very good for bees. Fruit coat is eaten by birds. Bassia seeds contain 20-30% oil. Bassia oil is eatable and is also used in industry. Bassia has developed root system, thick canopy and can be planted on poor soil. At present there is Bassia forest in Tam Quy, Thanh Hoa.

6. Dracontonelum mangiferum is big timber. It wood is used for construction. Dracontonelum has deep root system thick canopy and eatable fruits. This species is planted in streets. Although this species is suitable for planting along the streamline, it can also survive in forest garden. Dracontonelum can provide fruits after 7 – 8 years.

7. Calsalpinia sappan is the medicine species. It is planted around making fences.

8. Leucaena glauca is soil improving species. Its leaves are used for hunsbandry and its trunk is used for fuelwood. This species grows badly on poor soil.

9. Indigofera teyamanii is bush tree. This is soil improving species which supports main species in the forest. Indigofera can also be used for fuelwood.

10. Cajanus plevus is bush tree. It is soil improving species and can survive on poor soil. Cajanus seeds is eatable for people and animals. Cajanus can be the tree for canhkien rasing.

11. Bamboo species:
   - Bambusa arandinacea
   - Dendrocalamus latiflorus
   - Dendrocalamus sp.
   - Dendrocalamus membranacetis
   - Gigantochloa seribneriana
   - These are species which are easily to plant. They have many uses such as material for paper production, housing materials, food, material for handicraft. Bambusa species are short term species.

12. Other valuable timber species: Chukrasia tabularis for wood production, Erythrophloeum fordii for wood production and soil improvement. However, these trees can be harvested only after 30 – 40 years.

13. Morinda oppicinalis Hou is a creeper which occupies not much of area. Morinda can be harvested after 4 years. Its bulb is a valuable medicine. Morinda can be planted by sowing seeds or with homthan.

14. Acrocephalus capitatus is high grass (40 – 100cm) which wild grows in midlands and mountainous provinces. Acrocephalus can grow on poor soil. In last years Acrocephalus is used for drinking. This species is planted by seeds. In some areas in Vinh Phu they already planted Acrocephalus.

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**Planting Cinamomum ilieioides**
Scientific name: Cinamomum ilieioides

Family: Lauraceae

In order to supplement the species structure in appropriate ecological regions according to the program of planting indigenous broad leaves species, we introduce technique for planting Cinamomum ilieioides based on the research results in the period 1991 – 1995.

I. Topic and method of the study

When we select a species from the nature to plant, we need knowledge on its sivilcultural specification in order to have the basis for completed sivilcultural measures. Therefore, it is necessary to study its morphological specifications, distribution, characteristics of individual and population, growing and regeneration specifications as well as techniques for seedling production, planting and tending techniques.

Our studying method is application of sivilcultural surveys as following: establishment of criteria plots, collection of necessary materials, implementation of experiments on seedling production, vegetation treatment, planting and tending in the field.

Place of experiment: Vinh Phu

Limitation of the study: Study only sivilcultural specifications relating technique

Studying results are processed with IRRISTAT version 3/93.

II. Results of the study and discussion

1. Morphological specifications: Cinamomum ilieioides is a big timber. It can reach 30 m in height and 60 – 70 cm in diameter. In small ages Cinamomum has dark green branches, straight stem and neat canopy. Single leaves have three veins. Upper side of Cinamomum leaves is smooth, has shining green colour and light fragrant. Length of the leave is 8 – 10 cm, the width is 4 – 6 cm. Cinamomum ilieioides bark is silver grey and slippery. Its flowers are on the beginning of the branch. The fruit is round. Young fruit has green colour and it is black green when it is ripen. Fruit inside is light violet. Each fruit has one seed. Seed coat is light brown.

2. Sivilcultural specifications: Cinamomum ilieioides prefers humid tropical climate with raining season. It is distributed widely in the region which has annual rainfall from 800 mm to 25,000 mm, annual average temperature from 20$^\circ$C to 22$^\circ$C and the height from 50 m – 1,500 m. Young Cinamomum ilieioides likes light shade, grown up tree prefers light. Growing rate of Cinamomum is high. In average, its diameter increases 1cm every year and 0.8 m – 1.0 m for the height. Cinamomum survives on different soil types. However, it grows faster on rich soil.
with thick layer. Cinamomum ilieioides regenerates very well from seeds. It planted mixed with other species such as Michelia, Authocephalus chinensis, Vatica ... In some cases it grows in a patch in the secondary forest and usually, it makes up a high percentage in the forest and occupies upper level. Cinamomum ilieioides can survive on poor, degraded soil with thin layer, even on Laterite.

3. Distribution: Cinamomum ilieioides is distributed widely in different ecological regions of Vietnam, especially on the height more than 200m. We usually meet Cinamomum ilieioides in secondary forests located from Northern provinces to Tay Nguyen. At present Cinamomum ilieioides is planted for wood production and tended in forest gardens in midland: Vinh Phu, Ha Giang, Hoa Binh, Tuyen Quang.

4. Use value: Cinamomum ilieioides has soft wood with light pink color. Its proportion is 0.42 – 0.47. Cinamomum wood rarely becomes curved and cracking, is rarely eaten by wood – eaters and used for furniture, housing. Cinamomum leaves and root contain oil. This species can grow on poor soil. Its leaves are green for whole the year and the system of tap-root is developing. Cinamomum ilieioides can be used for protection. In addition, it is a good fuel wood supply for the midland areas.

5. Planting technique:

1. Cinamomum ilieioides flowers appear in February and it fruits ripen in next January – February. Ripen fruit has black color. Fruits collected are kept warm for 1-2 days. Then wash out the fruit meat. Cinamomum seeds are spread in order to make them dry. Then, put the seed in to the moist sand. When the seed germinates, sow it in the soil tube. Seed contains oil and it is very difficult to preserve it. Therefore, we should sow collected seeds as soon as possible. 1 kg seed equal 2,500 – 3,000 seeds. The germination rate is 70 – 80%. 1 kg seeds can provide 1,500 – 2,000 seedlings.

2. Seedling production: Germinated seeds are sowed in beds or in soil tubes. The tube is plastic and has the size 8 x 12cm. The tube content is a mixture of nursery soil or surface layer of the forest soil which has light structure and 15% of rotten manure. Soil tubes are put in beds which has the width of 70 – 80 cm. Each seed is sowed in one tube. Soil surface is lightly covered with ferns and always watered in order to make it moist enough. Leaves will appear after 10 – 20 days. Seedlings should be protected from diseases by spraying chemicals. Disease funguses always appear in spring when the climate is warm and humid.

3. Seedling criteria: Seedlings should reach the age of 7 or 12 months. The height is 30 – 35 cm or 50 – 65 cm.

4. Soil: Soil from poor or secondary forest, soil with bushes, forest garden soil with the layer thickness 30 cm or more.

5. Planting and soil treatment measures: on poor soil and soil with bushes make ditches for planting with the width of 2 – 2.5m. Distance between ditches is 6m, between trees is 3m. Cinamomum ilieioides can be planted mixed with other species which have the same ecological specifications such as Michelia medicornis, Michelia dandi in one line. It also can be mixed planted by lines. During vegetation treatment the important thing is
to cover seedlings in the first stage. Hole size is 30 x 30 x 30 cm.
Cinamomum ilieoides can be planted with density 250, 500 or 1,100
trees/ha.
6. Planting time: Spring planting: February – April; Autumn planting: July –
   September. Plastic tube should not be removed.
7. Tending: Cinamomum ilieoides planted in poor vegetation with bushes
   should be tended for 3 years in order to free it from creepers and bushes.
   For Cinamomum ilieoides planted in autumn tending should be carried out
   2 times in the first year and for spring planting – 4 times. Tending includes
   vegetation clearing 1 – 2 times, soil loosing. Loose soil 2 times before and
   after raining season. Tending is also carried out 3 – 4 times for the second
   and the third years. In the third and fourth years the tree reaches the
   height of 3 – 4m and it can join the restoring vegetation. The Cinamomum
   in age of 20 – 25 years has the D = 30 – 35 cm, H = 20 – 25 m and can be
   harvested for use.

Cinamomum ilieoides is widely distributed and appropriate for different soil types. It can
grow on poor soil. Cinamomum ilieoides tree grows fast and its wood has many uses.
We have numerous Cinamomum ilieoides seeds and it is easily to produce the
seedlings. The species is used for planting in the protection forest, for fuelwood supply
or for planting in the forest garden.