Forest Rehabilitation in Vietnam

by

Nguyen Hoang Nghia[1]

PART A
STATUS OF LAND USE AND FOREST (AND LAND) DEGRADATION

1. Forest Land Use and Land Use Change

Vietnam is a tropical country, located in the Southeast Asian region with a total land area of about 330,000 square km, extending from latitude 8°N to 23°N. Forest land covers 16 million hectares accounting for 48.3% of the total land area (Ministry of Agriculture and Rural Development, 2001). Vietnam has an abundant and diverse forest flora, largely understudied. According to Flore Generale L'Indo-Chine (Lecomte, 1907-1958), there are more than 7,000 plant species which belong to 1850 genera and 290 families. Recent studies by Nguyen Nghia Thin (1997) reported that Vietnam possesses 11,373 plant species of 7 phylla, 378 families and 2524 genera and the total number of plant species may even exceed 15,000 species (Table 1).

Table 1. ***Species composition of plant phylla in Vietnam (Nguyen Nghia Thin, 1997)***

	Phyllum	Number of		
		Families	Genera	Species
1	Bryophyta	60	182	793
2	Psilotophyta	1	1	2
3	Lycopodiophyta	3	5	57
4	Equisetophyta	1	1	2
5	Polypodiophyta	25	137	669
6	Gymnospermae	8	23	63
7	Angiospermae	299	2175	9787
	Total	**378**	**2524**	**11,373**
	Percentage of endemics	***0%***	***3%***	***20%***

Over a long period, forest resources in Vietnam continuously declined in terms of area and diversity. Especially during the 1980s, the forest area reduction is estimated at about 100,000 ha per year. However, because of forest rehabilitation and reforestation programmes since the beginning of the 1990s until to date, forest resources in Vietnam have steadily increased. The change of forest cover in Vietnam from 1943 to 2005 is presented in Table 2.

[1] Forest Science Institute Vietnam

Table 2. ***Changes of forest areas and forest cover between 1943 and 2005 (MARD, 2004; 2005; 2006a, 2006b; Vietnam Government, 2001)***

Year	Natural forest	Planted forest	Total forest area	Forest coverage %
1943	14,300	0	14,300	43
1976	11,077	92	11,169	33
1990	8,430	745	09,175	27
1995	8,252	1,050	09,305	28
1999	9,444	1,471	19,915	33.2
2000	9,865	1.919	11.785	35
2003	10,004	2,089	12,094	36.1
2004	10,088	2,218	12,306	36.7
2005	10,283	2,333	12,616	37

Note: *Unit = 1000 ha*

In 1943, the total forest area of Vietnam was about 14.3 million ha or 43% of the total land area, but had declined by 1990 to only 9.2 million ha or approximately 27%. By 2005, the forest area in Vietnam had recovered to 12.6 million ha, or 37%, of the total area of the country. In 1943, there were no planted forests in Vietnam but in 1995, the area of planted forests had reached about 1 million ha and this figure increased to more than 2.3 million ha in 2005.

Regarding timber production capacity, the total growing stock in Vietnam in 2004 is estimated at 813.3 million m^3, of which 764 million m^3, or 94%, are from natural forests while 49 million m^3, or 6%, are available in planted forest areas. In addition, the total bamboo resources in Vietnam are estimated at more than 8.5 billion stems. The average growing stock is 76.5 m^3/ha for natural forests and 40.6 m^3/ha for plantations. Based on the above-mentioned figures, the average forest area and standing timber volume per person in Vietnam is 0.15 ha and 9.16 m^3, while these indicators for the whole world are 0.97 ha/person and 75 m^3 timber/person, respectively (Ministry of Agriculture and Rural Development, 2006b). By comparison, Vietnam has currently a rather meager forest resource base in terms of forest area coverage and standing timber volume.

2. Status of Forest (and Land) Degradation

At present, the forest area of Vietnam is grouped into three main forest categories as follows:

- Protection forest (including forests for watershed management, windbreak and seawave-break forest),
- Special-use forest (including national parks, nature reserves) *and*
- Production forest.

These forest categories have evolved over time as a response to the changes in function and role of forests. As a consequence, the areas of protection and special-use forest have remarkably expanded in recent years due to the increasing awareness of people and the international community of the role of forests in environment protection and biodiversity conservation.

With regard to the standing timber volume of forests, the total area of rich and average forests has decreased rapidly (up to 1976 by about nearly 1 million ha) with an average stocking in rich forests of more than 200 m^3/ha and over 150 m^3/ha in average forests. At present, these figures are about 150 m^3/ha and 100 m^3/ha, respectively, and the area of these two types of forest amounts to only half a million hectares. Thus, areas of poorly stocked forest and natural regenerating forests have considerably increased. In 1990, this area was more than 7 million ha, and increased up to more than 9 million ha by 2002 accounting for 80% of the total forest area of Vietnam.

3. Causes of Forest (and Land) Degradation

It is commonly recognized that human activities are playing a key role in the destruction and decline of forests in the region. Therefore, it is important to critically analyse the various reasons of forest degradation so as to obtain a complete picture and recommend suitable solutions. There are two kinds of reasons: indirect and direct (Nguyen Van San and Don Gilmour, 2000).

3.1. *Indirect Reasons*

The main indirect reasons why forests are being degraded include:

- *Poverty in rural areas*. Because cash income of local people in remote areas is very low, mostly under 100 USD/yr, poor local people tend to use forests unsustainably for subsistence and by selling forest products to satisfy the ever increasing demand by the market. Local people collect fuelwood for heating and cooking all year round and also collect food and other NTFPs including medicines to meet their daily needs.

- *Lack of land for crop cultivation*. At present the population of Vietnam is more than 80 million with about 25 million people living within and in the vicinity of forests. According to recent studies, the population of Vietnam will reach 100 million in 2020 with an estimated annual population increase of 1.5% during 2001 – 2010 and 1.3% during 2011 – 2020. Population growth is higher in rural, mountain areas than in cities, thus pressure on forests and land for cultivation will increase.

- *Forest tenure and management*. Until recently, forests were considered as free resource for everybody, so that local people could go in and collect forest products at any time without limitations and payments. Forest land allocation has not yet been completed and appropriate policies and incentives for sustainable forest management are still lacking. Systematic forest planning is not applied in practice with only few local communities participating in forest management. Capacity for management at various levels (e.g. commune, district, province and forest enterprises) is also limited and cannot not meet the higher standards required by modern forest management systems. These constraints are further aggravated by an incomplete legal document system and lack of enforcement of laws and regulations.

3.2. *Direct Reasons*

The main direct causes of forest degradation include:

- *Impact of armed conflict:* In the course of development and protection of the country, Vietnam's forests had been severely destroyed by defoliants (primarily in Central Vietnam, Western Highlands, Southeast Vietnam and Mekong River Delta), bombardment and excessive forest exploitation for the construction of military installations such as roads and other related structures. It has been estimated that about 13 million tons of the defoliant “Agent Orange” were used in the war in South Vietnam destroying some 4.5 million hectares (World Bank, 1995).

- *Over-exploitation of forest:* The primary cause leading to degradation of forest resources is the application of unsuitable forest exploitation practices. Instead of an integrated land-use and harvesting based on socio-economic and environmental values, the tropical forests were mainly exploited for their rich timber resources. Destructive harvesting methods lead to a decline in biodiversity and other forest ecosystem services. Besides timber, many other NTFPs such as honey, wildlife (e.g. snake, gekko, turtle) for food and medicine have been collected from the forest. According to estimates, 90% of the energy consumption originates from biomass such as fuelwood, agricultural residues and charcoal. Vietnam’s fuelwood consumption is more than 20 million tons per year (Nguyen Van San and Don Gilmour, 2000). About 2,300 forest species have been exploited for their timber and NTFP values, the latter including flower, leaf, bark, root, branch, resin and essential oils.

- *Shifting cultivation:* Vietnam is a densly populated developing country with limited agriculture land. About 25 million people live in and around forest areas. A considerable number of these forest dwellers practice shifting cultivation. In the past, mountain areas were not densely populated, so that shifting cultivation could be practiced at long intervals of 5-7 years or more after the first burning. In contrast, because of high population pressure to date the shifting cultivation cycle is considerably shortened to only 2-3 years, leading to a rapid increase of degraded forest land.

- *Forest land conversion:* Rapid socio-economic development also resulted in the conversion of forest land to aquaculture (e.g. Mekong river delta), construction of infrastructure (i.e. mainly national irrigation works, establishment of hydro-electric power plants and transportation systems), plantations of agro-industrial crops such as coffee, cashew nut, rubber, tea, and pepper mainly in the Central regions, Western Highland and Southeast of Vietnam and food production including fixed paddy rice, hill rice, maize, sugarcane, and cassava.

- *Increasing demand of forest products:* This is a major cause of forest degradation in Vietnam due to the increasing demand for timber and non-timber forest products. In the beginning of the 20th Century, demand for forest products could be satisfied. However, to date, demand by far exceeds supply thus leading to an accelerated decline in forest resources.

A survey by the Ministry of Science, Technology and Environment (1998, cited from Nguyen Van San and Don Gilmour, 2000) shows the range of causes of forest destruction in the different regions of Vietnam (Tab 3).

Table 3. ***Causes of forest loss in Vietnam according to their importance (in %) (Ministry of Science, Technology and Environment, 1998)***

Regions of Vietnam	Over-exploitation	Shifting-cultivation	Conversion for crops	Free migration	War	Exploitation for other purposes
Red river delta	12		17	41	9	21
Northwest Vietnam	27	29	11	7	8	18
Central part of North Vietnam	29	27	16	9	5	23
Northwest Vietnam	11	36	12	11	3	27
North of Central Vietnam	34	21	14	6	14	11
South of Central Vietnam	28	17	11	9	29	6
Western Highland	31	24	21	5	17	2
Southeast Vietnam	29	15	13	9	24	10
Mekong river delta	19	4	19	21	31	6

4. Impacts of Forest (and Land) Degradation

Forest degradation in Vietnam had its most severe visible impact on the standing timber volume. Previously, timber-rich forests with more than 200 m^3/ha at present show only a growing stock of about 150m^3/ha while average forests at best are stocked with 100m^3/ha.

There are no official statisitics on non-timber forest products (NTFP) but it is well established that both the quantity and quality of NTFP species and products have decreased significantly (e.g. rattan, shellac, benzoin, agarwood, resin, forest bee honey, Ngoc Linh ginseng, and medicinal plants). Only cinamon trees (*Cinnamomum cassia*), star anise (*Illicium verum*), some bamboos (*Dendrocalamus barbatus, Phyllostachys edulis*) and a few other species have been planted on a larger scale due to the demand by well-established markets.

Table 4. ***Amount of some NTFPs exploited for processing (Luong Van Tien, 1992)***

NTFP	Unit	1986	1987	1988	1989	1990
Agarwood	ton	78.5	81.7	45.4	36.9	20.0
Oil of Alerites	ton	150	90	60	10	10
Forest bee honey	ton	351	277	108	na	na
Shellac	ton	89	143	92	na	na
Cinamon bark	ton	1520	1450	1080	1901	2100
Anise flower	ton	1500	1310	1305	4323	2500
Big bamboos	million stems	135.2	121.9	133.2	128.7	132.7
Slender bamboos	million stems	179	155.7	177.1	149.5	147.9

Note: na = not available

Other floral and faunal forest resources, precious and rare species have also decreased noticeably. During the Vietnam War the number of elephants, tigers, panthers and other animals was still abundant, but today, the quantity of these animals has severely decreased. Precious timber species such as the four "Iron woods" namely *Erythrophloeum fordii, Markhamia stipulata, Madhuca pasquieri* and *Vatica* spp. as well as some others like *Dalbergia bariensis, Sindora tonkinensis, Aquilaria crassna* etc. can still be found in very limited areas.

The Red Book of Vietnam, Volume 2: Plants (MOSTE, 1996) lists 356 species of which 231 species belong to *Magnoliopsida* Class (Dicotyledones) of *Magnoliophyta*, 74 species of *Liliopsida* (Monocotyledones) and 27 species of *Pinophyta* (Gymnospermae). In order to avoid the cutting of threatened tree species, the Vietnamese Government issued Decree No. 32/2006/ND-CP on 30 March 2006 (replacing the old one issued 10 years ago) which provides for two additional important lists. The list IA includes the names of 15 forest plant species (and species groups such as *Anoectochilus* spp. and *Paphiopedilum* spp.) which must not be exploited and the list IIA includes the names of 37 forest plant species (and species groups such as Cycads, *Asarum* spp., *Stephania* spp., *Nervilia* spp.) of which the amount of exploitation from natural forest must be limited (Table 5 and 6).

Table 5. ***The list IA, the species which must not be exploited***

	Species name		Species name
1	*Cupressus torulosa*	9	*Berberis wallichiana*
2	*Taiwania cryptomerioides*	10	*Diospyros salletii*
3	*Xanthocyparis vietnamensis*	11	*Dalbergia tonkinensis*
4	*Abies fansipanensis*	12	*Coptis chinensis*
5	*Pinus kwangtungensis*	13	*Coptis quinquesecta*
6	*Taxus wallichiana*	14	*Anoectochilus* spp.
7	*Glyptostrobus pensilis*	15	*Paphiopedilum* spp.
8	*Berberis julianae*		

Table 6. ***The list IIA, the species for which exploitation is limited***

	Species name		Species name
1	*Cephalotaxus mannii*	*20*	*Codonopsis javanica*
2	*Calocedrus macrolepis*	21	*Garcinia fagraeoides*
3	*Calocedrus rupestris*	22	*Dalbergia cochinchinensis*
4	*Fokienia hodginsii*	23	*Dalbergia oliveri*
5	*Keteleeria evelyniana*	24	*Pterocarpus macrocarpus*
6	*Pinus dalatensis*	25	*Cinnamomum balansae*
7	*Pinus krempfii*	26	*Cinnamomum glaucescens*
8	*Taxus chinensis*	27	*Cinnamomum parthenoxylon*
9	*Cunninghamia konishii*	28	*Coscinium fenestratum*
10	*Cycas* spp.	29	*Fibraurea tinctoria*
11	*Panax bipinnatifidum*	30	*Stephania* spp.
12	*Panax stipulenatus*	31	*Thalictrum filiolosum*
13	*Panax vietnamensis*	32	*Excentrodendron tonkinensis*
14	*Asarum* spp.	33	*Disporopsis longifolia*
15	*Markhamia stipulata*	34	*Lilium brownii*
16	*Afzelia xylocarpa*	35	*Poligonatum kingianum*
17	*Erythrophloeum fordii*	36	*Dendrobium nobile*
18	*Sindora siamensis*	37	*Nervillia* spp.
19	*Sindora tonkinensis*		

PART B
IMPLEMENTING OF FOREST RESTORATION/REHABILITATION

1. History of Restoration/Rehabilitation

1.1 *Paul Maurand's Trials in 1920s with Native Tree Species in South Vietnam*

In the 1920s, the French forester Paul Maurand undertook attempts in the Trang Bom Silvicultural Experimental Station (Dong Nai province, Southern Vietnam) to introduce *Dipterocarpus alatus* and *Hopea odorata* from natural forests into forest plantations, by testing the following three approaches (Nguyen Hoang Nghia, 2003):

- *Single-tree plantation with a density of up to 20,000 trees/ha:* Close spacing of planted trees in this method proved to be a disadvantage, leading to heavy competition among the trees. The necessary thinning operations were hardly carried out on a larger scale;

- *Line planting in disturbed natural forests (1931):* The trees grew poorly because of competition by natural forest trees and insufficient light. Thus, line planting could only be applied for shade-tolerant species with regular silvicultural treatments aiming at widening the planting lines to suppress competing vegetation.

- *Planting with support tree species such as Indigofera teysmanii and Senna siamea (Cassia siamea):* The role of these species was to rapidly cover bare soil, inhibit weed invasion, provide shade for trees in the first years as well as create a mixed forest and gradually wither when target trees reached maturity. *Indigofera teysmanii* coppicing was very strong and they could be cut annually, creating favorable conditions for the growth of dipterocarp trees while the soil was still covered and weed suppressed.

Later on, dipterocarp species and some other native tree species were planted as trial plantings for many years in single-tree plantations (*Manglietia conifera, Styrax tonkinensis, Cinnamomum cassia, Illicium verum, Aquilaria crassna, Chukrasia tabularis*) or under canopy of support trees such as *Acacia auriculiformis, A. mangium, Leucaena leucocephala,* or mixed with other tree species such as *Anacardium occidentale*, coffee, or used as enrichment planting species in degraded natural forest (*Michelia mediocris, Erythrophloeum fordii*).

1.2 *Other Planting Experiments in Vietnam with Native Species*

Several trial plantings in Southeastern Vietnam were established using commercial dipterocarp species, especially those of the moist tropical forests such as *Dipterocarpus dyeri, D. alatus, Hopea odorata, Anisoptera costata, Shorea roxburghii*. These species are adapted to the regions with an annual rainfall over 1800 mm, mean temperatures of between 23° and 24° C, and with a rainy season starting in April or May coinciding with the fruit ripening season. The above-mentioned species grow naturally on yellowish or reddish yellow feralit soils on meca-schist, basalt, old or new riparian alluvial soils. The soil layer is still thick with good moisture retention capacity in the dry season. *D. alatus* and *A. costata* prefer light soil texture. *Hopea odorata* grown in single tree plantations shows more drought and water-logging tolerance than *D.alatus*.

Researchers of the Forest Science Sub-Institute of Vietnam (Vu Xuan De, 1985) recommend site-species matching for dipterocarps as follows:

- Riparian old and new greyish alluvial soils: *D. alatus, Hopea odorata, A. costata*;
- Yellowish or reddish yellow feralit soil on mica-schist: *D. dyeri, Shorea guiso, D. alatus, Hopea odorata, A. costata*;
- Shalow basalt tuff soil: *Hopea odorata*, selected leguminous species; *and*
- Black basalt soil (Binh Duong, Binh Phuoc provinces): *D. costatus, Hopea odorata*.

The results of planting dipterocarp species in South Vietnam are shown in Annex 1 (Nguyen Hoang Nghia, 2003). Various trials combined mixed species planting with agricultural crops and shade trees, leading to some growth limitation which, however, could be overcome. In the earlier years *Hopea odorata* and *D. alatus* planted with coffee showed very good growth performance, but as they have a large crown and give much shade, local people usually pruned off all twigs hindering the trees to further develop. In the option of planting dipterocarps with *A. auriculiformis*, it was found that by early thinning and cutting of the acacias, the growth of *Hopea odorata* and *D. alatus* was rather good. On the contrary, if thinning or pruning of acacias was not done, the growth of dipterocarps was very poor, a clear disadvantage for stand management.

A typical example of a *D. alatus* plantation without support trees has been established in Duong Minh Chau (Tay Ninh province, Southern Vietnam, in 1984. Ten years later the trees grew very well and the plantation was recognized as seed stand.

The forest plantation in Xuan Son (Ba Ria – Vung Tau province, Southern Vietnam) is also considered a fine model for *Hopea odorata* planting. 20 years after planting both diameter and height increments were rather satisfactory, 1.4 cm/yr and about 1 m/yr respectively.

Three main systems for plantation establishment have been used in Southern Vietnam and include:

- Single-tree planting with or without agricultural crops (coffee, cashew nut),
- Mixed planting with or without agricultural crops, *and*
- Planting with support tree species (*A. auriculiformis*).

Planting density varied considerably from 200 trees/ha to 5000 trees/ha depending on the planting system. The results obtained are summarized as follows:

- In general, trees planted at high density (> 1600 trees/ha) usually showed average or poor results while in low density plantings tree growth was much better.
- *Hopea odorata* and *D. alatus* plantations at densities 416 trees/ha (*Hopea odorata*) and 312 trees/ha (*D. alatus* mixed with agricultural crops), respectively, grew well 15 years after planting. Mean annual increments for height and diameter were about 0.78-0.95 m/yr and 1.10-1.92 cm/yr, respectively for *Hopea odorata* and 1.13 m/yr and 1.63 cm/yr for *D. alatus*. The height growth of *Hopea odorata* is poorer than that of *D. alatus*. Growth performance in general is encouraging.
- As regards *Hopea odorata* and *D. alatus* plantations with *A. auriculiformis* as support species, a problem to be resolved arises from the need of cutting acacia trees on time. Where acacia trees were cut, the increment of *Hopea odorata* and *D. alatus* plantations remained high while the increment was poor where acacias were maintained. Therefore thinning and cutting at the right time of acacias or other support trees proved to be a technically compulsory requirement.
- *Hopea odorata* and *D. alatus* mixed planted with *Anacardium occidentale* and coffee attained a rather good growth rate in the early stage (e.g. planted in the years from 1991 to 2001) but in older trials the growth rate declined considerably due to many reasons, such as prunning at various intensities, sometimes rather heavy so that successful dipterocarp plantations could not be established.

In the last 50 years, two main enrichment planting systems in degraded forest were tested and widely used as described below:

1) *Line planting:*

Usually, trees are planted along narrow lines of 2 - 3 m width. Since tending operations were not applied or not done appropriately on time, natural vegetation started to compete for light with the planted commercial trees. The failure was not because of inappropriate techniques but of inappropriate management. Some important lessons learned from these trials are as follows:

- *Silvicultural treatments:* Tall, unhealthy trees along the planting lines should be thinned or pruned to give more light to the main species planted. Physiological studies showed that most of the tropical tree species from natural forest require light shading in the first 2 – 3 years, but after that they cannot tolerate shading. Most of the tall, mature trees belonging to the upper canopy layers require full sunlight for their satisfactory growth.

- *Width of line:* Usually not less than 2 m and not more than 5 m in order to keep species diversity and keep enough space for the planted species to grow.

- *Spacing between lines:* Generally, lines should be 10 m apart; within each line, tree spacing should be about 3 x 3 m. This will result at mature age in about 150-170 stems per hectare of main commercial species.

- Seedling size for planting: Should be of big size (up to 1 m high or more), so that in the first years young trees will not be affected by surrounding trees and climbers.

- Tending: Should be applied in the first 3 years and includes climber cutting on main trees or removal of surrounding trees that give too much shade.

2) Strip planting:

This system should be used in agroforestry projects. Planting strips must not be more than 30 m wide while the width of area untouched between strips should not be more than 20 m wide. Other species can be planted together with the main species to provide shade, but they should be eliminated in time to provide for enough space for good growth performance of the main species.

2. Forest Rehabilitation Status

After many years of forest development, the forest plantation area of Vietnam has exceeded 2.3 million ha with both exotic and indigenous tree species. Statistical data on the plantation area by species was found only before 2000 (Vietnam Government, 2001), for 5 exotic and 28 native species or species group including bamboos and palms.

Table 7. ***Area of forest plantation of exotic and native tree species by December 1999 (Vietnam Government, 2001)***

Species	Area (ha)	Remarks
Eucalyptus spp.	348,001	On the national scale
Acacia spp.	228,073	On the national scale
Casuarina equisetifolia Forst.	43,884	On the national scale
Tectona grandis L.	11,583	On the national scale
Khaya senegalensis L.	4,777	On the national scale
Dipterocarp plantation	26,924	On the national scale
Pure Dipterocarp plantation	16,064	On the national scale
Mixed Dipterocarp plantation	10,860	On the national scale
Dipterocarpus alatus Roxb.	4,908.8	Southeastern Vietnam
Hopea odorata Roxb.	9,651.3	Southeastern Vietnam
Shorea roxburghii G.Don	140	Southeastern Vietnam
Pinus spp.	218,056	On the national scale
Melaleuca cajuputi Powell	114,837	On the national scale
Rhizophora apiculata Blume	80,216	On the national scale
Bamboos	73,852	On the national scale
Styrax tonkinensis Craib. ex Hardw.	64,734	On the national scale
Manglietia conifera Dandy	50,023	On the national scale
Cinnamomum cassia Presl	27,270	On the national scale
Illicium verum Hook.f.	18,085	On the national scale
Cunninghamia lanceolata Hook.	13,866	On the national scale
Senna siamea Irwin & Barneby	10,163	On the national scale
Chukrasia tabularis A.Juss	9,044	On the national scale
Vernicia (Aleurites) spp.	9,146	On the national scale
Melia azedarach L.	8,354	On the national scale
Palms	7,766	On the national scale
Bruguiera spp.	5,156	On the national scale
Avicennia spp.	5,107	On the national scale
Sonneratia spp.	4,700	On the national scale
Canarium album Raeusch.	2,502	On the national scale
Afzelia xylocarpa Craib.	2,467	On the national scale
Tarrietia javanica Blume	972	On the national scale
Camellia sasanqua Thunb.	645	On the national scale
Fokienia hodginsii Henry & Thomas	335	On the national scale
Erythrophloeum fordii Oliv.	309	On the national scale
Castanopsis spp.	307	On the national scale
Liquidambar formosana Hance	92	On the national scale

2.1 *Selection of Species for Forest Rehabilitation*

In Vietnam, forest managers and producers are allowed to use any species, including native and exotic ones for forest rehabilitation. However, the selection of species will depend on many factors such as the objective of the planting, rotation, site conditions, financial and technological situation etc. Some important criteria for the selection are listed below (Nguyen Hoang Nghia, 2002; 2004):

- Site and climatic conditions;
- Objectives of forest rehabilitation (e.g. timber production fodder, fire wood, conservation etc.);
- Type of benefits for local people, private sector;
- Market conditions for intended products;
- Availability of seed and propagation techniques; *and*
- Availability of planting and tending technology.

For success of forest rehabilitation, planters must answer the following questions:

- *Why:* objectives of planting
- *Where:* where to be planted; where to process and sell forest products
- *Which species*: based on species/site matching
- *When*: select suitable time for planting and harvesting
- *What technique*: select suitable technique for planting, harvesting, processing
- *Who*: who will plant, process, sell and consume the products.

After planting, the species selected should be re-evaluated according to key criteria whether or not they can meet the requirements. If they cannot meet local people's requirements, they will not be widely accepted.

2.2 *Silvicultural Problems*

Many native tree species have been planted successfully on a large scale, in home gardens or in farm forests by farmers and enterprises. Among a hundred species suggested for forest rehabilitation, only some dozen species have technical guidelines for planting such as *Manglietia conifera, Styrax tonkinensis, Tectona grandis, Pinus merkusii, P. kesiya, Eucalypts, Acacias, Casuarina equisetifolia*. Based on large scale planting, only 31 species have been evaluated and concluded for wide-scale planting (Do Dinh Sam and Nguyen Hoang Nghia, 2003). There are some silvicultural problems relating directly to the success of plantings as follows:

- Some species proved to be successful such as *Manglietia conifera*, but they require better soil for growth, so that planting scale is limited, therefore they could not be planted on poor soils and in single-tree plantations.

- Some other species such as *Styrax tonkinensis*, have high productivity in the first rotation. Because of reduced productivity in subsequent rotations, they require suitable silvicultural interventions to maintain soil fertility and increase productivity.

- Some native species such as *Canarium album, Chukrasia tabularis* and *Toona surenii*, have been attacked by insects in the first years causing significant problems for the planters. If these problems could be overcome, growth is expected to be satisfactory.

- Some species were successful when planted in home gardens, but failed when planted on a large scale such as *Artocarpus heterophyllus* and *Cleidiocarpon* spp.

- Some native species having long rotations ranging between 50 and 100 years, such as *Erythrophloeum fordii* or *Chukrasia tabularis*. Since research has not yet covered the entire rotation the results in terms of technical guidelines for planting, tending, thinning and exploitation can only serve as orientational guidelines.

- Most of the native tree species require moderate shading in the first years after planting. Therefore, they have been planted under support trees. However, at a later stage they require much light for their growth so that it will be necessary to remove the support trees in time.

Table 8. ***Criteria for selection of tree species for forest rehabilitation (Nguyen Hoang Nghia, 2002; 2004)***

Criteria	Exotics in general	Native species	1	2	3	4	5	6
Growth rate	Fast	Slow	Average	Average	Fast	Fast	Slow	Fast
Wood quality	Average	Variable	Average	Average	Average	Low	Average	Average
Stem form	Straight	Variable	Average	Straight	Straight	Straight	Straight	Straight
Seed quantity	Large	Variable	Small	Large	Large	Large	Large	Large
Seed periodicity	2-3 years	3-4 years	3-4	3-4		3-4	2-3	1-2
Storage ability	Easy	Difficult	Difficult	Difficult		Difficult	Easy	Easy
Improvement	Much work	Not much	Not yet	Yes	Yes	Yes	Yes	Yes
Adaptability	High	Average	Average	Average	High	Low	High	High
Rotation	Short	Long	Long	Average	Short	Short	Average	Short

Table 8. ***Continued***

Soil requirement	Low	High	Average	Average	Average	Average	Low	Average
Pests and diseases	High	Low	Low	Average	Average	Average	Average	Low
Economic value	High	High	High	Average	High	High	Average	High
NTFP value	Average	High	Low	High	High	High	High	Average
Environment value	Low	High	Average	High	Average	Average	High	High
Cultural value	Low	High	Average	High	High	High	High	High
Market	High	High	High	High	High	Average	Average	Average

Note: (1) *Chukrasia tabularis*; (2) *Canarium album*; (3) *Dendrocalamus barbatus* (bamboo); (4) *Cinnamomum cassia*; (5) *Pinus merkussii*; (6) *Melaleuca cajuputi*.

Table 9. ***Evaluation of successful and unsuccessful species according to key criteria (Nguyen Hoang Nghia, 2002; 2004)***

Criteria	**Successful species**			**Unsuccessful species**		
	3	**6**	**4**	**1**	**2**	**5**
Growth rate	Fast	Fast	Fast	Fast	Slow	Slow
Soil requirement	Not high	Not high	Average	Not high	Average	High
Adaptability	Good	Good	Good	Good	Good	Low
Rotation	Short	Short	Short	Average	Short	Long
Economic value	High	High	High	Not high	Not high	Average/ high
NTFP value	Very high	Average	High	Low	Low	Average/ high
Market	High	Average/high	Average/high	No market	Low	High
Seed supply	Easy	Easy	Easy	Easy	Easy	Easy
Planting technique	Available	Available	Available	Available	Available	Available

Note: (1) *Vernicia fordii*; (2) *Camellia sasanqua*; (3) *Dendrocalamus barbatus* (bamboo); (4) *Cinnamomum cassia*; (5) *Artocarpus heterophyllus*; (6) *Melaleuca cajuputi*.

Table 10. ***List of main species planted in the production forest in the 9 ecological regions of Vietnam (Department of Forestry, MARD, 2005b)***

	Name of species	Forest ecological regions								
		1	2	3	4	5	6	7	8	9
1	*Acacia auriculiformis* A.Cunn.	+	+	+	+	+	+	+	+	+
2	*A.crassicarpa* Cunn. Ex Benth.					+	+		+	
3	*A. mangium* Wild.	+	+	+	+	+	+	+	+	+
4	*A.mangium* x *A.auriculiformis*	+	+	+		+	+	+	+	
5	*Aquilaria crassna* Pierre	+				+	+	+	+	+
6	*Bambusa oldhami* Keng.f.		+		+					+
7	*Bombax malabarica* DC.				+					
8	*Calamus tetradactylus* Hance				+					
9	*Canarium album* Raeusch.	+	+	+						
10	*Casuarina equisetifolia* Forst.				+	+	+			
11	*Cedrela odorata L.*				+				+	
12	*Ceiba pentandra* (L.) Gaertn	+					+		+	
13	*Chukrasia tabularis* A.Juss	+			+	+				
14	*Cinnamomum cassia* Presl.		+			+	+			
15	*Cunninghamia lanceolata* Lamb.		+	+						
16	*Dendrocalamus barbatus* Hsueh-Li	+	+			+				
17	*Dipterocarpus alatus* Roxb.						+	+	+	
18	*Eucalyptus camaldulensis* Denhn.						+		+	+
19	*E. tereticornis* Sm				+	+	+			+
20	*E. urophylla* S.T.Blake	+	+	+	+	+		+		
21	*E.urophylla* x *E.camaldulensis*	+	+	+	+	+				
22	*Hopea odorata* Roxb.						+	+	+	
23	*Ilex kaushue* S.Y.Hu			+						
24	*Illicium verum* Hook.f.			+						
25	*Khaya senegalensis* A.Juss				+			+	+	+
26	*Litsea glutinosa* Roxb.							+		
27	*Lithocarpus fissus* Champ. Ex Ben.			+		+				
28	*Manglietia conifera* Dandy		+	+						
29	*Melaleuca cajuputi* Powell									+
30	*Melaleuca leucadendra* L.									+
31	*Melia azedarch* L.	+	+		+		+	+	+	
32	*Michelia mediocris* Dandy							+		
33	*Neolamarckia cadamba* Booser								+	+
34	*Phyllostachys edulis* H. de Leh			+						
35	*Pinus caribaea* Morelet					+	+	+	+	
36	*Pinus kesiya* Royle ex Gordon							+		
37	*Pinus massoniana* Lamb.			+						
38	*Pinus merkusii* Jungh. et de Vries					+				
39	*Rhizophora apiculata* Blume									+
40	*Sophora japonica* L.				+					
41	*Styrax tonkinensis* Craib ex Hardw		+							
42	*Tarrietia javanica* Blume					+				
43	*Tectona grandis* L.	+						+	+	
44	*Toona sinensis* A.Juss			+						
45	*Toona surenii* Blume								+	
46	*Vernicia montana* Lour.	+								
		13	13	15	14	16	14	14	16	10

Note: (1) Northwestern region,
(2) Central part of North Vietnam,
(3) Northeastern region,
(4) Red river delta,
(5) North of Central Vietnam,
(6) South of Central Vietnam,
(7) Western Highland,
(8) Southeastern Vietnam *and*
(9) Southwestern Vietnam.

2.3 *Challenges in Using Native Species for Forest Rehabilitation*

Using native species for forest rehabilitation is an imperative demand in Vietnam. However, this policy has many challenges as detailed below (Nguyen Hoang Nghia, 2002):

- *Scientific knowledge:* Foresters in the country do not yet have all the necessary knowledge and deep understanding of the functioning of the forest ecosystem, and the unique characteristics of indigenous species such as soil, climate, nutrition and light requirements in different growth periods, relationships between species within multi-species associations; potential for natural regeneration and adaptability; phenology and seed supply potential, techniques for sowing, planting and tending. Most of the native species are long-lived and have not been domesticated, thus lacking much research. Because they have only been planted on a small-scale the establishment of large scale plantations of native species should be considered.

- *Awareness:* Frequently forest managers would like to establish large-scale plantations with native species, but for investors, rotations of 50 or 100 years are too long. This is rooted in the fact that potential investors cannot obtain long-term loans from banks at low interest rates making plantations with high risk due to pests and diseases or harsh climate unattractive. Producers tend to invest into species with short rotations of 5 to 7 years, in order to obtain returns quickly. There are also still limited incentives to promote people's investment into tree planting.

- *Technology:* Indigenous species are adapted to the natural environment in terms of soil and climate and coexist with other species in a more or less stable forest plant association. We cannot bring indigenous species from a moist forest environment to barren hills and denuded lands or to large-scale monoculture tree plantations. For many reasons such as long lifespan, less knowledge on species, incomplete techniques for propagation and stand management, the establishment of large-scale plantations of native species is not an easy task. More financial support for research on native species must be made available.

- *Socio-economic aspects:* It is well established that forest rehabilitation with native species, more often than not, is implemented in remote mountain areas with harsh living conditions for poor local communities. Major constraints are related to a lack of sufficient external investments in these remote areas, difficult access through roads and attitudinal barriers preventing local people to accept new technologies.

Wood processing facilities and markets are also important factors which can affect the forest rehabilitation parctice in Vietnam. Given these constraints usually local people do not have the resources for forest rehabilitation.

3. Success Stories

3.1 *Reforestation Success with Dendrocalamus*

Dendrocalamus barbatus Munro (previously called *D. membranaceus*) is a very famous bamboo species in Vietnam that can be found naturally in the Thanh Hoa province in the Northern part of Central Vietnam. At present, this bamboo species is widely planted in some provinces in Northern Vietnam and covers some 80,000 ha (FAO, 2005). People call this bamboo "the forest species for the poor" because young shoots and stems can be exploited early, only 3 years after planting, therefore poor people can get income very early. Bamboo can be planted as monoculture plantation or in patches or belts along the foot hills.

This bamboo species was traditionally planted by rhizome. However, transportation of a million rhizomes from one province to another is very difficult, and therefore this bamboo could not be widely planted throughout Vietnam. An important contribution to this success is that the Forest Science Institute of Vietnam developed an efficient method to mass propagate planting material by air-layering of branches rather than using rhizomes. This method is very simple and easy to apply, so that local people themselves can mass-propagate bamboo by using air-layered branches for planting and selling to different provinces. This propagation method is considered as a starting point for large-scale planting of *Dendrocalamus barbatus* Munro in Northern Vietnam.

3.2 *Enrichment Success with Michelia*

Among 31 forest tree species listed in a book edited by Do Dinh Sam and Nguyen Hoang Nghia (2003) on evaluation of indigenous species in forest rehabilitation in Vietnam, *Michelia mediocris* Dandy showed promising results after 20 years. *Michelia mediocris* Dandy is a tree species found in natural forests and was tested in trial plantings in wide bands or strips within a matrix of residual vegetation.

In 1980 in Nghe An province, *Michelia mediocris* was planted employing the following spacings:

- *Line planting:* 5 m wide lines, left-over strip is 10 m wide;
- *Improved line planting:* 5 m wide lines, trees with height over 5 m in left-over strips were cut;
- *Strip planting:* 20 m wide strip, left-over strip is 10 m wide.

The growth performance of *Michelia mediocris* in the two planting trials is summarised in Tables 11 and 12.

Table 11. ***Growth of Michelia mediocris in Nghe An province (Sam and Nghia, 2003)***

Planting system	Planted in 1980, measured in 2000			
	$D_{1.3}$ (cm)	H (m)	V/ha (m^3)	Survival (%)
Line planting	24.3	17.5	121.7	65
Improved line	25.3	18.1	136.5	63
Strip planting	22.1	15.7	90.33	62
Mixed with *Chukrasia*	23.1	16.2	119.3	61

Table 12: ***Growth of Michelia mediocris in Kon Ha Nung (Gia Lai province) (Sam and Nghia, 2003)***

Year of planting	Planting strip/left-over strip (m)	Measured in 2000			
		Number of stems	$D_{1.3}$ (cm)	H (m)	Survival (%)
1982	5/10	330	14.6	15.7	65
1982	10/10	350	16.2	17.3	62
1985	5/10	330	12.4	14.3	60
1989	5/10	330	7.8	9.2	
1993	5/10	330	4.8	5.6	75

4. Forest Germplasm Supply

Germplasm is of importance in planting programmes including production forest, protection forest, special-use forest and scattered tree planting. In order to carry out effectively the “5 Million Hectare Reforestation Programme” (5MHRP), Vietnam’s major forest rehabilitation initiative until 2010, several national germplasm programmes have been proposed and developed to ensure a regular supply of high quality germplasm. The programme aims at increasing the diversity of germplasm and at eliminating those with unknown origin, thus increasing the future commercial productivity of forests.

According to the detailed plans of the 5MHRP, in the period from 1999 to 2000 on average 300,000 ha were planted annually, 368,000 ha in the period 2001 to 2005, and 470,000 ha are planted in the period from 2006 to 2010. If 1,000 seedlings are planted on one hectare plus additional seedlings in scattered tree plantings, there will be the need to produce billions of seedlings in the nurseries. A large-scale and efficient nursery system must be established on the national scale in order to supply seedlings for key planting areas and for farm forests.

One of preconditions for the 5MHRP to be successful is the management and supply of sufficient and high quality germplasm. This is a heavy task including planning of germplasm production areas (i.e., seed stands, seed orchards), collection, storage, pre-processing, transportation, supply, and production of seedlings.

Estimates showed that seeds collected from seed production areas satisfy only 15-20% of the actual demand for seedlings. The remaining supply is collected from natural forests or scattered

trees of unknown and uncontrolled provenance. As a consequence there are low germination and survival rates. This will – in the long run – lead to low quality and productivity of plantation forests.

Many years ago there was little understanding for proper seed production and management and thus germplasm activities were not given appropriate attention. Some seed production areas were not properly maintained because of little demand for seed. Increasing demand for seed of some species could not be satisfied because of the lack of seed production areas. Meanwhile for some of the other species thousands of hectares of seed production areas have been established, exceeding the demand for seed by far.

One of the earlier shortcomings in germplasm activities in many localities was that local forerst managers were not familiar with the exact requirements for the establishment of germplasm and seed production areas. Generally, the seed production areas were not different from commercial forests in terms of financial investment and techniques applied. In some areas, seed of unknown origin collected by local people were purchased at low prices. At present, the Central Forest Seed Company (CFSC) has established 73 ha of clonal seed orchards, 906 ha of seedling seed orchards and 1,200 ha of seed production areas. Since 1994, areas for seed production have been maintained for some of the main commercial tree species, i.e., 1,000 ha for *Pinus kesiya*, 400 ha for *Pinus merkusii*, and 160 ha for *Tectona grandis*. However, the proportion of these trees species compared to total forest plantation establishment is not very high. Therefore, these seed production areas thus far did not play a major role in the country's planting programmes.

Apart from seed production areas that have been planned by the central government, some provinces have been assigned the task to undertake the seed production for some of the species. However, these projects have many shortcomings. For *Pinus merkusii*, for example, the demand for seedlings has not been very high, but the provinces have established too large an area for seed production, thus exceeding the demand for planting material in their respective provinces. Since other provices did the same, the excess in seed supply cannot be sold in other provinces. Moreover, the objective defined for *Pinus merkusii* is on resin production but the existing seed production areas did not focus on trees with increasing resin yield.

Using rooted-cuttings of high productivity of *Eucalyptus* clones and *Acacia* hybrid clones in planting forests is a favourable measure which brings remarkable results. Many producers in Vietnam have shifted from seed supply to rooted-cuttings supply. They established nurseries to produce rooted-cuttings and applied the advanced technology for mass production. This technology is very popular throughout the whole country.

In order to improve the situation of seed supply the Minister for Forestry in 1993 has issued a Directive No. 08 on germplasm in order to establish seed production areas (according to Decision No. 327). Many germplasm projects have been approved and carried out and have brought initial results. Awareness on germplasm has increased. Germplasm supply is not restricted to seed, seed production areas and seed orchards, but has expanded to new concepts such as establishment of production units for cutting techniques, production of hybrids and tissue culture techniques. Besides the focus on germplasm production for planting new forests, localities also focus on gene resources conservation areas to promote rare and valuable species. However, species with high conservation potential have not yet been planted on a large scale.

5. Species/Provenance Trial, Tree Breeding and Propagation

Before 1975, about 20 *Acacia* and 50 *Eucalyptus* species have been imported into Vietnam and planted in some locations. However, these plantings were not designed and managed for species trials. Since 1970s, complete sets of seedlots have been imported and many organisations established species and provenance trials for *Eucalyptus* (120 provenances of 15 main *Eucalyptus* spp.), *Acacia* spp. (70 provenances of 5 lowland species; 15 provenances of 10 dry-zone species; and 20 provenances of 20 highland species), *Casuarina* (international provenance trial), *Pinus caribaea* (10 provenances of 3 varieties: var. *hondurensis, bahamensis* and *caribaea*), *Azedirachta indica* (international provenance trial), and *Melia* spp. (international provenance trial).

Provenance trials for indigenous tree species have not been established on a larger scale in Vietnam, but some work was started with *Pinus merkusii, Pinus massoniana, Pinus kesiya , Manglietia conifera, Styrax tonkinensis* and *Chukrasia tabularis*. Breeding activities for indigenous species are still restricted to *Pinus merkusii* (for resin yield), *Pinus massoniana, Pinus kesiya* and *Manglietia* (for growth performance). At the same time, many other important species have not been tested in tree improvement programmes and trials.

In the past, germplasm supply had to rely on natural forests, newly established seed production areas and seed orchards. At present, very effective technologies include cutting propagation and a new advanced technique in tissue culture. The latter technique has been employed in Vietnam for species such as *Eucalyptus, Acacia, Casuarina* (mainly for cutting and partly for tissue culture). Many species have been successfully propagated by the cutting technique and include *Camellia sasanqua, Calocedrus macrolepis, Fokienia hodginsii, Dacrydium elatum, Cinnamomum balansae, Podocarpus imbricatus, Rhodoleia championii, Taxus chinensis, Taxus wallichiana*.

6. Current Policies Governing Land Use and Restoration/Rehabilitation

Over the past 15 years several major national forest sector policies have been elaborated and implemented. These include amongst others the Tropical Forest Action Plan (1991), the Law for Forest Protection and Development (issued in 1991 and revised in 2004), the Forestry Development Strategy (2001-2010), the Five Million Hectare Reforestation Programme, 1998-2010, and the National Forestry Strategy (2006 -2020).

In early 1990, Vietnam's forest sector evaluation started with the development of the Tropical Forest Action Plan which was completed in 1991. In this process, Vietnamese and overseas experts worked together on an analysis and evaluation of the forestry conditions and elaborated guidelines for future forestry development in the country. Many important decisions were made to promote decentralization of managment, participation of local people in forest management, institutional changes, public awareness on environmental protection, and initiatives to enhance the livelihood of people living in or in the vicinity of forests. The forest sector stepped into a transition process from "centralized forestry" to "social forestry". This period was very important for the Forestry Sector. While clearly recognising the degradation of natural forests the Government tried to act on both policy and practice in order to effectively address the problem. More funding coupled with more appropriate policy pursued by the government provided a good basis for forestry development.

The legal system also evolved rapidly. The Law on Forest Protection and Development (issued in 1991 and revised in 2004) and the Land Law (issued in 1993 and revised in 2003) allowed land

allocation to farmers, households and organizations for long-term utilization within the framework of the forestry development goals.

During the late 1990s, the Ministry of Agriculture and Rural Development with the help of forestry experts formulated a Forestry Development Strategy, for the period 2001 - 2010. This strategy was issued in 2001 (Ministry of Agriculture and Rural Development, 2001) providing the following objectives of forestry development until 2010 (Table 13):

Table 13: ***Main area targets for forestry development during 2001-2010 (Ministry of Agriculture and Rural Development, 2001)***

Targets	2001 - 2005	2006 - 2010
The national forest cover	39%	43%
Protection forest	5.4 million ha	6.0 million ha
Special use forest	1.6 million ha	2.0 million ha
Production forest	6.2 million ha	8.0 million ha

Another programme called “Programme 327” was started in 1992 by the Decision No. 327/CT and approved by the Prime Minister. This was the first attempt by the Government to mobilize nationwide efforts towards forest protection and development. This program concentrated on rehabilitation of special-use and protection forests with financial support from the Government.

Within the programme contracts were signed with farmers to protect forests and compensating them with 50,000 VND per ha per year for 5 years. For the establishment of the plantation, the programme supported 1,500,000 VND per ha for the first year and another 500,000 VND per ha for the second year as well as 50,000 VND per ha for protection (1 USD equals approximately 16,000 VND). Besides the obligation to establish at least 40% long-lived native species in protection forests, this programme also allowed to plant 60% other species such as fast growing species (*Acacia mangium, A. auriculiformis*) as well as fruit and industrial species either in plantations or agroforestry systems.

The Five Million Hectare Reforestation Programme (5MHRP) was approved by the National Assembly in 1997, followed by the Government Decision No. 661/QD-TTg in 1998 to guide the objectives, tasks, policy and implementation of the programme for the period from 1998 to 2010 (Department of Forestry, MARD, 2005).

The main objectives of this programme include

- To establish 5 million ha of forest to obtain a national forest cover of 43% aiming to ensure environmental security, reduce natural disasters (droughts, floods), and protect biodiversity;

- To use barren hills and denuded land for reforestation so as to create jobs, reduce poverty, settle agricultural cultivation and increase income for local people living in remote mountain areas; *and*

- To supply forest products, especially timber for the wood industry, for both domestic consumption and export in order to increase the forest sector contribution to the country’s economic development.

The five million ha forests to be established will be divided as follows:

- Special-use forest and protection forest: a total of 2 million ha as follows:
    - One million ha by natural regeneration and enrichment planting;
    - One million ha by newly established plantation in sensitive areas such as riverbasin, coastal areas, and steep slopes.
- Production forest: a total of 3 million ha as follows:
    - Two million ha planted with industrial tree species such as acacias, pines, eucalypts, bamboos and other valuable commercial species;
    - One million ha with industrial crops such as rubber, tea and fruit trees.

The Programme will be implemented through projects with participation of local people, so that local people will be the main actors for protecting the forests, promoting natural regeneration and tree planting. Local people will also be the main beneficiaries of the forestry activities.

Similarly to the Programme 327, the 5MHRP also applied 50,000 VND per ha and year for forest protection activities. However, it was recognized that this amount is too low and should be doubled in future. Financial support for the establishment of plantations in the 5MHRP was much higher than in the Programme 327.

After 5 years of implementing the 5MHRP, the Ministry of Agriculture and Rural Development requested experts to formulate a new strategy, called “National Forestry Strategy, 2006 - 2020”, with a longer vision and more effective approaches (Ministry of Agriculture and Rural Development, 2006). Although the formulating process has not been completed the preliminary targets have been identified as presented in Table 14.

Table 14: ***Orientation for forest land planning (million ha) (Ministry of Agriculture and Rural Development, 2006)***

Forest land categories	2004	2010	2020
Total forest area	16.2	16.2	16.2
1. National forest area	12.3	14.0	14.3
a. Protection forest	5.9	5.7	5.7
b. Special-use forest	1.9	2.3	2.3
c. Production forest	4.5	6.0	6.3
2. Forest area for other production purposes	-	-	1.9
3. Forest land without forest	3.9	2.2	0
Forest cover	**36.7%**	**43%**	**43%**

The development of a national nature conservation strategy is important to Vietnam’s Government and will contribute considerably to the conservation of biodiversity as well as of genetic resources in Vietnam. Forest rehabilitation is also carried out as part of the nature conservation strategy particularly in areas where forests have been destroyed before the forest was reserved for conserva-

tion. The areas with conservation function as well as future conservation targets are presented in Table 15.

Table 15. ***Present national nature conservation areas (Government of Vietnam, 2003)***

Category	Number	Area
I. National Park	**27**	**957.330 ha**
II. Nature Conservation Reserve	**60**	**1.369.058 ha**
II.a. Nature Reserve	49	1.283.209 ha
II.b. Species/habitat reserves	11	85.849 ha
III. Landscape reserve	**39**	**215.287 ha**
Total	**126**	**2.541.675 ha**

Table 16: ***Government target for National Nature Conservation Areas (Vietnam Government, 2003)***

Category	Number
I. National Park	32
II. Nature Conservation Reserve	52
III. Species/habitat Reserve	28
IV. Landscape Reserve	21
Total	**133**

7. Forest Restoration/Rehabilitation Initiatives

7.1 *Programme 327 (1993 - 1997)*

From 1993 to 1998, the Vietnam Government invested 2,987 billion VND or 185 million USD into Programme 327. Major achievements include (MARD, 1998):

- Signed contracts with farmers to protect 1.6 million ha of forests,
- 1,368,618 ha forest rehabilitated, of which 638,500 ha were newly established plantations and 748,118 ha by natural regeneration
- Industrial and fruit tree planting was 119.939 ha including 19,744 ha rubber; 7,588 ha tea; 28,186 ha other industrial crops; 26,733 ha fruit trees and 31,223 ha home gardens.
- Animal husbandry: 53,025 animals.
- Resettlement to project areas: 92,420 households.
- Infrastructure: 5000 km road, construction of 86,405 m^2 building sites for schools, hospitals.

7.2 *Five Million Hectare Reforestation Programme*

After 7 years of implementation of the 5MHRP, the Government organized a meeting to discuss the results obtained in the programme and to provide a guide for the next five years of work as shown in Table 17.

Table 17. ***Results of the 5MHRP during 1998-2005 (Department of Forestry, MARD, 2005a)***

Task	Objective to 2010	Objective to 2005	Result during 1998-2005	Compared to 2005 objective	Compared to 2010
1. Contract to forest protection	2,000,000 ha	2,000,000 ha	2,263,361 ha	113%	113%
2. Special-use & protection forest	2,000,000 ha				
2.1 Natural regeneration	1,000,000 ha	1,000,000 ha	723,450 ha	72%	72%
2.2 New planting	1,000,000 ha	610,000 ha	631,317 ha	103%	63%
3. Plantation	3,000,000 ha	2,000,000 ha	1,401,667 ha	70%	47%
3.1 Production forest	2,000,000 ha	1,390,000 ha	683,369 ha	49%	34%
3.2 Industrial crops	1,000,000 ha		86,954 ha		9%

From the above-mentioned achievements it can be seen that forest protection and management activities have obtained good results. Thus, the annual destroyed forest area could significantly be reduced, and the livelihood of local people living in or around the forests could be improved. However, the amount of 50,000 VND per ha and year for forest protection was too low and was not an attractive incentive for local people.

The funding provided by the Central and Provincial Governments was sufficient to reach the plantation targets for the special-use and protection forests. However, the area established as commercial plantations remained very small. The reason for this is that the funding for planting production forests was to come entirely from the private sector. Obviously, for private sector companies it was too risky to invest their own resources or taking commercial bank loans.

8. Assessment of Existing Capacities of Stakeholders' Involvement

Since 1987 the Government is implementing the so-called "renovation policy" aiming at the transition from a centralized economy to a market economy. This policy is based on the following fundamental principles (Nguyen Van San and Don Gilmour, 2000):

- Appreciate private sector contributions to the country's economy;
- Accept and highly appreciate household economy;
- Promote investment by the private sector and from overseas;
- Eliminate most of the subsidies for State's enterprises;
- Allow farmers to decide about production and marketing, *and*
- Keep prices close to market levels.

Based on the above-mentioned policies, various stakeholders including the private sector are able to participate actively in forest protection and development. Also local people play a central role in the implementation of the Programme 327 and the 5MHRP as well as in many other programmes for reducing poverty such as the Programme 135, and the Programme for settled farming.

PART C
FUTURE ACTIONS FOR ENHANCING RESTORATION/REHABILITATION

1. Improving/Revising Policies

1.1 *State Forest Enterprises (SFEs)*

The State Forest Enterprises (SFEs) have played an important role in forest rehabilitation in Vietnam. SFEs are state management organizations that operate at three levels: the central, provincial and district level. In the early 1990s there were 413 SFEs of which 138 SFEs operated at district levels, 199 at the provincial level and 76 at the central level. They managed more than 6 million ha of forests.

According to the new guidelines (Prime Minister Decision 187/1999/QD-TTg issued in September 1999, and Political Bureau Resolution 28-NQ/TW issued in June 2003), SFEs should be reformed into the following four organizational types:

- Forest service enterprises;
- Forest exploitation and processing enterprises;
- Forest industry enterprises; *and*
- Environmental protection enterprises.

In 2002, there were still 241 SFEs that had logging permits, but only 107 had forests where they could log between 1000-2000 m^3 per year. Some 90 SFEs have been able to invest in plantations using their own resources. At the same time at least 120 SFEs depend entirely on Government funding to stay operational (Wil de Jong, D.D.Sam and T.V.Hung, 2006).

1.2 *Benefit Sharing*

According to the new policies, local people (i.e. individuals and households) have the right to a forestland allocation for 50 years. Under this arrangement a farmer signs a contract for forest protection and receives support of 50,000 VND per year. He is also allowed to harvest some forest products and thus obtains additional benefits from the allocated forest (Decision 178). At present, the implementation of Decision 178 is under consideration with the aim to increase the benefits for local people.

2. Building Research and Education Capacities

2.1 *Forestry Research Strategy, 2006 – 2020*

During the last two years the Forest Science Insitute of Vietnam collaborated with other institutions and experts to formulate a new research strategy for the period 2006 to 2020. This strategy provides guidelines for research directions as well as capacity building. The final draft of the strategy was submitted to the Ministry of Agriculture and Rural Development for approval and includes the following 7 research fields (Forest Science Institute of Vietnam, 2006):

Forecast, Planning, Monitoring and Evaluation

- Forecast the trends in forest development in each period (demand, market, supply capacity),
- Base for determination of the national forest area and three forest types,
- Macro land-use planning, selection of priority region for development,
- Criteria for evaluating and monitoring forestry sector development,
- Role of forestry sector in poverty reduction and its contribution to the country's economy.

Policy and Institutional Issues in Forestry

- Lessons learnt from practice: policy and project implementation,
- Land allocation, credit loan and environmental services,
- Benefit sharing suitable for three forest types,
- Policy for multi-component development,
- Forest valuation: legal base and practice,
- Forestry management system of State.

Sustainable Forest Management

- Types for management and development: households, management boards, SFEs, joint management, management of community forests;
- C&I for sustainable management: natural forest and plantation.

Environment and Biodiversity

- Role of forest and water regime,
- Valuation of forests for environment and landscape,
- Determination of baseline standards for forest environment,
- Management of natural disasters, risks, environment,
- Biodiversity in natural forest and increasing biodiversity in plantations,
- Conservation and use of wildlife and rare, valuable plants,
- Methods for evaluating environments which support biodiversity conservation,
- Urban forestry development.

Silviculture

- *Natural forest*
    - Characteristics of main natural forest ecosystems and value of main animal and plant species,
    - Silvicultural technical systems to increase the quality of degraded natural forest towards intensive cultivation,
    - Sustainable harvesting techniques and forest rehabilitation after harvest.
- *Plantation*
    - Scientific base for determining main economic species for each ecological region,
    - Tree improvement for main planting tree species (productivity and resistance),
    - Intensive cultivation of economic plantation (small and sawn logs),

- Integrated measures combining planting and natural regeneration for some special ecosystems (mangrove, dry deciduous dipterocarp forest),
- Measures for pests, diseases and fire management and control.

- *NTFPs*
  - Evaluating NTFP resources,
  - Sustainable exploitation and development of NTFPs at household and farm level,
  - Planting, processing and storage of valuable and potential NTFPs.

Wood Utilization and Forest Products Processing and Preservation

- Evaluating market and development trends,
- Evaluating development potentiality of timber and NTFP sources. Diversifying use of material sources,
- Potential of forest products processing at small and average scale; improvement of techniques for product processing,
- Research on new goods for domestic and export market. Standardization of processed products,
- Measures for enhancing competiveness of processed products (by scientific, institutional management measures or marketing).

Collaborating Research, Education and Extension

- Evaluating effectiveness of research, education, training and extension,
- Measures to increase quality of research, education and extension.

2.2 *New Policies on Research*

The Government Decree No.115/ND-CP issued in September 2005 allows R&D institutions to finance their operations through governmental research grants and science and technology businesses. The Government will provide more funding through research projects based on competitive bidding and R&D institutions will have more autonomy on institutional, financial and personnel matters.

3. Reconciling Global and National Policies

The Government of Vietnam gives high priority to forest rehabilitation. This is demonstrated by the many policies formulated over the past 20 years (Table 18).

Table 18. ***National policies affecting forest rehabilitation in Vietnam***

YEAR	NATIONAL POLICY
1984	National Nature Conservation Strategy
1991	Tropical Forest Action Plan
1991 and 2004	Law for Forest Protection and Development
1993 and 2003	Land Law
1995	Biodiversity Action Plan
1992	Programme 327 (1993-1997)
1998	Five Million Ha Reforestation Programme (5MHRP)
1994	Government's Decree 02/CP on the mechanisms of forestland allocation to organizations, households and individuals
1995	Government's Decree 01/CP on the allocation through contract for the purpose of agriculture, forestry and aquaculture.
2001	Decision 178 about Rights and Duties of households and individuals with forest allocation (Benefit Sharing)
2007	Biodiversity Law (in preparation)

The Government Decree 02/CP provides the opportunity for local farmers to obtain extensive rights over forest land which include rights to exchange, transfer, lease, mortgage and inherit. The duration of these rights is 50 years. This forest land allocation policy is based on the realization that forest land must have an owner in order to promote sustainable forest management.

The Government Decree 01/CP allows individuals, households and household groups to sign a contract for the management and protection of forest. This is a very good way for local people to participate actively in forest protection because they also have some limited rights to harvest forest products.

For many years Vietnam has invested considerable amounts of funds in forest rehabilitation, especially since the 1990s. The national investments have been complemented with important international support (Wil de Jong, D.D.Sam and T.V.Hung, 2006). Proof for the commitment of the Vietnam Government is the amount invested into the 5MHRP over the last years. According to the Forestry Department (MARD, 2003) between 1998 and 2003, a total amount of 3,848 billion VND (about USD 256 million) was allocated to this programme. State budget funds accounted for 63.5%; loans for 24%; donors for 6% and self-finance by the private sector for 4.3% (Table 19). This means that the Government contributed the largest part to the implementation of the 5MHRP (mainly for special-use forest and protection forest). The second largest investment could be mobilized through loans, mainly invested in production forests.

Table 19. ***Investments from Government and other sources for the 5MHRP***

Origin of funds	Amount (million VND)	USD Equivalent (million USD)
State budget	2,443,970	163
Credit loans	920,664	61
Overseas funds	279.558	15
Self-finance of enterprises	164,913	11
Other sources	87,250	6
Total invested funds	**3,848,355**	**256**

PART D
MISCELLANEOUS

1. Regional Collaboration

During the 1990s, through the FAO's Programme "Forest Research Support Programme for Asia and the Pacific" (FORSPA), FSIV was involved in a regional forest rehabilitation network. With financial support from FORSPA, forest rehabilitation experiments have been established in Kon Ha Nung station (Gia Lai province, Western highland).

In three years from 2001-2003, the Japanese International Cooperation Agency (JICA) supported FSIV in establishing some trials relating to forest enrichment planting as well as publishing a book titled "Use of Native Tree Species in Reforestation in Vietnam" (Do Dinh Sam and Nguyen Hoang Nghia, 2003). The book includes 31 tree species which were used in many trial plantings in Vietnam showing promising results.

During 2003-2005, FSIV was the main collaborator of the ASEAN-Korea Environmental Co-operation Project (AKECOP) titled "Restoration of Degraded Forest Ecosystem in Southeast Asian Tropical Regions" in Vietnam. The support included trial plantings in some areas, organising meetings and a Master training programme.

Currently, the FSIV carries out a 5-year project with the title "Rehabilitation of Natural Forest in Degraded Watershed Area in the North of Vietnam" (RENFODA, 2003 - 2008) supported by JICA. The project site is in the watershed area of Hoa Binh Dam (Hoa Binh province, North Vietnam), where measures for natural forest rehabilitation are being tested.

2. Pests and Diseases, Exotics

During the 1980s, only one promising provenance of *E. camaldulensis* (Petford) was imported for large-scale planting in Vietnam. In the late 1980s and early 1990s, the disease called "die back" occured on extensive areas in Southeastern Vietnam and caused serious damage for eucalypt plantations in that region. The disease is caused by several fungi of which the most common one is *Cylindrocladium quinquestatum*) as presented in Table 20.

Table 20. ***Fungi investation of eucalypts in Vietnam***

Name of pathogens	***Eucalyptus* species**
Ralstonia solanacearum (Yabuuchi & al. 1995) Smith	*E. urophylla*
Cryptosporiopsis eucalypti Sankaran & B. Sutton	*E. camaldulensis* *E. urophylla*
Phaeophleospora destructans (M.J. Wingf. & Crous) Crou, Ferreira & Sutton	*E. urophylla*
Phaeophleospora epicocoides (Cooke & Massee) Walker, Sutton & Pascoe	*E. camaldulensis, E. exerta,* *E. urophylla*
Mycosphaerella marksii Carnegie & Keane	*E. camaldulensis*
Pestalotiopsis sp	*E. camaldulensis*
Coniella australiensis Petr.	*E. camaldulensis*
Coniella fragariae (Oudemans) B. Sutton	*E. camaldulensis*
Cylindrocladium quinqueseptatum Boediji & Reisma	*E. camaldulensis*
Aulographina eucalypti (Cooke & Massee) Arx & Mull	*E. camaldulensis*
Cryphonectria cubensis (Bruner) Hodges	*E. urophylla*
Cryphonectria gyrosa (Berk & Br.) Sacc.	*E. camaldulensis*
Coniothyrium zuluence M.J. Winf., Crous & Coutinho	*E. camaldulensis*

Some plantations of *Acacia* species (*A. mangium*, *A. auriculiformis* and acacia hybrids) were also attacked by some fungi, of which the most serious one is *Corticium salmonicolor*. *Pinus merkusii* (a native pine species) plantations are prone to serious attacks by *Dendrolimus punctatus* (leaf eaters) at 2-3 years' intervals. Pine trees will not die but their growth and resin production is reduced considerably.

3. Invasive Species

Mimosa pigra is an especially dangerous invasive plant species in Vietnam. The species has its origin in tropical America and invaded into Vietnam in the middle of 20th Century, first along the rivers in Southwestern Vietnam, then to the big lakes of Southeastern Vietnam and to North Vietnam. The species has caused big problems for natural water environments in national parks in South Vietnam where important native and migrant birds could not find food (freshwater fishes) for their living. *Mimosa pigra* can regenerate very easily and quickly and in the absence of effective control measures the species will cover thousands of hectares in nature reserves.

REFERENCES

Department of Forestry, MARD, 2005a. Five million ha reforestation programme. Hanoi, 2005, 154 pp.

Department of Forestry, MARD, 2005b. List of main planting species for production forest in 9 forest ecological regions of Vietnam. Hanoi, 2005, 68p.

Do Dinh Sam and Nguyen Hoang Nghia, 2003. Use of indigenous tree species in reforestation in Vietnam. Agricultural Publishing House, Hanoi, 188pp.

FAO, 2005. Helping forests take cover (compiled by David Lamb). RAP Publication 2005/13. Bangkok 2005, 21pp.

Forest Science Institute of Vietnam, 2006. National Forest Research Strategy. Hanoi, 2006, 40pp.

Lecomte, H., 1907 – 1958. Flore Generale l'Indo-Chine. Paris.

Luong Van Tien, 1992. Forest special products of our country. Forest Scientific, Technical and Economic Information, Ministry of Forestry, No.4, 1992, 3 – 6.

MARD, 1998. Report on technical evaluation of program 327 implementation. Hanoi, October 1998.

MARD, 2001. Forestry Development Strategy, 2001 - 2010.

MARD, 2004. Decision No. 1281/QD/BNN-KL dated May 17, 2004 on statistics of forest area in 2003.

MARD, 2005. Decision No. 1116/QD/BNN-KL dated May 18, 2005 on statistics of forest area in 2004.

MARD, 2006a. Decision No. 1970/QD/BNN-KL dated July 7, 2006 on statistics of forest area in 2005.

MARD, 2006b. National Forestry Strategy, period 2006 – 2020. (Draft No.4).

MOSTE, 1996. The Red Book of Vietnam, Volume 2. Plants. Science and Technics Publishing House, Hanoi, 1996, 484 pp.

Nguyen Hoang Nghia 2002. Planting native tree species in Vietnam: Obstacles, changes and potentiality. Journal of Agriculture and Rural Development, Special No., 2002, 28 – 30.

Nguyen Hoang Nghia 2003. Dipterocarp species in Vietnam. In: H. Aminah, S.Ani, H.C.Sim and B.Krishnapillay (eds), “Proceedings of the Seventh Roundtable Conference on Dipterocarps, 7-10 October 2002, Kuala Lumpur, Malaysia”. APAFRI, Kuala Lumpur, Malaysia 2003, 73-79.

Nguyen Hoang Nghia, 2004. Science and Technology for Farm Forest. Journal of Agriculture and Rural Development, No.2/2004, 247 - 249.

Nguyen Nghia Thin, 1997. Manual on Biodiversity. Agricultural Publishing House, Hanoi, 224 pp.

Nguyen Van San and Don Gilmour, 2000. Policy and practice of forest rehabilitation in Vietnam. In: Policy and practice of forest rehabilitation in Vietnam, IUCN-GTZ-DFD-WWF. 4 – 34.

Vietnam Government, 2001. Decision No. 03/2001/QD-Ttg dated January 5, 2001 on statistics of forest area by December 1999.

Vietnam Government, 2003. Strategy for Management of Nature Reserve System in Vietnam. Hanoi, 2003.

Vu Xuan De, 1985. Some preliminary research results for planting dipterocarps in Southeast Vietnam. Forest Scientific and Technical Information, Forest Research Sub-Institute of South Vietnam, 1985, 1-4.

Wil de Jong, D.D.Sam and T.V.Hung, 2006. Forest rehabilitation in Vietnam: History, realities and future (final draft).

World Bank, 1995. Vietnam: Environmental program and policy priorities for a socialist economy in transition. Document of the World Bank. Report No. 13200-VN.

ANNEX 1

Increment of some indigenous dipterocarps planted in Southern Vietnam in mixture with different forest and industrial tree species (*Khaya senegalensis*, *Acacia auriculiformis*, *Tectona grandis*, Cashew, Coffee) (Nguyen Hoang Nghia, 2003)

Location	Species	Planted in	Density	D (cm)	H (m)	D cm/n	H m/n
Xuan Loc	*D.alatus* + coffee	1984	280	30.20	17.34	1.78	1.02
Thong Nhat	*H.odorata*	1981	1660	16.27	13.57	0.85	0.71
	H.odorata + cashew	1986	416	6.62	6.26	0.47	0.32
	H.odorata	1982	2500	14.55	16.46	0.81	0.91
Long Thanh	*H.odorata* + acacia	1985	5000	7.46	6.69	0.49	0.46
	H.odorata + acacia	1985	416	19.67	10.72	1.31	0.72
	H.odorata + cashew	1984	416	17.04	11.31	1.06	0.71
	H.odorata	1985	416	16.55	11.68	1.10	0.78
La Nga	*H.odorata*	1987	416	21.91	12.47	1.68	0.95
	H.odorata	1987	416	24.96	12.29	1.92	0.94
	D.alatus + coffee	1993	280	20.40	12.60	2.55	1.57
	D.alatus	1983	312	29.76	20.38	1.63	1.13
	D.alatus + cashew	1993	185	19.83	16.60	2.48	2.08
Ma Da	*H.odorata* + acacia	1982	416	11.7	8.23	0.65	0.45
	H.odorata + acacia	1984	416	6.88	6.26	0.43	0.39
	D.alatus + cashew	1985	416	5.94	3.67	0.37	0.24
Hieu Liem	*D.alatus* + acacia	1986	416	8.58	6.43	0.61	0.45
	D.alatus + cashew	1995	300	5.02	4.47	1.00	0.95
Tan Phu	*H.odorata*	1984	1160	15.72	14.58	0.98	0.91
	H.odorata + teak	1981	416	21.24	14.21	1.12	0.75
SFE 600	*H.odorata* + cashew	1991	200	12.22	7.43	1.36	0.82
	H.odorata + cashew	1993	200	8.99	6.73	1.28	0.96
	H.odorata + cashew	1996	200	4.43	2.69	1.11	0.67

Table continued

Tan Uyen	*H.odorata* + acacia	1982	416	24.17	11.34	1.34	0.63
	H.odorata + acacia	1984	416	17.23	9.57	1.07	0.60
	H.odorata + acacia	1984	416	13.73	8.28	0.86	0.52
Phu Binh	*D.alatus* + *Khaya*	1999	416	2.47	1.95	1.23	0.98
	D.alatus + *Khaya*	1998	416	4.42	2.96	1.47	0.98
	Khaya + *D.alatus*	1999	416	5.84	3.62	2.92	1.81
Binh Long	*H.odorata* + acacia	1994	416	4.12	3.39	0.69	0.56
	H.odorata + acacia	1995	416	4.05	2.86	0.81	0.57
Bu Dang	*D.alatus* + cashew	1995	625	5.01	3.68	0.83	0.61
Nghia Trung	*D.alatus* + acacia	1990	550	13.35	10.73	1.21	0.97
	D.alatus + cashew	1996	550	6.45	4.52	1.29	0.90
	D.alatus + cashew	1996	400	8.26	5.45	1.65	1.09
Thong Nhat	*D.alatus* + cashew	1985	370	11.54	7.0	1.92	1.16
	D.alatus	1990	416	14.5	9.43	1.32	0.86
Dong Xoai	H.odorata	1982	1250	25.80	18.46	1.35	0.97
Minh Duc	*D.alatus* + *Khaya*	1995	250	15.73	6.56	2.62	1.09
Loc Ninh	*D.alatus* + acacia	1990	416	14.66	8.43	1.33	0.77
Duong Minh Chau	*H.odorata* + acacia	1998	416	4.49	2.93	1.49	0.97
	H.odorata + cashew	1995	200	9.36	3.0	1.56	0.50
	D.alatus	1984	416	22.37	13.49	1.32	0.79
	D.alatus + acacia	1993	500	6.24	4.58	0.78	0.57
	D.alatus + acacia	1993	200	14.08	6.58	1.76	0.82
Tan Bien	*D.alatus*	1984	1000	17.24	13.38	1.01	0.79
	D.alatus	1988	1000	15.25	10.69	1.17	0.82
	D.alatus + acacia	1994	500	7.95	5.14	1.14	0.73
Dau Tieng	*Khaya* + *H.odorata*	1997	416	11.48	6.28	2.87	1.57
Chau Duc	*H.odorata* + acacia	1981	500	24.82	20.54	1.30	1.08
	H.odorata + acacia	1982	500	25.07	16.82	1.39	0.93
Xuyen Moc	*H.odorata* + cashew	1982	2500	14.74	15.77	0.82	0.88
	H.odorata	1982	1100	18.69	17.27	1.04	0.96
	H.odorata	1983	2200	19.28	19.12	1.13	1.12
	D.alatus + cashew	1987	550	20.14	12.06	1.44	1.50
	D.alatus	1987	1100	19.93	11.67	1.42	0.83
Tanh Linh	*Shorea* + cashew	1988	312	13.06	7.71	1.00	0.59
	H.odorata + cashew	1984	416	14.46	7.2	0.9	0.454
Ham Thuan Bac	*H.odorata* + *acacia*	1996	416	3.36	2.19	0.84	0.54
	H.odorata in lines	1994	250	9.16	6.77	1.53	1.13

Dong Nai province: Ma Da, Hieu Liem, SFE 600, Tan Phu, Xuan Loc, Long Thanh, Thong Nhat and La Nga Forest Enterprise.
Binh Duong: Tan Uyen, Phu Binh.
Binh Phuoc: Binh Long, Bu Dang, Nghia Trung, Dong Xoai, Minh Duc, Loc Ninh.
Tay Ninh: Duong Minh Chau, Tan Bien, Dau Tieng.
Binh Thuan: Tanh Linh, Ham Thuan Bac.
Ba Ria - Vung Tau: Xuyen Moc, Chau Duc.