

## Assess State Forest and Determine Main Group of Forest Tree Species for Different Purposes in Hoang Su Phi District, Ha Giang Province, Vietnam

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**Abstract:** North region in Hoang Su Phi district, a largest forest land area including 5 communes received a great attention of Vietnam's and local government. In this region, natural forests consist of a number of different forest types in which most of them are young forests and regenerated forests with some main species such as *Schima wallichii* (DC.) Korth., *Alnus nepalensis* D. Don, *Betula alnoides* Buch. - Ham., *Toona surelii* (Blume) Merr. Despite of the fact that these forest areas had a low volume, they still have a great potential to develop much better such as having a good regeneration tree layer, a larger of proportion of target trees and a high percentage of regenerated trees at a good quality level. Moreover, the group of non-timber trees, a rich species diversity group, has 289 species of 4 main life-forms. In study area, the largest plantation area consist of 3 species (*Pinus Kesiya*, *Acacia mangium* and *Cunninghamia lanceolata*) that adapted to site condition and found to have a normal growth. Based on evaluation criteria for afforestation purpose, this study selected 10 species for protection forests and 19 species for plantation production purposes. However, when combined with the results of forest investigation and ecological conditions in research region, the number of selected forest tree species were proposed 15 timber tree species and 8 non-timber species for planting in this area.

**Keywords:** Hoang Su Phi district, natural forest, selected forest tree species, protection forest, production forest

### INTRODUCTION

Afforestation is not only an important step in increasing forest coverage but also plays an important role in improving forest quality. In Vietnam, recently, it is necessary to have in-depth research on native and valuable plant species, especially the research and assessment of the suitability of species to local conditions in order to build solutions to preserve species from the risk of extinction and improve biodiversity in the region. Establishing and developing forests with many species, multiple levels and multiple functions are the ultimate goal of forest restoration in order to ensure to grow and develop forests sustainability. This is considered as a central issue of forest development strategies in Vietnam. Additionally, a number of studied and analyzed results show that tree species and forest types can be planted and developed based on their adaptation to local site conditions. This adaptation is evaluated through suitability of the ecological characteristics of the plant with the terrain conditions. Forest land in 5 communes in North of Hoang Su Phi district has been degraded; management plan is not really suitable; forest land has not been used rightly in many areas. As a result, deforestation has been happened in some areas and forest quality has been decreased.

Therefore, improvement regeneration of native tree species and forest ecosystems restoration are major tasks of Hoang Su Phi's Government to create good conditions for animals and plants to survive and grow well.

### STUDY AREA

The study will be conducted in 5 communes in North of Hoang Su Phi district. This area is located absolutely in Hoang Su Phi district, along with Road No.06 and far from Ha Giang township about 110 km. Geographic coordinates are from 22° 26' 30'' - 22° 51' 7'' North latitude, 104° 31' 12'' - 104° 48' 36'' East longitude. The terrain in the area is mainly high and medium mountains mixed with valleys and stream systems. Terrain is fragmented with elevation ranges from 300 to 2200 m above sea level and the average slope is 10°-35°. This region has hot and humidity climate with annual rainfall more than 2000mm; annual temperature 22,6°C and average air humidity more than 85%. As a result of having diverse terrain, forest plant resources of conservation area is very rich and abundant with a large of species number, the different forest status at different elevations, the proportion of species, number of storeys, and types of forest. Because of that, it makes



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convenient conditions for forest development and diversification of tree species in study site, in

addition to favorable transportation system also is an advantage of this site.

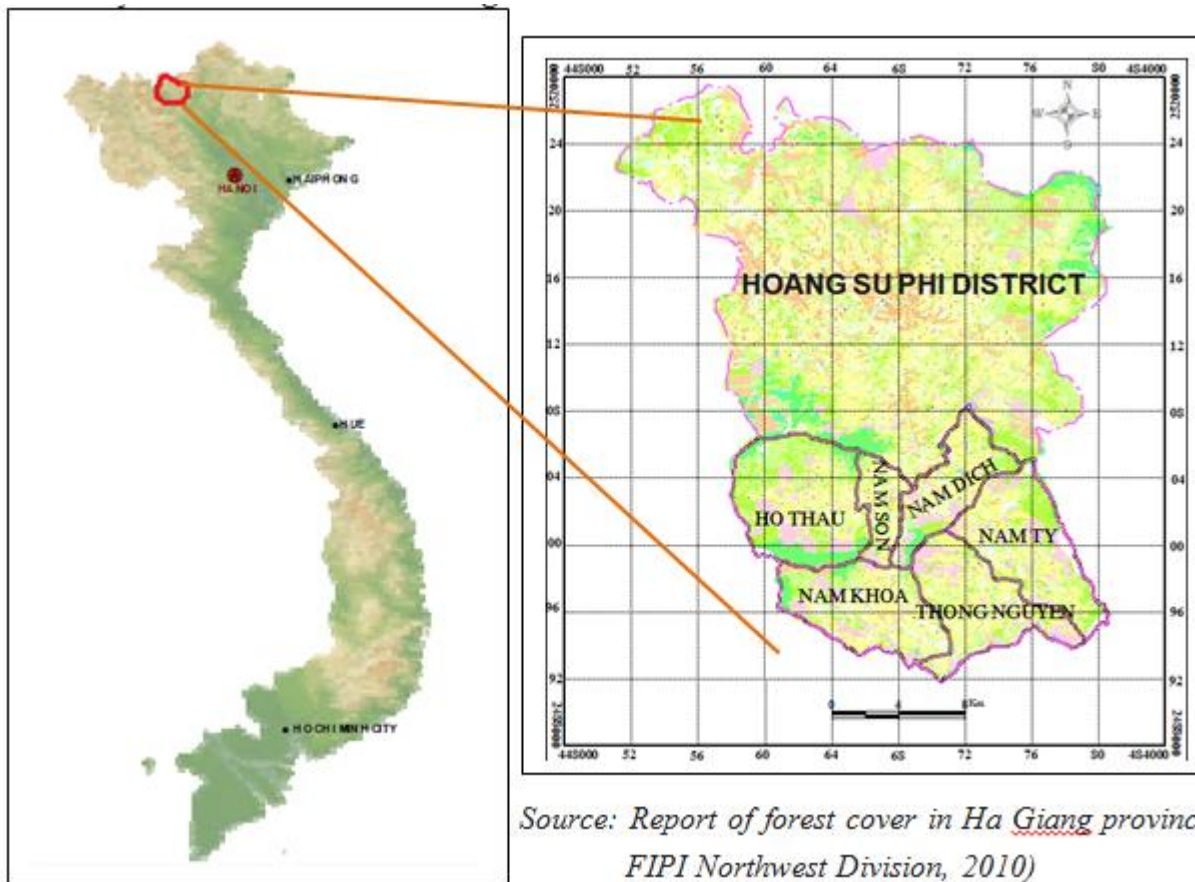


Fig.1 Location of study area in Vietnam

## MATERIALS AND METHOD

In order to select forest tree species in researched area, some basic principles of plant species selection for the site area have been chosen including ecological characteristics of species, ability to meet planting objectives.

### Data gathering:

Collected printed and digital maps and other secondary data from published and unpublished forest statistics and reports on the study area.

Interviewed forest biology experts, managers to assess the importance level of criteria, indicators for proposed scale.

Established 30 temporary and representative sample plots of 1000m<sup>2</sup> (25x40m) each in natural forest and 500 m<sup>2</sup> (25x20m) each in plantation forest to collect data on vegetation status in order to classify them.

**Tree selection** mainly for researcher area based on the following:

Ecological characteristics of species: Choose species is well adapted to site conditions and provides high

yield. Adaptation is represented here by a number of ecological criteria, such as: Temperature, humidity, rainfall, altitude, slope, soil type, soil depth, soil texture.

Economic conditions: Select the species can form forests, timber and Non-Timber Forest Productions' (NTFPs) in accordance with the needs of the national economy (local and household), available at the same time.

### Method of determining criteria and selecting forest tree species:

To select plants for economic forest land area should first be based on ecological adaptability (manifested through resistance to cold, drought and high soil be poor); useful economic performance health (with faster growth characteristics, increased production, better quality), disease resistance, population and demand of the market, Eco-efficiency (the ability to protect soil and prevent erosion).

**The formula for calculating** the suitability index of each layer as follow:

$$S_i = \sum_{i=1}^n X_i \times W_i$$

Where:

$W_i$  : weight of the each criterion.

$X_i$  : fact value of each criterion.

$S_i$  : suitability index.

n: number of criterion

Value or score ( $X_i$ ) of each level of criterion is computed for each evaluated land unit. Scores for the social-economic, physical environment criteria were

calculated basing on expert and farmer opinions as well as local conditions derived from questionnaire, seminar and discussion.

Based on synthesis of value  $S_i$  to conduct classified into 4 levels: Level I:  $S_i > 0.85$ ; Level II:  $S_i$  from 0.75 to 0.85; Level III:  $S_i$  from 0.65 to 0.75; Level IV:  $S_i < 0.65$ .

**Table-1. The assessed result of suitable index for each species**

No.	Species	Criteria for species selection method					$\sum S_i$	Type
		$X_1$	$X_2$	$X_3$	$X_4$	$X_5$		
		0,35	0,25	0,20	0,10	0,10		
1	A	0,35	0,25	0,20	0,10	0,10	1,00	I
2	B	0,35	0,25	0,134	0,10	0,10	0,93	I
3	C							

Based on above result, tree species belonged to Level I, II and III will be selected. The level of priority decreases from level I to level III.

## STUDY RESULTS

### The statue of natural land and forest land in 5 communes

There are some key features in the study area (located in 5 communes in Hoang Su Phi district) including dissected terrain; steep slopes; poor favorable on traffic conditions; Additionally, the forestry services are found only in some lowland districts, forestry

economic development is not commensurate with its potential. Therefore, they became main issue for management leaderships and scientists to concern and thought to develop forest and living standard of citizen in high land along with the policies of the Government on forestry. The results of verifying 3 forest types in study sites are summarized in Table-2.

**Table-2. Natural land & forest land in 5 communes in study area (Unit: hectare)**

Commune	Nature land	Agriculture land	Forest land	Protection forest		Production forest	
				Forestland	Bare land	Forestland	Bare land
Ho Thau	5288	712.2	3997.3	2083.3	773.4	926.5	214.2
Nam Son	3085	890.8	1789.4	665.9	60	430.8	632.8
Nam Khoa	4205	890.8	2644.8	1017.3	124.1	430.8	632.8
Nam Ty	4334	1292.1	2762.9	1000.8	239.6	923.2	599.3
Thong Nguyen	4094	1130.2	2107.1	387	2.6	1069.2	648.3
Total	21006	4940.4	13281.6	3146.8	425.7	3398.5	2963.6

(Source: The results of verifying 3 forest types in Ha Giang province, FIPI Northwest Division, 2010)

Forest land was 13281.6 ha (accounting for a large proportion of total natural land nearly 62.23 %) in research area, in which protection forest land is 3572.5 ha (accounting for 17 %) and production forest land is 6362.1 ha (accounting for 30.29 %). It is clearly that investment to develop forest is very potentiality due to a large forest area. Thus plantation, forest protection and taking advantage of forest resources can totally bring to local people a stable life in this region. Following by Forest Orientation of Hoang Su Phi District, the total land area is used for planning and afforestation is 2155 ha in 5 communes from 2008 to 2015 so the requirement

of tree selection has become an indispensable demand.

### The status of plantation forest

Plantation forest area in study region encompasses some species such as *Pinus kesiya*, *Acacia mangium*, *Manglietia conifer* and *Cunninghamia lanceolata*. In which, the plantation area of *Pinus kesiya* is usually a simple forest with same age and species. *Pinus kesiya* was planted on mountain side or top of mountain. On other lower positions, there was used for agricultural cultivation.

**Table-3. Some statistical characteristics of *Pinus kesiya*'s growth in study area**

Elevation (m)	Planted year	DBH (cm)	H (m)	$\Delta D$ (cm/year)	$\Delta H$ (m/year)	Quality (%)				
						Good	Medium	Bad		
< 700		Mean	18.08	12.74						
	1996	SE	3.06	1.57	1.21	0.85	54.39	39.18	6.43	
		S%	16.93	12.35						
		Mean	14.88	10.41						
	1999	SE	4.34	2.14	1.24	0.87	72.46	23.19	4.35	
		S%	29.19	20.52						
		Mean	15.46	12.74						
	2000	SE	3.34	1.59	1.41	1.16	59.54	23.66	17.56	
		S%	21.60	12.46						
		Mean	22.01	15.76						
	> 700	1993	SE	5.76	2.02	1.22	0.88	77.11	21.69	1.20
			S%	26.18	12.84					
Mean			23.99	17.35						
1989		S	4.41	1.59	1.09	0.79	43.27	54.39	2.34	
		S%	18.39	9.16						
		Mean								

The figure on Table-3 shown that *P. kesiya* forest had a good growth in the region, its height and DBH (Diameter at Breast Height –  $D_{1.3}$ ) fluctuated with a narrow range with DBH from 16.93% to 29.19% and height from 9.16% to 20.52%. This means that the growth was evenly in this area. Moreover,  $\Delta D$  (DBH growth rate) varied from 1.09 to 1.41 cm per year and  $\Delta H$  (Height growth rate) ranged from 0.79 to 1.16 m

per year. When compared with other *P.s kesiya*'s common growth ability, it presented a rapid growth with a large proportion in good and medium quality. However, the medium quality of *P. kesiya*s still accounted for a high percentage (ranged from 21.69% to 54.39%). It confirmed *P. kesiya* only meet somewhat its growth potential in this region.

**Table-4. Some statistical characteristics of *Cunninghamia lanceolata* in study area**

Elevation (m)	Planted year	DBH (cm)	H (m)	$\Delta D$ (cm/year)	$\Delta H$ (m/year)	Quality (%)				
						Good	Medium	Bad		
<700		Mean	15.18	10.73						
	1995	SE	3.43	0.89	0.95	0.67	91.25	8.75	0.0	
		S%	22.59	8.25						
		Mean	12.28	9.23						
	1999	SE	2.90	4.66	1.01	0.77	51.43	31.43	17.14	
		S%	24.05	50.65						
		Mean	2.53	0.94						
	2009	SE	0.51	0.26	1.27	0.47	57.33	47.70	4.97	
		S%	20.14	27.62						
		Mean	16.29	10.38						
	>700	1995	SE	3.66	1.23	1.02	0.65	44.32	42.80	12.88
			S%	22.49	11.88					
Mean										

Results in Table-4 indicates that *C. lanceolata* belonged to group of good growth tree. In study area, DBH growth of *C. lanceolata* is quite equally in forest states. The gap of DBH ranged from 20.14% to

22.59%.  $\Delta D$  had a high value (ranged from 0.95 to 1.27) while  $\Delta H$  got a low one (ranged from 0.47 to 0.77). The quality of this species mostly distributed in 2 level of quality: Good and Medium level, in

which planted year forest in 1995, 1999 and 2009 had high ratio of medium level (ranged from 31.43 % to 47.7 %) while plantation forest in 1995 had much lower value (8.75%). This indicated that *C. lanceolata* had yet to fully grow its potential and forester should apply suitable silviculture to get higher value of forest resources.

Plantation forest in this region had several areas for planting *Manglietia conifera* which was very suitable with the ecological conditions in the region. Through investigation on line survey showed that *M. conifera* was a fast growth species and people in study area seemed to be interested in planting this one and tended to expand the scale of planted area. On communes land, there were planted some individual trees, including these *Cinnamomum camphora* (L.) Presl, *Cinnamomum bejolghota* (Buch. - Ham. Ex Ness) Sweet, *Melia azedarach*, *Calamus platyacanthus* Warb. ex Becc., *Fernandoa collignonii* (Dop) Steen . They had some characteristics such as:

*Melia azedarach* L. was good growth at elevation lower than 800m and average and bad growth at elevation higher than 1000m; *Melia azedarach* L. was growth individual on fields on the mountain, bare land belonged IB and IC forest type (forest types is classified based on Vietnam Forest classification) ; *Calamus platyacanthus* Warb. ex Becc. is a high value tree for NTFPs (Non-Timber Forest Products) and planted in wet cross-valley; Most of *Indosasa amabilis* McClure forest was natural forest with a high volume. This species also is a high value species from tree-trunk and young tree in communes in North of Hoang Su Phi District.

#### The state of natural forest in study sites

##### Canopy characteristics

In order to assess the state of natural forest, this project carried out a study about characteristics of canopy by determine the composition formula according to number of species with 15 plots created in field (Table - 5).

Table-5. Composition of tree species in 5 study sites

Forest state	Elevation (m)	Composition formula
IIA	< 700	1,01Cht + 0,63 Bij + 0,63 Lip + 0,51 Mab - Mac - Fas -Cap - Caa - Mea - Mim + 7,23 LK
	700 - 1000	0,62 Aln -Lic - Mab -Cap - De - Cul - Dai + 9,16LK
	> 1000	1,1 Cht + 0,97 Cip + 0,83 Paf + 0,56 Soi - Cap - Caa - Aln + 6,58 LK
IIIA <sub>1</sub>		0.96Cip + 0.74 Mat + 0.6 Nel + 0.53 Eld + 0.53 Sco + 0.53 Lip - Mea - Cap + 6,11 LK

##### In which:

Cht: *Chukrasia tabularis*

Sco: *Schefflera octophylla*

Cap: *Canarium pimela*

Mim: *Michelia mediocris*;

Fas: *Fagus sylvatica*

Lip: *Lithocarpus pseudosundaicus*

Cip: *Cinnamomum parthenoxylon*

Bij: *Bischofia javanica*

Mab: *Manglietia baillonii*

Caa: *Canarium album*

Aln: *Alnus nepalensis*

Cul: *Cunninghamia lanceolata*

Lic: *Litsea cubeba*

Dai: *Dacrycarpus imbricatus*

Nel: *Nephelium lappaceum*

Mac: *Manglietia conifer*

Mea: *Melia azedarach*

Eld: *Elaeocarpus dubius*

Paf: *Paulownia fortune*

LK: Other species

Table 4 indicates that study areas had a quite biodiversity about number of species. However, the ratio of high value species was still low, such as *Chukrasia tabularis*, *Canarium album*, *Lithocarpus fissus*, *Phoebe cuneate*, *Castanopsis indica* and others. Non-target species accounted for a high percentage and they are some species that mainly demands strong light (*Macaranga denticulata* (Blume) Muell-Arg, *Mallotus floribundus* and etc). At the study sites, most of natural forest belonged to young forest and forest after mining with low volume, while high volume of natural forest accounted for a low ratio and distributed discretely. Some results when investing on line plot survey about natural tree species were that: *Schima wallichii* (DC.) Korth is popular tree growth on this region;

*Alnus nepalensis* D. Don. Si pioneer tree growth frequency on forest after mining and young forest; *Altingia siamensis* Craib also growth much on natural forest because of having winged seed and being very abundant so this species becomes the most common on this sites; *Manglietia megaphylla* Hu et Cheng is a big tree with having soft wood, easily worked and durable. Local people interested in planting this species abundantly; *Toona surelii* (Blume) Merr grew relatively common in the region providing good wood for furniture and have been planted and developed by citizens nearby streams and around residential areas: *Betula alnoides* Buch-Ham also growth much and was used for building, furniture and medicine; In the study area, we also met a number of populations of *Indosasa amabilis* McClure,



*Phyllostachys aurea* mostly growing to be single forest with having large area and good increment

rate. They were planted scattered along the rivers and streams or moist slit.

**Regeneration characteristics**

**Table-6. Regenerated trees at 5 communes in Hoang Su Phi district**

State	Density (N/ha)	Target tree (%)	Potential tree (%)	$\bar{H}$ (m)	Seeding (%)	Vegetative reproduction (%)	Good tree (%)	Medium tree (%)	Bad tree (%)
<b>Wood &amp; Bamboo</b>	585	28.50	30.65	0.98	71.46	28.54	26.08	55.59	18.33
<b>IIA</b>	782	43.73	50.26	1.41	80.11	19.90	48.66	38.08	13.33
<b>IIIA<sub>1</sub></b>	881	46.35	52.19	1.95	80.36	18.21	52.43	37.89	9.67

Table-6 indicates that number of regeneration tree varied from 13 to 18 species, target trees accounted for a high proportion in plots setting on research region. This is an advantage for the region. We could fully use some silvicultural measures for localizing and nurturing target trees. On the other hand, the distribution of quality regeneration tree showed that good quality with high proportion will create favorable conditions for silvicultural measures to ensure easy interaction and get high efficiency. Besides, regeneration tree from seed derived a large proportion (greater than 70 % in survey region), especially some native trees, will be facilitating the process of reforestation and make the forest to take a long-term structural stability in the future. However,

problems encountered in study area is density of regeneration tree of states relatively low, this suggests the need to have suitable measures to increase the number of target tree such as planting under canopy of native species.

**Non-timber species' characteristics**

Through process of assessing and collecting data to show that diversity of non-timber species groups in the region is very high. Combined results of line survey and inherited previous research have found to be 289 timber species in the study area. These plants had different life forms such as large trees, shrubs, vegetation, vines and parasites plant.

**Table-7. Distribution of life form of non-timber species in study sites**

No.	Life form	Number of species
1	<i>Woody plants</i>	75
2	<i>Bamboo, Palmae</i>	18
3	<i>Shrubs, vegetation, vines</i>	177
4	<i>Parasites plants</i>	19
	<b>Total</b>	289

(Source: Results of survey forest by Silviculture Dept. - Vietnam Forestry University, 2009)

**Woody plants:** this group consist 75 species and provided a number of different products for human needs, such as: fruit and seed (*Dracontomelon dupperreanum* Pierre, *Canarium album* (Lour.) Raeusch, *Canarium pimela* Leench, *Michelia mediocris* Dandy and *Castanopsis indica* (Roxb.) A. DC); resin (*Erythrophleum fordii*, *Bischofia javanica* Blume); attar (*Litsea cubeba*, *Cinnamomum camphora*, *Litsea glutinosa* and etc); leaf (*Ficus racemosa*, *Schefflera octophylla* (Lour.) Harms, *Liquidambar formosana*, *Barringtonia acutangula*, *Heliotropium indicum* and etc); bark (*Artocarpus tonkinensis*, *Schefflera octophylla* (Lour.) Harms), aloes wood (*Aquilaria crassna* Pierre);

**Bamboo, Palmae group:** bamboo shoot and knit (*Indosasa amabilis* McClure, *Dendrocalamus flagellifer* Munro, *Schizostachyum pseudolima* MacClure, *Dendrocalanus membranaceus* Munro, *Bambusa blumeana* Schultes and etc).

**Shrubs, vegetation, vines:** this tree group is the most variety among of 4 groups of NTFPs species. Up to 177 different species was found by Silviculture Dept.-Vietnam Forestry University, 2008. There were some high value tree such as: *Oldenlandia diffusa* (Willd) Roxb, *Anoectochilus setaceus*, *Calamus platyacanthus* Warb, *Calamus tetradactylus* Hance, *Amonum Xanthioides* Wall, *Fallopia multiflora* and etc.

The abundance and diversity of non-timber species are not only valuable asset, but also source of many people's lives, especially for the poor people in localities. Developing non-timber species will bring high efficiency and help people have confidence in processing of reforestation. Meeting with business objectives comprehensively integrated use all the values and beneficial functions of forests to meet many different goals, not just stop at a single target

business is wood. This is also the question of forestry activities in these sites.

**Selection tree forest for study areas**  
*For protection forest purpose*

In order to protect water resource, land and against erosion, sandy invasion, limited to natural disasters, climate regulation, contribution to environmental protection forest was built in Vietnam. In fact that local people used cultivation and terraces to get negative impacts on the environment in the study area so that eroded land and barren land existed commonly in the area.

Based on the legislation of the decision announced by the 16/2005/QĐ-BNN for selecting of main forest tree, “Forestry Handbook - Chapter Select a priority species for reforestation programs Vietnam”, expert and farmer opinions as well as local conditions derived from questionnaire, seminar and discussion, there are some specified criteria for Protection forest following that:

Adapted to local site conditions and environment and landscape (Adaptive criterion – B<sub>1</sub>): Selected trees could be suffered dry condition, steep slope, high altitude, complex terrains, poor soils, low temperature, and frost.

Prevent soil erosion (B<sub>2</sub>): Characteristics of selected tree are wood trunk, perennial, deep roots, dense foliage and evergreen. This criterion is an important role in group tree plantation species protection.

Adapted to planting method of mixing forests with multi-storey stands (B<sub>3</sub>): Group targets are assessed through criteria such as growth ability and ecological characteristics of species.

Multi-purposes and able to provide a number of products contributed to increase income but not have impacts on protection ability (B<sub>4</sub>). This criterion is assessed through economic efficiency criteria.

Participation of local people (B<sub>5</sub>): This criterion ensures that management and taking advantage of forest could get high efficiency.

Ability to resist pests and diseases (B<sub>6</sub>).

**Table 8. Criteria (B<sub>i</sub>) and its Weight for Protection forest**

No.	Species	Criteria						Σ (Y)	Level
		B <sub>1</sub> (0.3)	B <sub>2</sub> (0.2)	B <sub>3</sub> (0.15)	B <sub>4</sub> (0.15)	B <sub>5</sub> (0.1)	B <sub>6</sub> (0.1)		
1	<i>Castanopsis boisii</i>	3	3	3	3	3	3	1	I
2	<i>Canarium album</i>	3	3	3	3	3	3	1	I
3	<i>Acacia hybrid</i>	3	3	3	3	3	3	1	I
4	<i>Cleistocalyx operculatus</i>	3	3	3	3	2	3	0.97	I
5	<i>Cunninghamia lanceolata</i>	3	3	3	2	3	3	0.95	I
6	<i>Chukrasia tabularis</i>	3	3	2	3	2	3	0.92	I
7	<i>Betula alnoides</i>	3	3	2	3	2	3	0.92	I
8	<i>Michelia mediocris</i>	3	3	2	2	2	3	0.87	I
9	<i>Pinus kesiya</i>	3	3	3	2	1	1	0.82	II
10	<i>Alnus nepalensis</i>	3	3	2	1	2	3	0.82	II

Each of above criteria is further subdivided into ability to meet and also be assessed according to the level of importance (there are 3 level of ability to meet including as Level 1: low ability, Level 2: medium ability and Level 3: high ability).

**For Production forest purpose**

Ecological characteristics of species match local conditions  
Economic value suitable to the purpose of forestry industry  
Large and stable market and People like  
Ability to protect land and prevent erosion  
Source of Seed

Primarily target of production forests is to be used for wood business, non-timber forest products and forest specialties. Thus, compared with protection forest this one benefits to local people who are forest-dependent faster and higher. Specified criteria for Protection forest are including:

(B<sub>1</sub> – Weight: 0.35).  
(B<sub>2</sub> – Weight: 0.30).  
(B<sub>3</sub> – Weight: 0.20).  
(B<sub>4</sub> – Weight: 0.10).  
(B<sub>5</sub> – Weight: 0.10).

**Table 9. Criteria (B<sub>i</sub>) and its weight for Production forest**

No.	Species	Σ (Y)	Level	No.	Species	Σ (Y)	Level
1	<i>Castanopsis boissii</i>	0.93	I	12	<i>Styrax liquidis</i>	0.87	I
2	<i>Toona sinensis</i>	0.93	I	13	<i>Manglietia conifera</i>	0.85	I
3	<i>Canarium album</i>	0.93	I	14	<i>C. lanceolata</i>	0.85	I
4	<i>Dendrocalamus asper</i>	0.93	I	15	<i>Michelia mediocris</i>	0.83	II
5	<i>Dendrocalamus sp.</i>	0.93	I	16	<i>Camellia sasanqua</i>	0.83	II
6	<i>Dendrocalamus farinosus</i>	0.93	I	17	<i>Delavaya toxocarpa</i>	0.83	II
7	<i>Manglietia conifera</i>	0.93	I	18	<i>Melia azedarach</i>	0.81	II
8	<i>Chukrasia tabularis</i>	0.9	I	19	<i>Broussonetia papyrifera</i>	0.81	II
9	<i>Melia azedarach</i>	0.87	I	20	<i>Pinus kesiya</i>	0.77	II
10	<i>Betula alnoides</i>	0.87	I	21	<i>Alnus nepalensis</i>	0.77	II
11	<i>Tectona grandis</i>	0.87	I				

**For group of non-timber species**

This tree group was determined based on a combination between experiences of local people, knowledge to choice NTFPs' species and survey results on field about this one in the study area. The survey results showed that the number of this group could be used for planting, including:

*Amomum aromaticum* Roxb: this species, having 2-3m height, is often grown under the canopy at moisture condition in primeval forest, of from 1100m to 1800m above sea level, scattered in several villages of communes.

*Acrocephalus indicus* Burm F. Kuntze: This medicinal tree is commonly met on some feral areas on upland mountain, hill and along the road. Currently, this species is mainly exploited in the wild by the people, used in their home and is not cultivated or transferred into markets.

*Garcinia multiflora* Cham ex Benth scattered in forest or near upland farm. This species has edible leaves. Seed contains oil and could be used for industry or making medicine.

*Artocarpus styracifolius* Pierre is timber tree, its bark used for eating.

**Table-10. Group of Non-timber species were tended to grow in study area.**

Species	Note
<i>Panax pseudoginseng</i> Wall	Planting under the canopy
<i>Amomum xanthioides</i>	Planting under the canopy
<i>Amomum aromaticum</i> Roxb	Planting under the canopy of <i>Alnus nepalensis</i>
<i>Eucomia Ulmoides</i> Olive	Planting around house farm.
<i>Abrus precatorius</i>	Planting under the canopy
<i>Indoasa amabilis</i> McClure	Planting in forest or bare land
<i>Calamus tonkinensis</i> Becc.	Planting in forest or around house farm.
<i>Calamus platyacanthus</i> Warb. ex Becc.	Planting in forest or around house farm.

**Group of proposed forest tree species**

After finishing the process of determination of planting tree groups, this project continued to compare them with each land conditions by application map overlay method as well as combined

with the results of inventory of the appearance of these selected species in field. In some areas which are over 1700m above sea level, there are preferred delimiting for caring and protection to plantation.

**Table-11. Selected forest tree species for plantation in study area**

No.	Name of species	Elevation	
		< 700 m	700 – 1500 m
1	<i>Melia azedarach</i>	√	√
2	<i>Toona sinensis</i>	√	
3	<i>Canarium album</i>	√	√



4	<i>Canarium nigrum</i>	√	
5	<i>Alnus nepalensis</i>	√	√
6	<i>Pinus khasya</i>	√	√
7	<i>Tectona grandis</i>	√	
8	<i>Cunninghamia lanceolata</i>	√	√
9	<i>Manglietia conifera</i>	√	√
10	<i>Delavaya toxocarpa</i>	√	√
11	<i>Chukrasia tabularis</i>	√	√
12	<i>Betula alnoides</i>	√	√
13	<i>Schima wallichii</i>	√	√
14	<i>Michelia mediocris</i>	√	√

## CONCLUSIONS

Study results indicate that forest vegetation takes many features of dominances of sub-regions vegetation in North of Vietnam and South of China. In nature forest, woody tree species grew mixing with broad leaved species and have a high biodiversity. However, the composition formula mainly consists of high preferred tree with ratio of quality of good tree and medium tree is quite high. Commonly, plantation forests in this region was very suitable with the ecological conditions on growth region. However, some main plantation tree species had yet to fully grow as comparing with their potential.

Based on the strict relationship between tree growth ability and ecological factors, study selected 21 tree species for establishing production forest, 10 species for protection purposes and 8 non-timber species to plant and protect forest as well bring to local people more income in this region .

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