


REPORT



Report on Changes of
Forest and Vegetation in
20 communes in MRDP
areas (1989-1998)





Report on Changes of Forest
and Vegetation in 20
communes in MRDP areas
(1989-1998)

*Forest Inventory and Planning
Institute (FIPI)*

*Vietnam - Sweden Mountain
Rural Development Programme
1996 - 2001 (MRDP)*

December, 1999



SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY



Vietnam Sweden Mountain Rural Development Programme (MRDP)

Ministry of Agriculture and Rural Development
2 Ngoc Ha, Hanoi

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Part1. Survey methodology

1.1 Criteria for selection of communes

To facilitate the evaluation of change in forest and vegetation cover in MRDP areas the following criteria for selection were used:

- Availability of aerial photographs taken 1989 and 1993, so that data was available for comparison with 1998.
- Topographical map (1: 10.000) issued by the state available.
- Half of the communes were to be located in the project areas and half outside, so comparisons could be made between programme and non-programme areas.
- Communes selected had to be in different areas and of differing environmental and social status of land use, such as:
 - + Evenly distributed in different ecological zones: low mountain, hilly areas, and medium mountain.
 - + Distributed in different ethnic minority areas, and with different population densities.
 - + Distributed in the areas where farmers have traditional experience of land use for reforestation, garden, forest garden, fruit garden, industrial crop, terraced fields, and rice paddy.
 - + Convenient for access (highly populated areas, remote areas, and areas near roads).
 - + To be evenly distributed in the 5 provinces

With these principles, 20 communes were selected (10 communes in the project areas, 10 communes in non-project areas) in the 5 provinces of Lao Cai, Yen Bai, Ha Giang, Tuyen Quang, and Phu Tho:

Communes in the project areas			Communes outside the project areas		
No	Name	Area (Ha)	No	Name	Area (Ha)
1	Trung Chải	3,879	11	Tả Phìn	2,357
2	Minh Quân	1,971	12	Bảo Hưng	1,057
3	Phú Thịnh	1,183	13	Đào Thịnh	1,349
4	Hoà Cường	1,878	14	Mông Sơn	4,421
5	Hùng An	3,617	15	Hương Sơn	3,873
6	Việt Vinh	4,730	16	Yên Hà	4,377
7	Phú Lâm	3,828	17	Lang Quán	2,782
8	Mỹ Bằng	3,223	18	Tứ Quận	3,564
9	Đức Ninh	2,070	19	Bình Xa	2,750
10	Thượng Long	2,744	20	Phúc Khánh	2,495

1.2 Documentation used and sources of data

To develop maps for different periods and report the change in forest and vegetation, the following documentation have been used:

- Aerial photos scale 1: 30.000 - 1: 35.000 taken in 1989 and 1993.
- Topographical map 1:10.000 UTM issued by the Department of Maps, general commander or map 1:10.000 - GAUS by General Department of Land Administration.
- The results of a baseline survey on natural conditions of concerned institutions.
- The results of the survey of forest status and land use in 20 communes

1.3 Methodology used to construct forest and vegetation cover maps

1.3.1 *Methodology used to construct forest and vegetation cover maps for 1989 or 1993*

Interpretation of aerial photographs

Based on the aerial photographs, and the regulations for interpretation of aerial photos (which have been developed by FIPI) forest and land types were mapped on transparent paper. The items drawn were based on the ToR for the assignment (Appendix 1)

Transfer of results of aerial photos onto the topographical map 1:10.000

Before transferring onto maps, the results of aerial photo were checked by experts. The following checks were carried out:

- Correct allocation and correct boundaries
- Closed contour lines
- Sufficient information of stand and clear codes

Commune maps were mainly done manually, because it was easier and more reliable to transfer by stereo scope and - based on aerial photos - to draw all top lines, stream systems and roads onto the map with special ink. This was used as a base for control, identifying the location of forest stands and land in the aerial photo. This was then transferred to its relative position on the topographical map.

Experienced cartographers continually checked the results of the transfer. The checking was for:

- Comparing location, shape, size of stand on aerial pictures and topographical maps.
- The contour line had to be closed with full coding in accordance with the written ones on the photo map.

This was in order that the map transfer was faithful to the results from aerial photo. However, mistakes could not be avoided as:

- It was not easy to distinguish between newly planted stand with elephant grass areas and agricultural crops
- It was not always possible to distinguish clearly between bush, young and newly rehabilitated forest, and young bamboo forest, as would have been desirable

In order to minimize the mistakes during the drawing process, the map was field checked by the field working groups. Through checking, errors found were corrected. After this checking, the map was regarded as the original map and transferred to map making unit for printing and analysis.

1.3.2 Forest and vegetation map making in 1999

The forest and vegetation map of 1999 was based on the maps from 1989 and 1993 and complemented with a field survey. The forest maps of 1989 and 1993 were taken to the field. If the forest stand, vegetation or land parcels had changed, these changes were recorded in the new maps. The field check revealed that the land use had changed considerably. Therefore the advantages of the earlier aerial photos was limited.

Generally, the survey communes have hilly and low mountain topography, so the method of using an opposite hill was used to define stand. Control points, that were easy to find both on the map and in the field, were used (such as mountain tops, state triangulation points, road junctions, junctions of rivers and streams, pagodas, and any feature that could easily be found on the map and in the field through good observation of the surrounding land).

Using the control points (and a system of ridges, hill sides, and streams), it was easy to relatively accurately estimate the location, size and shape of the forest stand and land types, both on the old maps, and in the field. From this, the information could be drawn onto the new maps. Normally one forest and/or vegetation stand was drawn from two or three control points.

The boundary between different forest land types was drawn by pencil, with fine and clear lines, coding forest types or land types in accordance with regulations. The drawing line was then transferred into ink lines by the end of the working day.

During the process of making forest and vegetation maps 1999, the project manager was in regular contact with the field groups, solving technical problems and speeding up the implementation. Discussions took place between the different field groups allowing an exchange of information, agreement on the solution of problems, self-checking of the results of the groups, and correction of the errors that had occurred.

Experts from FREC checked the output of the fieldwork on spot. Before making the output map and calculation in the office, a group of experts, consisting of technicians from FREC and northwestern division, worked in the field with technicians from MRDP and Phu Tho Province, and with cadastral officers and village leaders. If an error was found, the field workers were requested to correct it.

1.3.3 Methodology used to calculate vegetation and forest changes over time, and transfer between the different vegetation categories

- Contour lines of forest and land types during different years were put on transparent paper in two ink colours.
- The establishment of a point system at intervals of 5 x 5 mm (one point represents 0.25 ha).
- Fixing a point system on transparent paper with contour lines of forest and vegetation cover.
- Noting the forest categories and vegetation in a point.
- Inputting this information into computers and calculating the changes and transfer between them. The results are recorded into a table, making it easy to calculate the area of forest and land types in 1989 and 1999, using normal software.

Table to calculate forest and vegetation changes

1998	Timber	Bambo o	Plante d	Bush	...	Sum
1989	forest	forest	forest	forest trees	...	1989
Timber forest						
Natural forest						
...						
...						
Sum 1998						Sum

1.3.4 Checking output maps and office work

Checking output map

Output maps were developed in two stages:

- **Stage 1:** Transfer of forest stand and land categories from the field map onto topographical maps; coding the transferred stand; completing procedures for map as writing names of maps, the names of neighboring communes, and legends. This process was also checked with the following methods:

+ Putting the original map and transferred copy on a lighting table to check contour lines, forest codes and

land, putting names of villages, location of people committees, neighboring communes, number of stand, status, and stand area.

+ Comparing forest and land types on map and legend

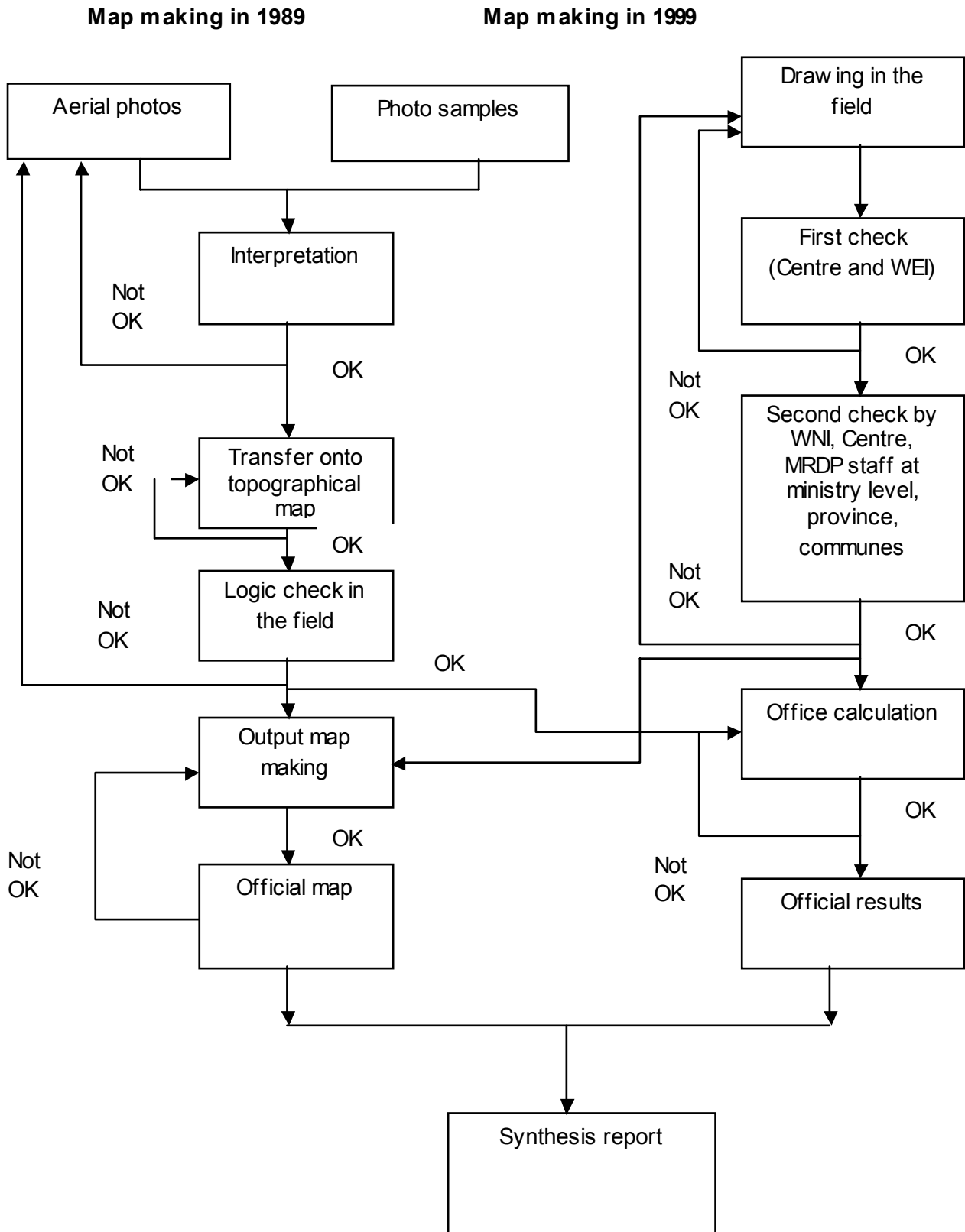
- **Stage 2:** Colouring. During this stage, correspondence with the map colour and colour scale of FIPI are followed.

Checking the office calculations

- Controlling errors.
- Checking the area of each stand
- Checking the calculation table of transfer between different vegetation and land categories

In all activities in which errors might occur, checks were made (including maps and data) to minimise the possibility of mistakes.

Diagram of steps



Part 2. The results of survey

2.1 Description of the surveyed area

2.1.1 *Natural conditions*

The study on change in forest and vegetation was conducted in seven districts, in five provinces in the north of Vietnam, which is part of the area where the works. This is also the raw material area for the Bai Bang Paper Mill in Phu Tho. The communes selected for the study are situated divided in two main zones:

- The mid mountain areas with altitude of 1200m, including the communes of Tá Phìn and Trung Chải, in Sa Pa District, Lao Cai Province.
- The low mountain areas with altitude of <700m, including the communes of Hùng An, Việt Vinh, Hương Sơn, and Yên Hà, in Bắc Quang District, Hà Giang Province. The communes of Thượng Long and Phúc Khánh, in Yên Lập District, Phú Thọ Province. The communes of Đức Ninh and Bình Xa, in Hàm Yên District, and Tứ Quận, Phú Lâm, Lang Quán, Mỹ Bằng, in Yên Sơn District, Tuyên Quang. The communes of Minh Quân, Bảo Hưng, Đào Thịnh, Hoà Công, Trấn Yên, Phú Thịnh, and Mông Sơn, in Yên Bình District, Yên Bái Province.

In spite of the fact that the communes are situated in different zones they have similar characteristics, typical for the northern mountain areas. These include; rugged topography, hilly areas of different types (lower hills, rocky outcrops, and hills with deep soils, and valleys & plains suitable for farming. The average slope is about 20%, - in some places as steep as >30% (e.g. in some highland communes in Sa Pa (Lao Cai) or Việt Vinh commune of Bắc Quang District, Hà Giang Province.

The main land types

Ferallitic soils are found in the low and medium hills and mountain areas. Formed from weathered clay and lime rock, the soil formation process has been accelerated by a hot and humid climate, creating thick soil layers. The areas with vegetation are rich in nitrogen, phosphate and potassium. On barren hills with little cover, the soil is very poor and shallow, which can easily be eroded and washed away. There are two types:

- **Alluvium soils:** These are popular with farmers due to the annual addition of sediment from rivers and streams. They are of light texture with light clay, brown in colour, and are found in thick

layers along the banks of rivers and streams, and in valleys and the plains at the foot of mountains.

- **Limestone soil:** is found in rocky areas in thin layers, but is very rare. It is black in colour, it is a good soil.

Generally, the soil in the 20 communes is fertile, characterized by forest soil. In some places the soil layer is thick and suitable for farming and reforestation. However, in some places the vegetation has disappeared because of deforestation, resulting in serious soil erosion, leading to shallow soils, poor nutrient content and low moisture contents.

Climate - weather

There are two distinct seasons: winter and summer. Winter is quite cool and wet and usually lasts from November to April. February and March are characterised by a persistent drizzling rain. The hot summers last from May to October. The climate can be classed as sub-tropical with occasional typhoons during the summer months. The northernmost provinces experience cool to cold winters.

During the rainy season, from May to October, about 70-80% of the total annual rainfall occurs. The remaining 20-25% of the total annual rainfall occurs during the dry season between November and April. Average humidity is between 80- 85%.

The following table 1 shows temperature and average annual rainfall in some districts in survey communes:

District	Mean Temperature	Min temperature	Max temperature	Rainfall
Sa Pa	15,2	- 3.2	29.8	2833
Trấn Yên	22.7	2.9	39.8	2107
Yên Bình	22.7	2.9	39.8	2107
Bắc Quang	22,6	0.3	38.4	4802
Hàm Yên	22.7	- 0.6	39.7	1875
Yên Sơn	22.9	2.4	39.6	1641
Yên Lập	22.5	0.5	40.7	1826

During the cold season there is a northeasterly monsoon wind. In the summer the predominant wind comes from the south east, from the South China Sea and Gulf of Tonkin. The studied communes do not particularly suffer from storms, as they are in the hinter areas and protected by high mountains. There is a great deal of fog and mist in the winter, especially at higher altitudes.

2.1.2 Socio-economic conditions

Ethnic minorities

According to statistics there are 5 main ethnic minority groups living in the 20 communes:

- Kinh: 46,704 people (52,8%).
- Tày and Nùng: 15,766 people (17,8%).
- Dao: 10,237 people (11,6%).
- H'mông: 3,170 people (3,6%).
- Others: 12,524 people (14,2%).

The minorities are mixed in the communes, but can be found in two main areas with different traditional farming and livelihood systems:

- Low areas: convenient for paddy farming, near to roads, along rivers and streams, which are convenient for trading, services and diversified production. The ethnic minorities living in these areas include Kinh, Tày, and Nùng. The main social and economic activities of the communes take place here. People are mainly engaged in paddy rice cultivation.
- Upland areas: the Dao people mainly inhabit the upland areas mixed with Tày, Nùng and various other minorities. These are sparsely populated, with less developed economy. The level of education is low, traditional farming practices are followed with little paddy rice cultivation. Some households still practice shifting cultivation. Forest products play an important role for local livelihoods.

Population

According to the results of the survey, there are 88,401 people and 17,343 households in the 20 communes. There are an average of 5 people in each household and average population density is 152 people /km².

The population growth rate at present is 2.0-2.1 %. At this rate it is estimated that by 2005 the population will reach approximately 99,500 people, and that by 2010 it will be 110,000 people. The demand of food, timber and fuel is considerable, and if there is no control of population growth and a plan to develop agriculture and forestry, the environment will not be able to meet the extra demands, leading to increasing deforestation and poverty.

Labour

The number of people of working age is 37,065 (42% of the total). They work mainly in agriculture and forestry. In recent years due to the changes in economic structure, activities in the communes central

parts have become more dynamic and diversified. However, due to limitations in labour distribution, it is mainly focused in agriculture. The average paddy field per labourer is 0.16 ha. The surplus labour is about 30-40 %. This is a potential for forest development and in other sectors.

2.1.3 Economic reality

Agriculture is the main means of production in the 20 communes. Rice is the main food crop, but productivity is not high, averaging approximately 4 tons /ha. Some communes reach 5 tons /ha, as does Bảo Hưng, Minh Quân, and Đào Thịnh (Trấn Yên District, Yên Bái Province). Some have low productivity, including Thượng Long and Phúc Khánh (Phú Thọ Province); Mông Sơn, Phú Thịnh, and Hoà Công (Yên Bái Province); and Bình Xá (Tuyên Quang Province), where productivity is only 3.0-3.5 tons. Generally, the farming practices are traditional with low productivity, and depending on good rainfall. There is almost no irrigation system. Due to lack of paddy fields, some people have to cut down forest for their farming.

In recent years thanks to support from the government and international organizations, especially MRDP, the productivity of land has increased, and some rice fields are producing two crops per years. Some families have received in-puts and training to develop forest, fruit trees, industrial crops, and forest gardens and livestock production.

This support to tree and forest establishment have increased the household income. However, Government and MRDP support is only partly meeting the production demands of the communes, and the standard of living of minority peoples is still well below the average in Vietnam.

In the communes, which have received direct support from MRDP, the standard of living is much improved and the number of rich and medium households is higher than the ones outside MRDP areas.

Family	MRDP Areas	Non-MRDP Areas
Rich households	1,111 hhs (11%)	778 hhs
Medium households	12,293 hhs (70,8%)	5,344 hhs
Poor households	3,161 hhs (18,2%)	1,812 hhs

2.1.4 Social reality

The socio-economic infrastructure in the 20 communes is very poor, and it will not be able to meet the development requirements in the future.

- Roads: There are roads passing through, but the internal roads are in a bad condition that will hamper transportation of products.
- The offices of People Committees' are not in good shape, especially in the communes outside MRDP areas.
- Health care: There are 14 clinics in the 20 communes. Only doctor assistants and nurses staff these. There is a lack of medical equipment and medicines.
- Education: there are primary and secondary schools in almost all the communes except Trung Chải and Tả Phìn, where the children go to secondary school in the district. School infrastructure is poor, along with the roads that lead to the schools. The result is that the students achieve lower academic levels than in other parts of the district.

Synthesis of population -economic - social situation

No	Items	Unit	Total	Communes in MRDP				
				area	Total inside MRDP	Trung Chải	Minh Quân	Phú Thịnh
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Number of hhs	Hhs	17,343	9,409	376	825	45	541
	Rich	Hhs	1,889	1,111	20	165	17	52
	Medium	Hhs	12,293	6,949	216	520	20	408
	Poor	Hhs	3,161	1,349	140	140	8	81
2	Labour	Person	37,065	20,393	1,402	1,341	901	1,623
3	Population	Person	88,401	49,842	2,491	3,728	1,992	2,340
	- Kinh	Person	46,704	26,626	18	3,713	1,992	2,215
	- Tày, Nùng	Person	15,766	10,077		12		
	- Dao	Person	10,237	3,558	809			
	- H'mông	Person	3,170	1,985	1,664			
	- Others	Person	12,524	7,596		3		125
4	Paddy field	Ha	5,561.5	3,021.5	98.0	206.0	92.1	100.0
	Productivity	100/ha			32	55	35	35
5	Non-rice	Ha	691.3	382.8	60.0	20.0		40.0
	Productivity	100/ha			12	24		15
6	Sw idden	Ha	299.9	112.0				
	Productivity	100/ha						
7	Fruit trees	Ha	817.1	434.0	26.0			2.0
8	ST industrial crops	Ha	591.0	324.3		20.0	108.0	
9	LT industrial crops	Ha	1,666.0	647.9		105.0	12.0	25.0
10	Forest garden	Ha	2,697.3	1,569.3		18.0	40.0	
11	Cattle	Pecs	15,751	8,417	446	470	409	586
12	Pig	Pecs	27,881	15,123	707	950	150	995
13	School							
	Primary (classroom)	Class	435	215	20	15	14	15
	Secondary classroom)	Class	183	104		8		5
14	Clinics	Station	14	7			1	1

Synthesis of population -economic - social situation

No	Items	Unit	Communes in MRDP					
			Hùng An	Việt Vinh	Phú Lâm	Mỹ Bằng	Đức Ninh	Thượng Long
(1)	(2)	(3)	(10)	(11)	(12)	(13)	(14)	(15)
1	Number of hhs	Hhs	1,269	163	1,415	2,400	1,294	1,081
	Rich	Hhs	40	2	70	350		395
	Medium	Hhs	1,005	42	1,212	1,920	1,053	553
	Poor	Hhs	224	119	133	130	241	133
2	Labour	Person	930	2,016	3,000	4,800	2,280	2,100
3	Population	Person	5,977	4,245	6,669	11,900	5,700	4,800
	- Kinh	Person	2,700	445	3,479	6,700	4,544	720
	- Tày, Nùng	Person	2,687	3,246	12	4,120		
	- Dao	Person	570	148		1,080	191	760
	- H'mông	Person	1	306	14			
	- Others	Person	19		3,164		965	3320
4	Paddy field	Ha	282.1	21,5	473.4	838.1	477.0	433.3
	Productivity	100/ha	47	35	40	56	40	30
5	Non rice	Ha	164.0	98.8				
	Productivity	100/ha	20	15				
6	Sw idden	Ha					112.0	
	Productivity	100/ha					10	
7	Fruit trees	Ha	155.0	160.0	30.0	49.0		12.0
8	ST industrial crops	Ha	164.0	8.3	14.0			10.0
9	LT industrial crops	Ha	20.0	20.8	314.1		140.0	11.0
10	Forest garden	Ha	1,381.3			130.0		
11	Cattle	Pecs	957	1,087	1,258	1,374	730	1,100
12	Pig	Pecs	1,700	1,215	1,900	5,405	910	1,200
13	School							
	Primary (classroom)	Class	20	23	32	35	29	12
	Secondary classroom)	Class	18	12	14	24	17	6
14	Clinics	Station	1	1	1	1		1

Synthesis of population -economic - social situation

No	Items	Communes outside MRDP					
		unit	Total outside MRDP	Tả Phìn	Bảo Hưng	Đào Thịnh	Mông Sơn
(1)	(2)	(3)	(16)	(17)	(18)	(19)	(20)
1	Number of hhs	Hhs	7,934	268	520	561	665
	Rich	Hhs	778	25	104	168	120
	Medium	Hhs	5,344	168	364	337	366
	Poor	Hhs	1,812	75	52	56	179
2	Labour	Person	16,672	714	1,202	1,057	1,995
3	Population	Person	38,559	1,847	2,412	2,425	3,518
	- Kinh	Person	20,078		2,412	242	2,788
	- Tày, Nùng	Person	5,689				730
	- Dao	Person	6,679	694			
	- H'Mông	Person	1,185	1153			
	- Others	Person	4,928			23	
4	Paddy field	Ha	2,540.8	249.0	127.0	164.0	29.7
	Productivity	100/ha		29	54	57	35
5	Non rice	Ha	308.5	66.0	15.0	15.0	17.5
	Productivity	100/ha		12	23	25	15
6	Sw idden	Ha	187.9				
	Productivity	100/ha					
7	Fruit trees	Ha	383.1	17,3	5,0		18,0
8	ST industrial crops	Ha	266.7			5,0	
9	LT industrial crops	Ha	1,018.1		400.0	150.0	
10	Forest garden	Ha	1,128.0			12.0	
11	Cattle	Pecs	7,334		287	225	730
12	Pig	Pecs	12,749		1,034	845	2,450
13	School						
	Primary (classroom)	Class	220	24	17	17	9
	Secondary classroom)	Class	79		7	9	3
14	Clinics	Station	7		1	1	1

Synthesis of population -economic - social situation

No	Items	Unit	Communes outside MRDP					
			Hương Sơn	Yên Hà	Lang Quán	Tứ Quận	Bình Xa	Phúc Khánh
(1)	(2)	(3)	(21)	(22)	(23)	(24)	(25)	(26)
1	Number of hhs	Hhs	378	634	995	1,239	1,543	1,131
	Rich	Hhs		10	93	248		10
	Medium	Hhs	172	304	788	855	1,312	678
	Poor	Hhs	206	320	114	136	231	443
2	Labour	Person	720	1,250	2,179	2,150	2,751	2,654
3	Population	Person	1,840	3,295	4,939	5,857	6,876	5,550
	- Kinh	Person	4	410	2,127	3,375	5,675	885
	- Tụy, Ning	Person	1,036	2,300	602	230	791	
	- Dao	Person	764	564	2,097	2,150	410	
	- H'Mông	Person	30			2		
	- Others	Person	6	21	113	100		4,665
4	Paddy field	Ha	286.6	176.4	284.0	458.6	286.2	478.5
	Productivity	100/ha	35	45	40	40	35	35
5	Non rice	Ha		25.0	70.0			100.0
	Productivity	100/ha		25	30			15
6	Sw idden	Ha	187.9					
	Productivity	100/ha						
7	Fruit trees	Ha	148.0	150.0	4.0	15.7		25.1
8	ST industrial crops	Ha			5.4	170.0		86.3
9	LT industrial crops	Ha			25.0	200.7	211.2	31.2
10	Forest garden	Ha	250.0		866,0			
11	Cattle	Pecs	630	1,235	862	900	1,017	1,448
12	Pig	Pecs	850	810	1,678	3,330	1,570	182
13	School							
	Primary (classroom)	Class	13	26	26	29	25	34
	Secondary classroom)	Class	3	6	12	15	15	9
14	Clinics	Station		1	1	1	1	

2.2 Status of forest, vegetation and land use

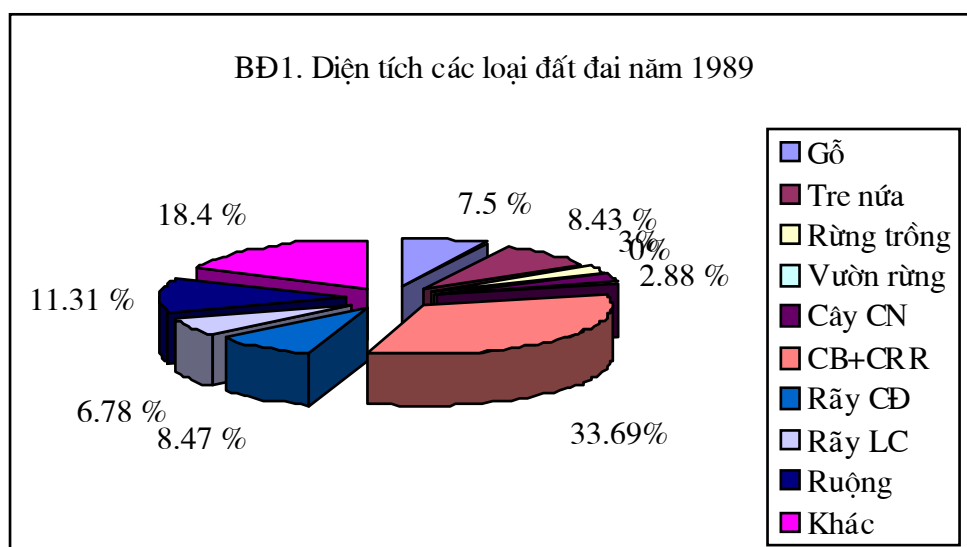
2.2.1 Area of forest and land types in 1989

The results of the interpretation of the aerial are as follows:

Table 2. Area of forest and land types in 1989

Unit: ha

No	Land types	Area	%	Notes
	Sum	58,148	100.00	
1	Natural timber forest	4,358.2	7.50	
2	Natural bamboo forest	4,902.1	8.43	
3	Planted forest	1,473.4	2.53	
4	Forest garden	0		
5	Industrial crops and LT fruit trees	1,674	2.88	
6	Bushes and scattered trees	19,592.8	33.69	
7	Fixed swidden land	4,925.4	8.47	
8	Rotated swidden land	3,944.1	6.78	
9	Paddy rice field	6,578.4	11.31	
10	Other	10,699.6	18.41	



The above table and the above diagram show the following information:

- In 1989 the forest area (including natural and planted forest) in the 20 communes was 10,733.7 ha (18.46 % of total natural area). If the LT industrial trees are included, the area would be 12,407.7 ha (21.34 % of total natural area).
- In 1989 the vegetation cover in general (including forest and bushes and scattered trees, but excluding industrial tree area) was 55.03%, of which:

+ Natural vegetation cover (natural forest, bushes and scattered trees) was 49.62%, and

+Man-made vegetation (planted forest, long-term industrial plantation) was 5.41 %

At that time forest gardens were not developing to any great extent. Income generation was mainly from food crops, from paddy rice fields, terrace fields and swidden land. Swidden land is mainly used for short-term crops (8,869.5 ha out of a total of 15,447.9 ha).

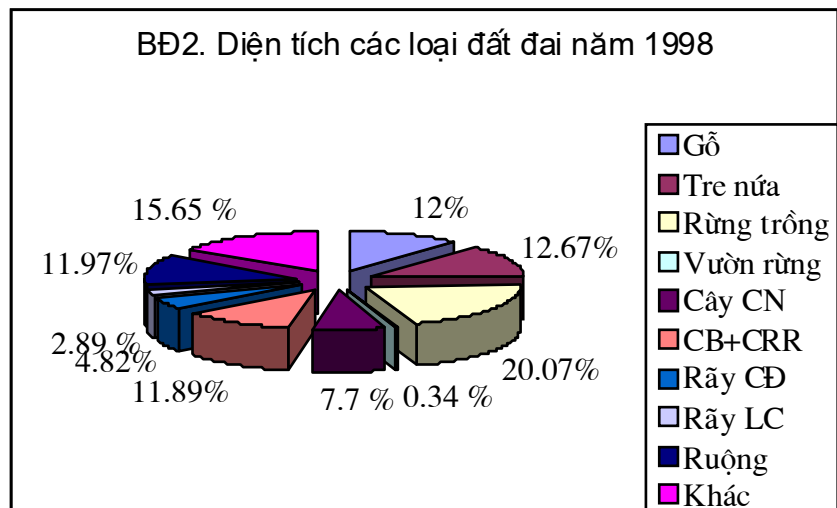
2.2.2 Area of forest and land types in 1999

The results of the survey from June to October 1999 are as follows:

Table. Area of forest and land types in 1998

Unit: ha

No	Land types	Area	%	Notes
	Sum	58,148	100.00	
1	Natural timber forest	6,975.5	12.00	
2	Natural bamboo forest	7,369.9	12.67	
3	Planted forest	11,668.2	20.07	
4	Forest garden	195.1	0.34	
5	Industrial crops , LT fruit trees	4,479.2	7.70	
6	Bushes and scattered trees	6,912.4	11.89	
7	Fixed Swidden land	2,803.4	4.82	
8	Rotated Swidden land	1,680.9	2.89	
9	Paddy rice field	6,962.3	11.97	
10	Other	9,101.1	15.65	



The above table and diagram show that in 1999:

- The forest area (including natural and planted forest) in the 20 communes was 26,013.6 ha (44.74% of total natural area). If the industrial trees are included, the area would be 30,687.9 ha (52.78 % of total natural area).
- The vegetation cover in general (including forest and bushes and scattered trees, but excluding the industrial tree area) was 37,600.3 ha (64.66 %) of which:
 - + natural vegetation cover (natural forest, bushes and scattered trees) was 21,257.8 ha (36.55 %)
 - + man-made vegetation (planted forest, long term industrial plantation) was 16,342.5 ha (28.11%)
- There were 195,1 ha of forest garden, which included *Mangletia*, *Eucalyptus*, palm, bamboo and some fruit trees. Industrial trees planted include the custard apple, plum, peach, orange, mandarin, and tea. Some were integrating forest products, and agriculture products with aquaculture production.
- Paddy rice fields and fixed swidden land, and rotated swidden land was 1,146.6 ha (19.69% of total natural land area). The swidden land occupies the smallest proportion of the three above-mentioned land groups (only 1,680.9 ha).

Of the remaining area of just over 9,000 ha, lakes, ponds, rivers and streams constitute more than 50 %.

2.3 Changes in forest and land types between 1989 and 1999

The requirement for the study was to survey forest and vegetation, assessing the changes from the start of the FCP in 1993, compared with present (1998/99), and earlier (1989) points of time. In practice the longer time period was used to allow changes to be visible. Information also depends on the availability of aerial photographs. At the same not all 20 communes have images taken in the same year - only 18 communes have aerial photos taken in 1989 whereas two communes in Lao Cai have images taken in 1993. However, in order to correctly assess the changes of forest and vegetation from 1989 to 1999, forest and land use data need to be from the same time period. The problem can theoretically be solved by extrapolation or interpolation - a method used by FAO in assessing global forest change.

For the specific conditions of the 5 provinces of Hà Giang, Tuyên Quang, Lao Cai, Yên Bái and Phú Thọ in period from 1989 to the present, it can be noted that:

- It is impossible to use the forest changes in 1993-1998 to extrapolate information for the period 1989-1993. This is so, because from 1993 to 1998 the forest cover increased at a very

fast rate, faster than in 1989-1993, due to the intervention of many projects. At the same time, some projects began in 1991 and some impact on forest and vegetation may be found (through direct survey methods or by satellite image).

- The results of the overall evaluation of forest and vegetation change in the 5 provinces between 1989 and 1993 using LANDSAT-TM images show that, during this period there was little change in vegetation.
- There are only 2 communes (Sa Pa in Lao Cai Province) that have aerial photographs taken in 1993, the remainder used aerial photographs taken in 1989. The change of forest cover in Lao Cai during this period was relatively small when compared with other provinces in the same period.

Due to the above-mentioned reasons, it was impossible to use extrapolation methods for to gain information on forest change in the two communes in the same year (1989) with the other 18 communes. This limitation has to be accepted, even though it is a small one.

2.3.1 Overall changes of the main vegetation cover in the survey area

Before studying the change in forest and land types in detail, it is necessary to have an overall understanding of the direction of change of the main vegetation types of importance to protection of soil, water and the ecological environment.

They are as follows:

- Natural vegetation: consisting of natural forest (timber and bamboo), bushes and scattered trees
- Man-made vegetation: consisting of planted forest, forest garden, industrial trees and long term fruit trees

Table 3. Changes of main vegetation in 1989-1999

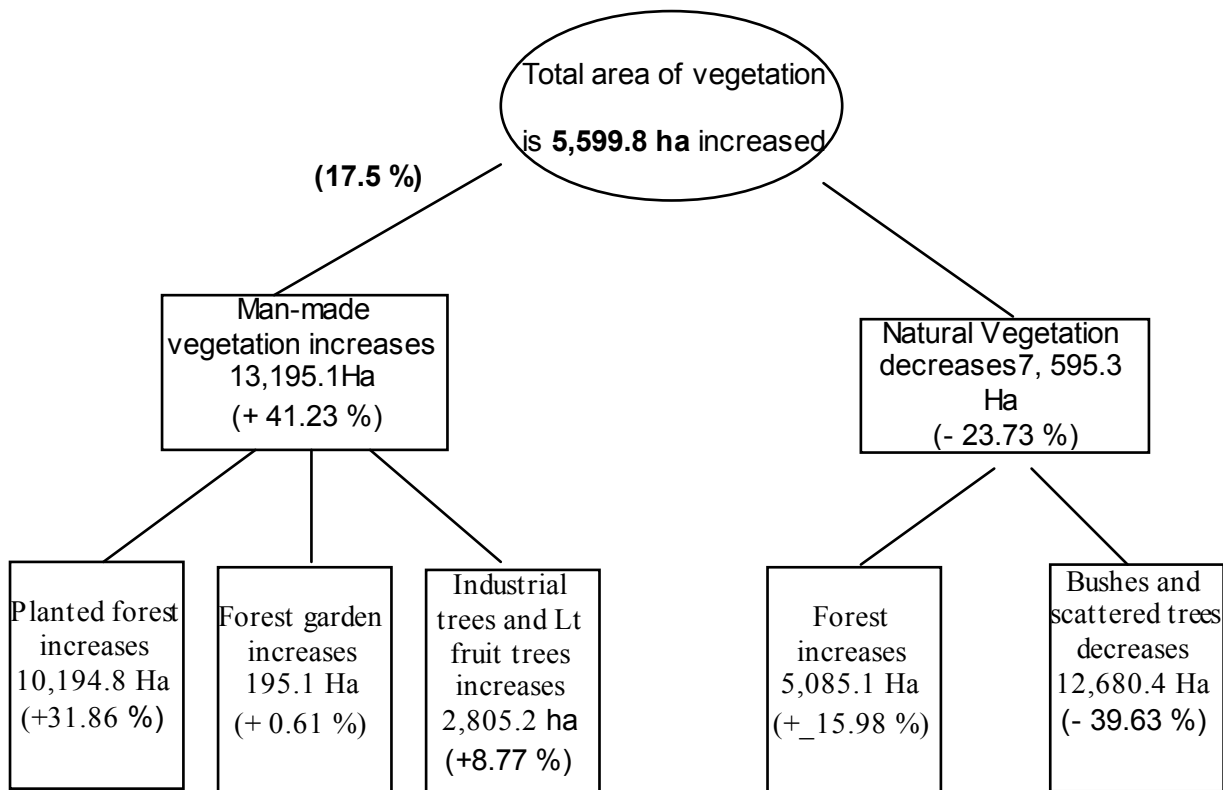
Unit: Absolute Ha, Relative: %

No	Main vegetation's	Increased		Decreased	
		Absolute	Relative	Absolute	Relative
	Total coverage	5,599.8	17.50		
I	Natural vegetation			7,595.3	23.73
1.1.	Forest	5,085.1	15.89		
1.2.	Bushes, Scattered trees			12,680.4	39.63
II	Man-made vegetation	13,195.1	41.23		
2.1.	Planted forest	10,194.8	31.86		
2.2.	Forest garden	195.1	0.61		
2.3.	Industrial trees and LT fruit trees	2,805.2	8.77		

*Notes: Relative value in the table is calculated by absolute changes of each vegetation species compared with the total area of vegetation in 1989 (32,000.5 Ha)

Changes of main vegetation are illustrated in the following diagram:

Total area of main vegetation: 1989: 32,000.5 ha
 1998: 37,600.3 ha



The above diagram shows that during the period:

- the natural forest coverage was decreasing;
- man-made vegetation was increasing, leading to large expansion in total forest coverage.

To arrive at a conclusion regarding the capacity of the different vegetation types to protect water, soil and other ecological and environment factors, they have to be compared with those of 1989. This requires a specific study.

Generally it can be understood though, that:

- The increasing forest cover indicates a positive sign of the changing direction in the ecological environment.
- Industrial trees and long-term fruit trees, forest garden, planted forest are the main source of income for the local people. The standard of living of people is improving, the forest will be protected, and the ecological environment will be guaranteed for the future.

2.3.2 Changes of forest and land types

Change of forest and land types.

Table 4. Change in area of forest and land types during 1989-1999

No	Forest and land types	Area		Changes	
		1989 (ha)	1999 (ha)	Absolute (ha)	Relative (%)
	Natural area	58,148	58,148		
1	Natural timber forest	4,358.2	6,975.5	2,617.3	60.05
2	Natural Bamboo forest	4,902.1	7,369.9	2,467.8	50.34
3	Planted forest	1,473.4	11,668.2	10,194.8	691.92
4	Forest garden	0	195.1	195.1	
5	Industrial trees and LT fruit trees	1,674.0	4,479.2	2,805.2	167.57
6	Bushes and scattered trees	19,592.8	6,912.4	-12,680.4	-64.72
7	Fixed sw idden land	4,925.4	2,803.4	-2,122	-43.08
8	Rotated sw idden land	3,944.1	1,680.9	-2,263.2	-57.38
9	Rice field	6,578.4	6,962.3	383.9	5.84
10	Other	10,699.6	9,101.1	-1,598.5	-14.94

After 10 years, the area of each forest and land type had changed considerably, as can easily be seen from the above table. Generally, the forested area and areas with industrial trees & fruit trees increased, and the areas with bushes & scattered trees and sw idden land decreased. Paddy fields and terrace fields also increased.

- The forested area increased with 15,280 ha, expanding by more than 50% compared since 1989. This was an average increase of 1,528 ha/year, or 5 %/year, of which.
 - + Planted forest increased by 10,195 ha, which is almost a 7 fold increase during the 10 years.

+ Natural forest increased to 5,085 ha, or 54.9 % of the total, compared to that of 1989. This includes timber forest increasing to 2,617.3 ha, and bamboo forest to 2,467.8 ha.

1. Industrial trees and fruit trees increased considerably (with 2,805 ha), including species such as tea, orange, plum, mandarin, leeches, and longan.
2. A fact worth mentioning is that forest gardens were introduced and have become popular in the 5 provinces. There are 200 ha of forest garden in the 20 communes, the main species being palm, bamboo, eucalyptus, mixed cassava, and custard apple in Phu Tho, Mangletia, Acacia, Cinnamon, tea, and cassava in Yen Bai, and Mangletia, jack fruit, Cinnamon, papaya, rice and fish pond production in Lao Cai.
3. The area of bushes & scattered trees decreased the most, with a reduction of 12,680 ha.
4. Managers will be pleased that paddy rice fields and terrace field production is increasing. Sw idden land is decreasing, particularly, rotated sw idden with 2,263.2 ha (57.38 %) since 1989.

Changes of main vegetation in the provinces

Of the 20 communes surveyed in the 5 provinces, two are located in Lao Cai and two in Phu Tho. Yen Bai and Tuyen Quang are represented by six communes, and Ha Giang with four communes. The changes have been calculated for each province as follows:

Table 5. Change in main vegetation types within the province

Unit: ha

	LC	TQ	HG	YB	PT	Sum	Notes
Natural timber forest	735.4	194.5	925.6	410.6	351.5	2,617.6	(+):
Natural Bamboo forest	324.3	36.1	1,875	47	185.1	2,467.8	increased
Planted Forest	171.5	5,254.1	593.2	3180.9	995.1	10,194.5	
Forest garden	2.1	25.1	0	154.7	13.2	195.1	
Industrial trees and LT fruit trees	0	705.5	1238.4	844.8	16.5	2,805.2	(-):
Bushes and scattered Trees	-1789.9	-3955.0	-3414.4	-3219	-302.1	-12,680.4	Decreased
Total	-556.4	2,260.3	1,217.8	1,419	1,259.3	5,599.8	

Due to the different number of communes selected (and hence different size of areas surveyed) in the provinces, it is not possible to directly compare the changes of forest and vegetation among the provinces by looking at area coverage. Therefore, the relative value has to be used for comparison.

Table 6. Changes of main vegetation 1989-1999 in the communes (divided by provinces)

Unit: %

Forest and land types	Lao Cai (2 com.)	Tuyen Quang (6 com.)	Ha Giang (4 com.)	Yen Bai (6 com.)	Phu Tho (2 com.)	Total area (20 com.)
Survey area (Ha)	6,236	18,217	16,597	11,859	5,239	58,148
Vegetation cover	-11.08	26.06	10.48	30.34	62.64	17.50
Natural timber forest	79.62	31.64	58.67	199.22	33.89	60.05
Natural bamboo forest	*	6.28	44.11	63.77	*	50.34
Planted forest	*	1,066.82	117.54	719.17	2,935.40	691.92
Forest garden	*	*	*	*	*	*
Industrial trees and LT fruit trees	*	91.83	238.34	277.35	20.25	167.57
Bushes and scattered trees	-43.69	-63.58	-71.63	-88.19	-35.19	-64.72

Notes: (*) not calculated as it did not exist in 1989.
 (-) Decreasing
 (without mark = increasing)

Relative values in the above table show that:

- The total vegetation cover in the 2 communes in Lao Cai decreased (Tả Phìn, Trung Chải in Sa Pa). It is increasing in the rest of the communes.
- The area of forest types in all the communes are increasing, especially planted forests. Planted forests are increasing at a fast rate in Tuyen Quang and Phu Tho.
- The area of natural forest (timber and bamboo) is increasing fastest in Yen Bai, followed by Lao Cai and then Ha Giang.
- The area of bushes and scattered trees in all communes is decreasing. The greatest reductions are in Yen Bai, Ha Giang, and Tuyen Quang. These are the main vegetation types being transferred to other uses.
- The total vegetation cover in the 2 communes in Lao Cai is decreasing, but the area of timber forest is growing considerably, at the same speed as in other provinces.

2.3.3 Changes of forest and land types inside and outside project communes

Changes of forest and land types inside and outside project communes, in the 5 provinces

Table 7. Changes of forest and land types between 1989-1998 in the two areas

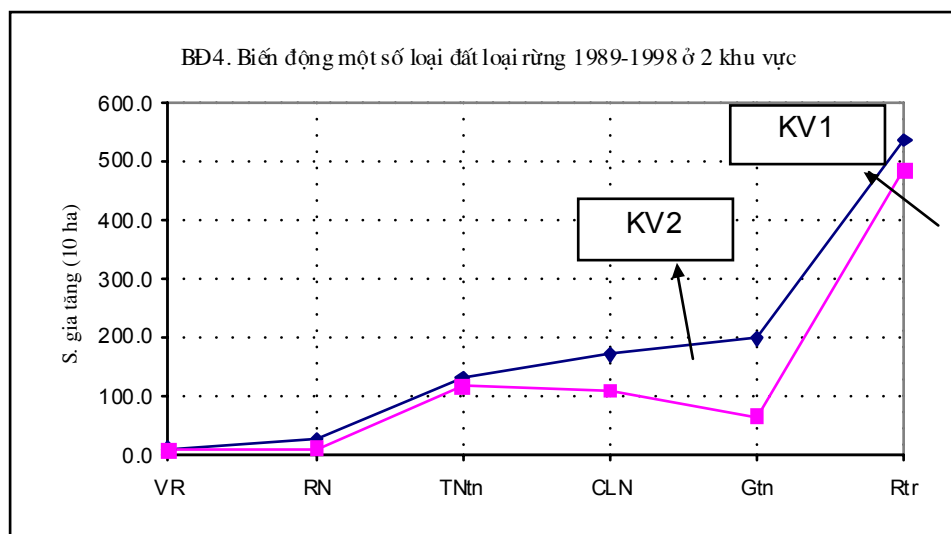
Unit: ha

Forest and land types (1)	Inside the project area			Outside the project area			Compar ed $\Delta_1 - \Delta_2$ (8)=(4)- (7)
	1989 (2)	1998 (3)	Δ_1 (4) = (3)- (2)	1989 (5)	1998 (6)	Δ_2 (7) = (6 - (5)	
Total natural area	29,123	29,123		29,025	29,025		
Natural timber forest	1,879.6	3,847.5	1,967.9	2,478.6	3,128	649.4	1,318.5
Natural bamboo forest	1,246	2,538.2	1,292.2	3,656.1	4,831.7	1,175.6	116.6
Planted forest	1,182.1	6,544.2	5,362.1	291.3	5,124.0	4,832.7	529.4
Forest garden		116.6	116.6		78.5	78.5	38.1
Industrial trees and LT fruit trees	1,331.3	3,037.4	1,706.1	342.7	1,441.8	1,099.1	607
Bushes and scattered trees	11,775.4	4,055.7	-7,719.7	7,817.4	2,856.7	-4,960.7	-2,759
Fixed sw idden land	2,133.4	1,547.8	-585.6	2,792	1,255.6	-1,536.4	950.8
Rotated sw idden land	1,893.0	713.9	-1,179.1	2,051.1	967	-1,084.1	-95.0
Rice field	3,393.3	3,675.7	282.4	3,185.1	3,286.6	101.5	180.9
Other	4,288.9	3,046	-1,242.9	6,410.7	6,055.1	-355.6	-887.3

The following conclusions can be made:

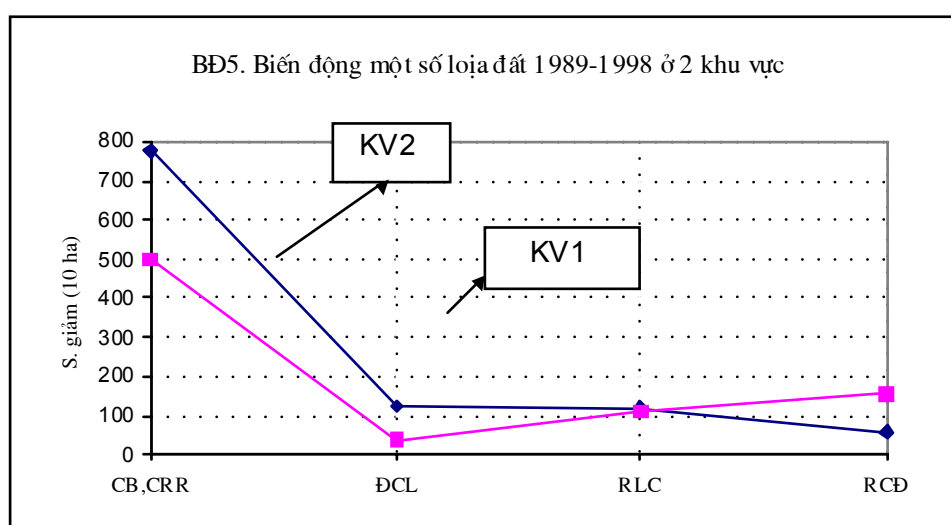
- The forest areas (natural timber forest, natural bamboo forest, planted forest), forest gardens, industrial trees and LT fruit trees are increasing both inside and outside the project area. Within the project area (KV1) it is rising at a faster rate than in non-project areas (KV2). This is particularly noticeable for the growth in the area of natural timber forest, industrial trees and LT fruit trees. Industrial trees and long-term fruit trees will generate income for the people and mean less forest destruction for farming purpose. This is very much in line with the results of the study in the northern part of the central plateau, which show the expansion of long-term industrial crops and a reduction of sw idden land area.
- The area of paddy rice field and terrace field in KV1 is also increasing more than in KV2.

This is also illustrated in the diagram below :



Notes: VR: Forest garden
 RN: Paddy field
 TNtn: Natural bamboo forest
 CLN: Industrial and long-term fruit trees
 Gtn: Natural timber forest
 Rtr: Planted forest

- The area of bushes and scattered trees, and rotated swidden land in the remaining area of KV1 is decreasing considerably when comparing them with those in KV2
- Fixed swidden land in KV1 is decreasing less than in KV2. This can be seen in the diagram below :



Notes: CB, CRR: Bushes and scattered trees
 RLC: Rotated sw idden land
 RCĐ: Fixed sw idden land
 ĐCL: Remaining land

Changes in area of forest and land types in project and non-project areas for each province

In this section the changes in different vegetation categories will be examined more in detail.

Changes of forest, forest garden, industrial crops and fruit trees

The survey data for area of forest (natural forest and planted forest), forest garden, industrial crops and long-term fruit trees in the two periods show that;

- The total area of these types in the project areas is increasing at a faster rate than in non-project areas in the provinces of Lao Cai, Yên Bái, Hà Giang, and Phó Thă. But the total area of forest vegetation is less than in Tuyen Quang
- The opposite is true in Tuy^an Quang.

Table 8. Total area of forest, forest garden, industrial trees and long-term fruit trees in and outside the project area.

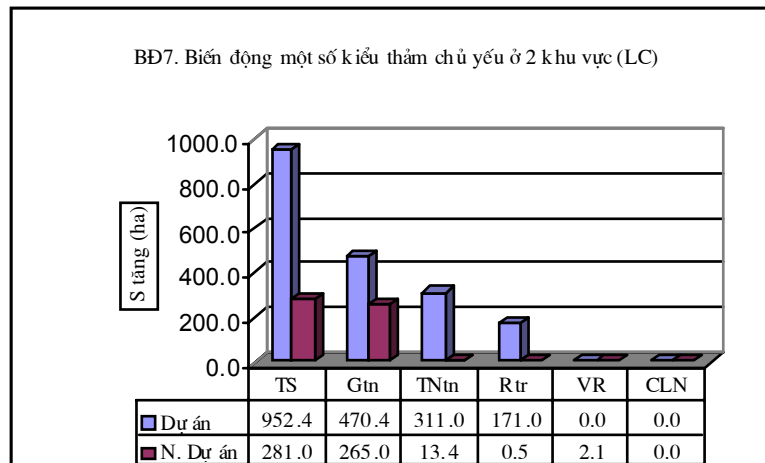
Unit: ha

Province	Inside the project area			Outside the project area		
	1989	1998	Increased	1989	1998	Increased
Lao Cai	412.8	1,365.2	952.4	510.8	791.8	281
Tuyen Quang	1,161	4,084.8	2,923.8	1,292.1	4,583.8	3,291.7
Hà Giang	2,787	5,548.7	2,761.7	4065.7	5,936.2	1,870.5
Yên Bái	527	3,327.5	2,800.5	499.7	2,337.2	1,837.5
Phú Thọ	751.2	1,758	1,006.8	400.4	955	554.6

(See details in Appendix)

This can be understood as follows. Tree planting and forest protection have a long tradition in Tuyen Quang with high participation at all levels (villages, communes and districts. Local authority regulations on forest protection and reforestation is more stringently applied than other parts of Vietnam, and forest management together with forestry production activities have been implemented seriously by local institutions. Therefore, wherever the conditions for reforestation have been suitable, it has been undertaken. And wherever natural forest regeneration has been possible the areas have been protected and left to regenerate. On the other hand, the communes surveyed are situated in hilly areas; and the land available for forestry is less than in communes outside the project area.

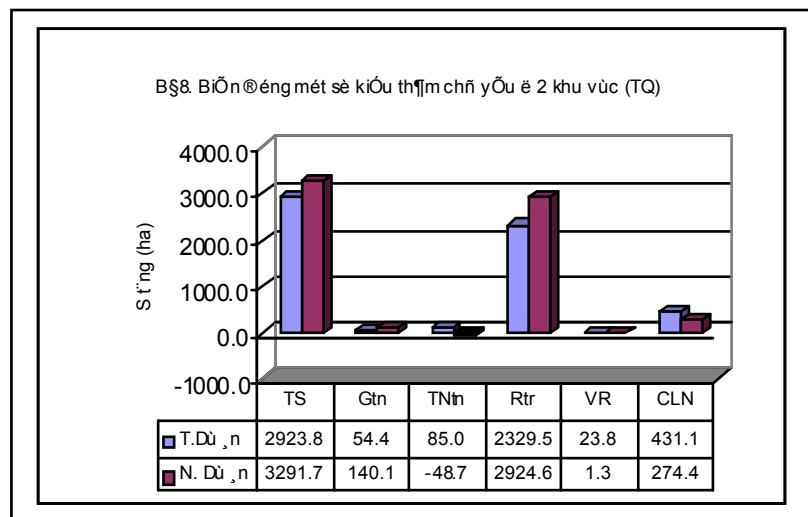
The changes in forests can be seen in the diagram:



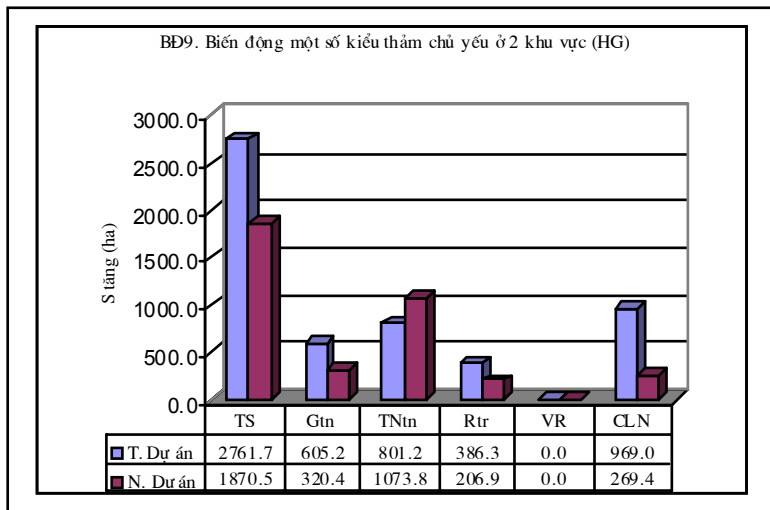
* Notes: TS is the total area of Gtn + TNtn + Rtr + VR + CLN.

Lao Cai: The areas of forest, forest garden, industrial trees and fruit trees in both project and non-project areas are increasing - but more so in the project area.

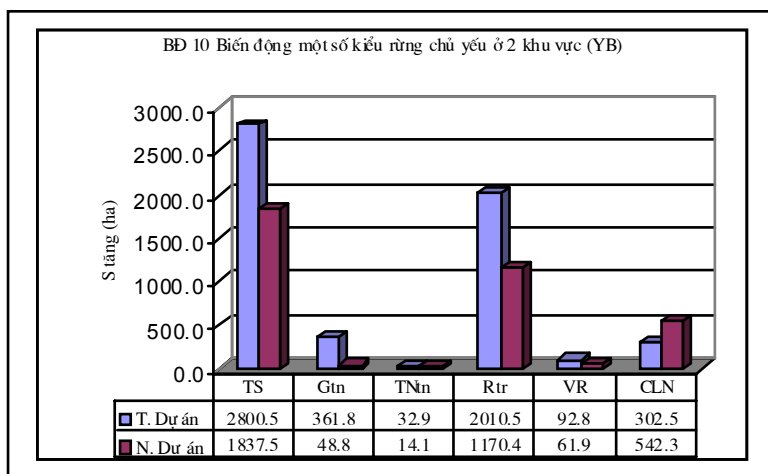
Tuyen Quang: Bamboo forest outside the project area is decreasing in comparison with the past. Timber forest and forest garden in the project area is increasing, but at a similar rate to those in non-project areas. Industrial trees and long-term fruit trees within the project are expanding more than those outside the project area.



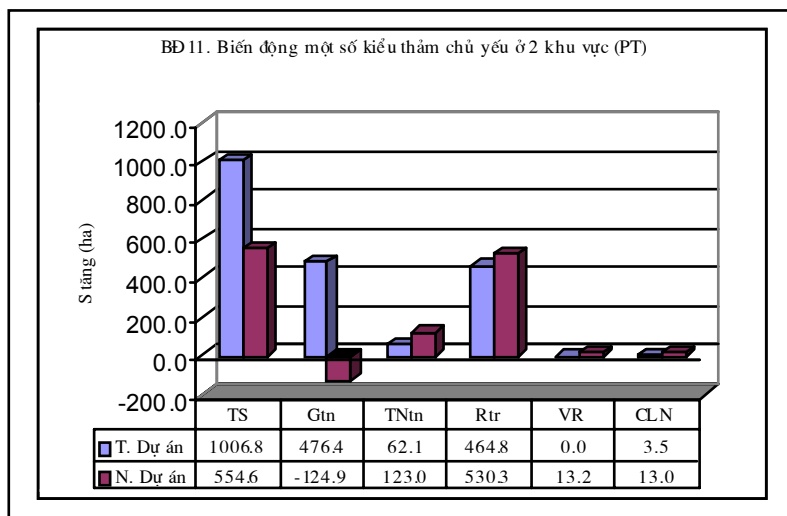
Ha Giang: Bamboo forest outside of the project area is increasing at a faster rate than inside the project communes. Other vegetation types are increasing more inside the project area (see the diagram below).



Yen Bai: Almost all types of forest areas are increasing in general, but more so inside the project communes than outside. This is especially true for industrial trees and long-term fruit trees. The details can be seen in the diagram below.



Phu Tho: The area of natural timber forest inside the project communes is expanding the most. Bamboo forest, planted forest, and industrial trees are also increasing more in the project areas than outside.



Change in area of bushes & scattered tree, swidden land, and paddyfiels in project and non-project areas

In contrast to the area of forests, forest garden, industrial trees and fruit trees, the areas of bushes and scattered trees, fixed swidden land, rotated swidden land in both areas are decreasing. Generally, it can be seen to be decreasing more inside the project areas than outside. Paddy field is increasing in both areas.

Table 9. Change in area of bushes and scattered tree, swidden land, paddy field and remaining land in the two areas between 1989-1998

Unit: Ha

Land and forest types	Inside the project area			Outside the project area			Compared
	1989	1999	Δ_1	1989	1999	Δ_2	
(1)	(2)	(3)	(4) = (3) - (2)	(5)	(6)	(7) = (6) - (5)	(8) = (4) - (7)
Total natural area	29,123	29,123		29,025	29,025		
Bushes and scattered trees	11,775.4	4,055.7	-7,719.7	7,817.4	2,856.7	-4,960.7	-2,759
Fixed swidden land	2,133.4	1,547.8	-585.6	2,792	1255.6	-1536.4	950.8
Rotated swidden land	1,893.0	713.9	-1,179.1	2,051.1	967	-1084.1	-95
Paddy field	3,393.3	3,675.7	282.4	3,185.1	3,286.6	101.5	180.9
Other	4,288.9	3,046	-1,242.9	6,410.7	6,055.1	-355.6	-887.3

2.4 Transfer between different vegetation types

As presented in chapter 3 above, between 1989 and 1999, forests and vegetation were changing very quickly. For each vegetation type there was changes in both directions, both increases and decreases. It is possible to conclude that the vegetation types and the land use is not static, but continuously changing.

2.4.1 Transfer between different vegetation types

Positive and negative tendencies are continuously and simultaneously taking place in all areas in this dynamic process. Vegetation types are being transformed through the impact of natural, social and economic factors. The impact of natural factors upon forests takes place very slowly, whereas the consequences of social and economic activity upon the forest are considerable both in terms of quality and quantity. The impact of human activity upon the environment can be both positive and negative. The development of forests will depend upon policy and implementation decisions.

In the hot and humid climate of the northern provinces, barren areas with the scattered trees regenerates very quickly (about 5-7 years), if the areas are properly protected – i.e if trees are not cut down and/or the land used for farming, fruit plantation or industrial plantation. This is evidenced in Tuyen Quang, Yen Bái, and Lao Cai. In the above provinces, several natural forest areas have regenerated, and in Tuyen Quang from 1991 to 1997 over 60,000 ha of forest have been rehabilitated.

The 5 provinces in the north of Vietnam are home to many ethnic minority communities who traditionally practise shifting cultivation. Shifting cultivation is practised in different types of vegetation. The extent and impact of shifting cultivation will depend on the location, population and farming techniques, as well as on the management

capacity of e.g. local authorities. Therefore, the area of forest and land types has also altered in diverse ways.

With the degeneration of forests and the associated environmental and livelihood problems, many mountain rural development projects have been active in the 5 provinces. Land is an important asset for the production of e.g. forest, industrial and fruit trees by farmers. The areas planted must have good soil with a high nutrient content and also be close to settlements, to ensure a successful outcome. It could be land under bush vegetation with scattered trees, bamboo forest or under timber forest or the remains of swidden land. Specific conditions of the exact location are the most important factor, as the areas of forest and land types are all different.

Timber and wood for fuel are basic demands of people in the mountainous areas. The needs of one family is not great, but the cumulative effects of many communities and over long period of time, will alter the status of forest and vegetation in an area. The extent of vegetation cover change is also dependent upon the rehabilitation capacity of natural forest and vegetation, both through natural processes and human intervention.

These activities occur continuously in all areas. This has complicated the collection of data detailing the change in forest and land types. It is therefore difficult to clearly and accurately quantify the alterations over time.

The results of the calculations of the changes in forest and land types between 1989-1999 are as follow :

Table 10. Transfer of forest and land types between 1989-1999

Unit: ha

1999 1989	natural timber	Bamboo forest	Planted forest	Forest garden	Industr. Fruit trees	Bushes, scattere d trees	Fixed swidden land	Rotated swidden land	Paddy field	other lands	total 1989
Timber	3,361. 3	339.9	67.9	4.5	7.3	299.2	8.9	51.5	12.2	205.5	4,358. 2
Bamboo	131.4	4,174.5	341.3		83.6	97.1	21.0	21.3	3.0	28.9	4,902. 1
Planted	24.4	30.9	1,180. 9	13.7	168.8	8.7	16.3	7.7	3.4	18.6	1,473. 4
F.garde n											0.0
Industr. fruit Trees	1.0	3.8	120.6	4.0	1,405.3	24.1	40.9	6.7	20.9	46.7	1,674. 0
Bushes, scattere d trees	2,448 .7	2,147 .0	6,601. 5	45.0	1,400. 9	4,923. 5	739.8	666.1	324.4	295.9	19,592 .8
Fixed swidden land	188.5	251.6	1,228 6	32.4	739.2	349.9	1,404. 1	203.4	284.9	242.8	4,925. 4
Rotated swidden land	339.2	325.5	1,223 9	25.8	249.7	699.6	316.8	646.1	31.7	85.8	3,944. 1
Paddy field	30.7	17.5	12.3	0.5	33.1	37.5	124.0	2.6	6,139.0	181.2	6,578. 4
Other lands	450.3	79.2	891.2	69.2	391.3	472.8	131.6	75.5	142.8	7,995. 7	10,699 .6
Σ1998	6,975. 5	7,369. 9	1,668.2	195.1	4,479. 2	6,912. 4	2,803. 4	1,680.9	6,962.3	9,101. 1	58,148

The data shown in the above table highlights the complicated changes in forest and land types during the period. There are many reasons why a particular forest category or land type present in 1989, after 10 years had changed to another and vice versa.

During the 10-year time period, the area of natural timber forest available in 1989 had decreased by 996.9 ha by 1998, transferred into other forest categories and land types. Bamboo forest accounted for 339.9 ha (34.1%), planted forest 67.9 ha (6.8%), forest garden 0.5 %, industrial trees and fruit trees 30 %, fixed swidden land 0.9%, rotated swidden land 5.2%, paddy field 1.2%, and other lands 20.6%.

For details of the areas of vegetation types in 1989 that decreased through transfer to other types in the period 1989-1999, see Table 10 and 11.

Table 11. Transfer of area of forest and land types available in 1989 to be reduced due to transferring into another types in 1989-1999

Unit: %

1999 1989	Natural timber	Bambo forest	Planted forest	Forest garden	Industr. Fruit trees	Bushes, scattere trees	Fixed swidde n land	Rotated swidden land	Paddy field	Other lands	Total 1989
Timber		34.1	6.8	0.5	0.7	30.0	0.9	5.2	1.2	20.6	100.0
Bamboo	18.1		46.9	0.0	11.5	13.3	2.9	2.9	0.4	4.0	100.0
Planted	8.3	10.6		4.7	57.7	3.0	5.6	2.6	1.2	6.4	100.0
F.garden											0.0
Industr. fruit trees	0.4	1.4	44.9	1.5		9.0	15.2	2.5	7.8	17.4	100.0
Bushes, scattered trees	16.7	14.6	45.0	0.3	9.5		5.0	4.5	2.2	2.0	100.0
Fixed swidden land	5.4	7.1	34.9	0.9	21.0	9.9		5.8	8.1	6.9	100.0
Rotated swidden land	10.3	9.9	37.1	0.8	7.6	21.2	9.6		1.0	2.6	100.0
Paddy field	7.0	4.0	2.8	0.1	7.5	8.5	28.2	0.6		41.2	100.0
other lands	16.7	2.9	33.0	2.6	14.5	17.5	4.9	2.8	5.3		100.0

In contrast, during the same period of time the total area of natural timber forest rose by 3,614.2 ha, being regenerated from other vegetation categories. Of which, 2,448.7 ha (67.8%) was reclaimed from scattered trees and self-rehabilitated, 339.2 ha (9.4%), from rotated swidden land, 5.2 % from fixed swidden land, and 12.5% from other lands. (For details see Tables 10 and 12.)

Table 12. Area of forest and land types in 1989 supplemented from other species/land uses in the period 1989-1999

Unit: ha

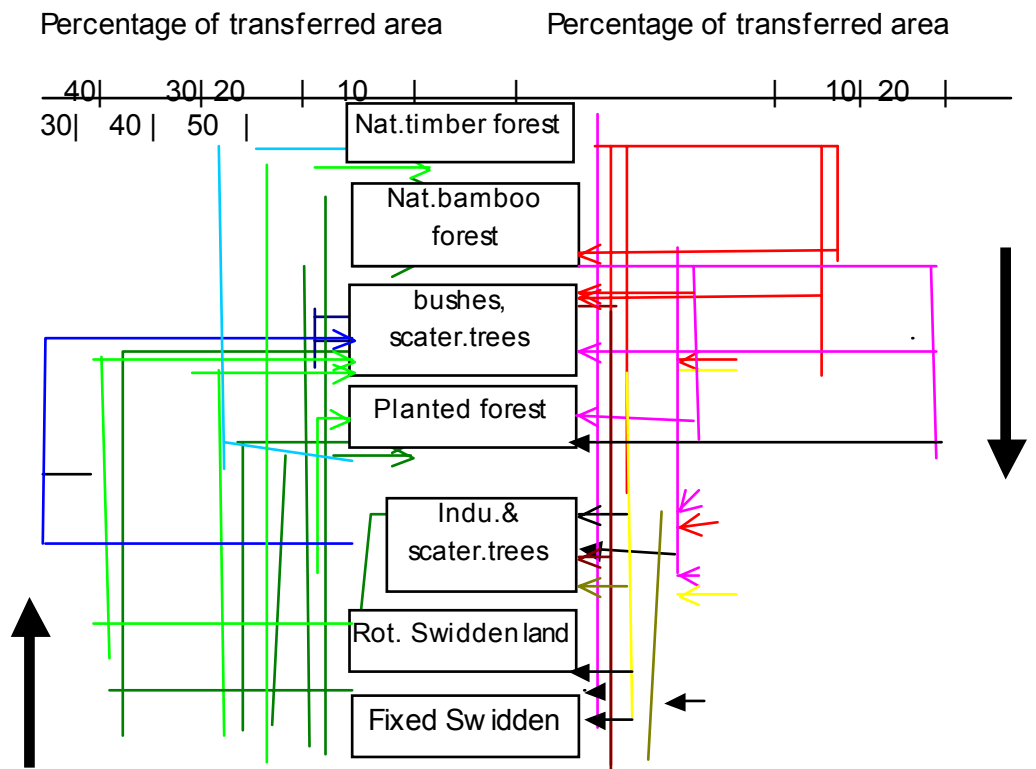
1989	1999	Natural timber	Bamboo forest	Planted forest	Forest garden	Industr. fruit trees	Bushes scattered trees	Fixed swidden land	Rotated swidden land	Paddy field	Other lands
Timber			10.6	0.6	2.3	0.2	15.0	0.6	5.0	1.5	18.6
Bamboo		3.6		3.3	0.0	2.7	4.9	1.5	2.1	0.4	2.6
Planted		0.7	1.0		7.0	5.5	0.4	1.2	0.7	0.4	1.7
F.garden		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Industr. fruit trees		0.0	0.1	1.1	2.1		1.2	2.9	0.6	2.5	4.2
Bushes, scattered trees		67.8	67.2	62.9	23.1	45.6		52.9	64.4	39.4	26.8
Fixed swidden land		5.2	7.9	11.7	16.6	24.0	17.6		19.7	34.6	22.0
Rotated swidden land		9.4	10.2	11.7	13.2	8.1	35.2	22.6		3.9	7.8
Paddy field		0.8	0.5	0.1	0.3	1.1	1.9	8.9	0.3		16.4
Other lands		12.5	2.5	8.5	35.5	12.7	23.8	9.4	7.3	17.3	
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

According to the analysis by the Forest Inventory Planning Institute (FIPI) experts, within the 5 provinces, the capacity for environmental protection (mainly water and soil conservation) of different vegetation and land types are listed as follows (in order of priority):

1. Natural timber forest
2. Natural bamboo forest
3. Bushes and scattered trees
4. Industrial and fruit trees
5. Planted forest
6. Rotated swidden land
7. Fixed swidden land

Through analysis of Tables 10, 11, and 12, the changes and trends - which will affect the environment - can be illustrated as follows:

Relation between vegetation changes and environment



2.4.2 Transfer between vegetation in project and non-project areas

Transfers within the 10 project communes

Table 13. Transfers of forest and land types 1989-199, within the project communes

Unit: ha

1999 1989	Natural timber	Bambod forest	Planted forest	Forest garden	Industr. fruit trees	Bushes, Scattere d trees	Fixed swidden land	Rotated swidden land	Paddy field	Other lands	total 1989
Timber	1,568.4	22.1	20.5			185.4	4.3	27.2	10.5	41.2	1,879.6
Bamboc	0.0	1017.4	93.4		48.6	57.8	5	6.7		17.1	1,246
Planted F.garder	24.4	28.5	924.8	12.3	150.2	4.8	16.3	2.4	1.0	17.4	1,182.1
Industr. fruit trees	1.0	2.4	54.2		1,167	15.9	27.3	4.5	17.0	42.0	1,331.3
Bushes, Scattere d trees	1,704.3	1,293.4	3,712	27.1	889.6	3,016	519.5	249.8	205.1	158.6	11,775. 4
Fixed swidden land	20.2	20.6	535.7	12.5	412.3	69.8	669.0	101.5	173.4	118.4	2,133.4
Rotated swidden land	105.2	73.1	655.1	15.5	96.8	454	152.2	286.2	12.7	42.2	1,893
Paddy field	24.8	17.1	7.2		0.7	21.3	68.4		3,175	78.8	3,393.3
Other lands	399.2	63.6	541.3	49.2	272.2	230.7	85.8	35.6	81	2,530.3	4,288.9
Total	3,847.5	2,538.2	6,544.2	116.6	3,037.4	4,055.7	1,547.8	713.9	3,675.7	3,046.0	29,123

Table 14. Area of forest and land types in the project area, decreased through transfer to other species/land uses between 1989-1999

Unit: %

1999 1989	Natural timber	Bamboo forest	Planted forest	Forest garden	Industr. fruit trees	Bushes, scattered trees	Fixed swidden land	Rotated swidden land	Paddy field	Other lands	total 1989
Timber		7.1	6.6	0.0	0.0	59.6	1.4	8.7	3.4	13.2	100.0
Bamboo	0.0		40.9	0.0	21.3	25.3	2.2	2.9	0.0	7.5	100.0
Planted	9.5	11.1		4.8	58.4	1.9	6.3	0.9	0.4	6.8	100.0
F.garden											0.0
Industr. fruit trees	0.6	1.5	33.0	0.0		9.7	16.6	2.7	10.3	25.6	100.0
Bushes, scattered trees	19.5	14.8	42.4	0.3	10.2		5.9	2.9	2.3	1.8	100.0
Fixed swidden land	1.4	1.4	36.6	0.9	28.2	4.8		6.9	11.8	8.1	100.0
Rotated swidden land	6.5	4.5	40.8	1.0	6.0	28.3	9.5		0.8	2.6	100.0
Paddy field	11.4	7.8	3.3	0.0	0.3	9.8	31.3	0.0		36.1	100.0
Other lands	22.7	3.6	30.8	2.8	15.5	13.1	4.9	2.0	4.6		100.0

Results from calculations of Tables 13, 14, and 15 show the following decreases in forest areas since 1989:

- Timber forest decreased by 311.2 ha, the area being transferred to:
 - + Barren land, scattered trees, and bushes (59.6 %), through harvesting
 - + Rotated swidden land (8.7 %)
 - + Bamboo forest (7.1 %), through harvesting, cultivation and then being left fallow
- Bamboo forest decreased by 228.6 ha, being transferred to:
 - + Planted forest (40.9 %), through cutting down bamboo for reforestation land or cultivating, and then reforestation
 - + Industrial and fruit trees (21.3 %), through cutting down bamboo for reforestation land or cultivation and then reforestation
 - + Bushes (25.3 %), through cultivation and then being left fallow
- Planted forest decreased by 257.3 ha, this area being replaced by:
 - + Industrial and fruit trees (58.4 %), through harvesting and then planting

- + Bamboo forest (11.1 %), through harvesting and then being left fallow
- + Sw idden land (7.2 %)

- Industrial and fruit trees decreased by 164.3 ha, mainly because of low productivity. The demand for food explains why land instead was utilised to produce food crops (29.3 %), whereas plantation land accounted for (33 %), and the remaining area was left fallow .

In contrast, the following increases were found:

- Natural timber forest increased by 2,279 ha of which:
 - + 1,704 ha (74.8 % of the area added) were from the rehabilitation of bush & scattered trees
 - + 575 ha were from other lands and by natural regeneration
- Bamboo forest increased by 1,520.8 ha of which:
 - + 1,293.4 ha were from barren land, bushes and scattered trees
 - + 227.4 ha were from other remaining lands
- Planted forest: 5,619.4 ha recently established from the following land types:
 - + 3,712 ha from barren land, bushes and scattered trees
 - + 1,190.8 ha from leftover sw idden land
 - + 716.6 ha from other remaining lands
- New plantations with industrial and fruit trees totaled 1,870.4 ha , mainly from land which had previously been bushes and scattered trees (889.6 ha), and leftover sw idden land (509.7 ha).

Table 15. The area of forest and land types in the project area supplemented from other types in the period 1989-1998
Unit: %

1998 1989	Natural timber	Bamboo forest	Planted forest	Forest garden	Industr. fruit trees	Bushes, scattered trees	Fixed swidden land	Rotated swidden land	Paddy field	Other lands
Timber		1.5	0.4	0.0	0.0	17.8	0.5	6.4	2.1	8.0
Bamboo	0.0		1.7	0.0	2.6	5.6	0.6	1.6	0.0	3.3
Planted	1.1	1.9		10.5	8.0	0.5	1.9	0.6	0.2	3.4
F.garden	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Industr. fruit trees	0.0	0.2	1.0	0.0		1.5	3.1	1.1	3.4	8.1
Bushes, scattered trees	74.8	85.0	66.1	23.2	47.6		59.1	58.4	41.0	30.8
Fixed swidden land	0.9	1.4	9.5	10.7	22.0	6.7		23.7	34.6	23.0
Rotated swidden land	4.6	4.8	11.7	13.3	5.2	43.7	17.3		2.5	8.2
Paddy field	1.1	1.1	0.1	0.0	0.0	2.0	7.8	0.0		15.3
Other land	17.5	4.2	9.6	42.2	14.6	22.2	9.8	8.3	16.2	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Transfers in the 10 non-project communes

Table 16. Transfer of forest and land types outside the project area between 1989-1999

Unit: ha

1999 1989	Natural timber	Bamboc forest	Planted forest	Forest garden	Industr. fruit trees	Bushes, scattere d trees	Fixed swidden land	Rotated swidden land	Paddy field	Other lands	Total 1989
Timber	1792. 9	317.8	47.4	4.5	7.3	113.8	4.6	24.3	1.7	164.3	2,478. 6
Bamboc	131.4	3157. 1	247. 9		35	39.3	16	14.6	3	11.8	3,656. 1
Planted	0.0	2.4	256. 1	1.4	18.6	3.9	0.0	5.3	2.4	1.2	291.3
F.garder	0.0		0.0							0.0	0.0
Industr. fruit trees	0.0	1.4	66.4	4	238.3	8.2	13.6	2.2	3.9	4.7	342.7
Bushes, scattere d trees	744.4	853.6	2889.5	17.9	511.3	1907. 5	220.3	416.3	119.3	137.3	7,817. 4
Fixed swidden land	168.3	231	692. 9	19.9	326.9	280.1	735.1	101.9	111.5	124.4	2,792. 0
Rotated swidden land	234.0	252.4	568. 8	10.3	152.9	245.6	164.6	359.9	19	43.6	2,051. 1
Paddy field	5.9	0.4	5.1	0.5	32.4	16.2	55.6	2.6	2964	102.4	3,185. 1
Other lands	48	15.6	349. 9	20	119.1	242.1	45.8	39.9	61.8	5,465. 4	6,410. 7
Σ1998	3128	4831. 7	5124	78.5	1441. 8	2856. 7	1255. 6	967	3286. 6	6055. 1	29025

Table 17. Transfer of forest and land in non-project areas and reductions through transfer to other types in the period 1989-1999

Unit: %

1999 1989	Natural timber	Bambo forest	Planted forest	Forest garden	Industr. fruit trees	Bushes, scattere d trees	Fixed swidden land	Rotated swidden land	Paddy field	Other lands	Total
Timber		46.3	6.9	0.7	1.1	16.6	0.7	3.5	0.2	24.0	100.0
Bamboo	26.3		49.7	0.0	7.0	7.9	3.2	2.9	0.6	2.4	100.0
Planted	0.0	6.8		4.0	52.8	11.1	0.0	15.1	6.8	3.4	100.0
F.garden											0.0
Industr. fruit trees	0.0	1.3	63.6	3.8		7.9	13.0	2.1	3.7	4.5	100.0
Bushes, scattered trees	12.6	14.4	48.9	0.3	8.7		3.7	7.0	2.0	2.3	100.0
Fixed swidden land	8.2	11.2	33.7	1.0	15.9	13.6		5.0	5.4	6.0	100.0
Rotated swidden land	13.8	14.9	33.6	0.6	9.0	14.5	9.7		1.1	2.6	100.0
Paddy field	2.7	0.2	2.3	0.2	14.7	7.3	25.1	1.2		46.3	100.0
Other lands	5.1	1.7	37.3	2.1	12.6	25.6	4.8	4.2	6.5		100.0

Tables 16 and 17 show the changes of forest and land types outside the project area.

The area of forest decreased by 1,219.9 ha in 1989, of which:

- Timber forest decreased by 685.7 ha, the land being transformed into:
 - + 113.8 ha became scattered trees, bushes (16.6 % of total area reduction)
 - + 317.8 ha became bamboo forest (46.3 % of total area reduction)
 - + Other remaining land accounted for more than 200 ha (36.9% of total area reduction)
- Bamboo forest decreased by 499 ha, transferred to:
 - + Planted forest grew by 247.9 ha, mainly from the cutting down of bamboo for reforestation land or cultivating and then reforestation
 - + Other remaining land totaled more than 200 ha (50 % of total reduction area)
- Planted forest decreased by 35.2 ha, being converting to industrial and fruit trees

Table 18. The area of forest and land types outside the project area supplemented by other types in the period 1989-1999

Unit: %

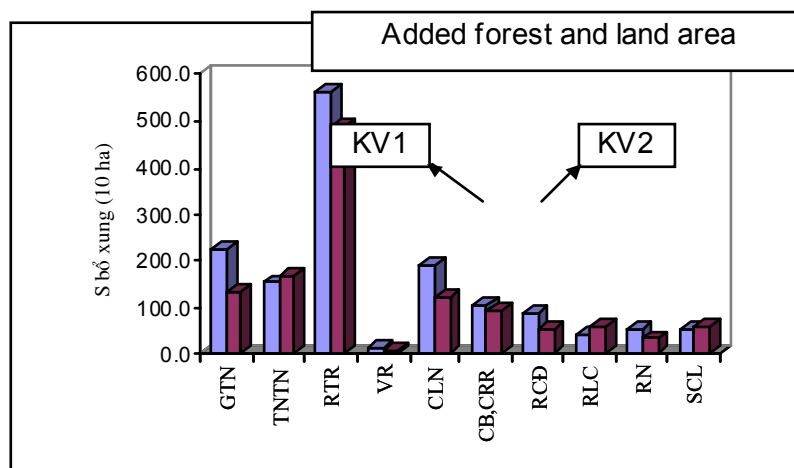
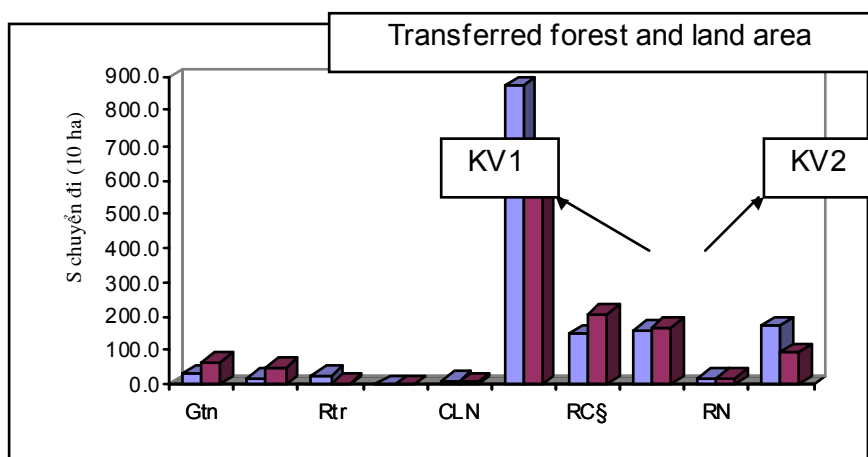
1999 \ 1989	Natural timber	Bamboo forest	Planted forest	Forest garden	Industr. fruit trees	Bushes, scattered trees	Fixed swidden land	Rotated swidden land	Paddy field	Other lands
Timber		19.0	1.0	5.7	0.6	12.0	0.9	4.0	0.5	27.9
Bamboo	9.8		5.1	0.0	2.9	4.1	3.1	2.4	0.9	2.0
Planted	0.0	0.1		1.8	1.5	0.4	0.0	0.9	0.7	0.2
F.garden	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Industr. fruit trees	0.0	0.1	1.4	5.1		0.9	2.6	0.4	1.2	0.8
Bushes, scattered trees	55.8	51.0	59.4	22.8	42.5		42.3	68.6	37.0	23.3
Fixed swidden land	12.6	13.8	14.2	25.4	27.2	29.5		16.8	34.6	21.1
Rotated swidden land	17.5	15.1	11.7	13.1	12.7	25.9	31.6		5.9	7.4
Paddy field	0.4	0.0	0.1	0.6	2.7	1.7	10.7	0.4		17.4
Other land	3.6	0.9	7.2	25.5	9.9	25.5	8.8	6.6	19.2	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

During this time the area of forest increased by 7,877.6 ha, as follows (see Tables 16 and 18):

- Timber forest grew by 1,335.1 ha, the land being rehabilitated from:
 - + Barren land, scattered trees, bushes - 744.4 ha (55.8 %)
 - + Leftover swidden land - 402 ha (30.1 %)
 - + Other lands 188.7 ha
- Bamboo forest grew by 1,674.6 ha, the land being recovered from:
 - + Barren land, scattered trees and bushes - 853.6 ha (51 %)
 - + Leftover swidden land - 483.4 ha (28.9 %)
 - + Timber and other lands - 337.6 ha

To compare the changes of forest and land types in project and non-project areas, see the tables 19 and the diagram below :

Forest and land types	Lost area (ha)		Added area (ha)	
	Inside the project area	Outside the project area	Inside the project area	Outside the project area
Natural area	29,123.0	29,025.0		
Natural Timber forest	311.2	685.7	2,279.1	1,335.1
Natural Bamboo forest	228.6	499.0	1,520.8	1,674.6
Planted forest	257.3	35.2	5,619.4	4,867.9
Forest .garden	0.0	0.0	116.6	78.5
Industrial and fruit trees	164.3	104.4	1,870.4	1,203.5
Bushes, scattered trees	8,759.4	5,909.9	1,039.7	949.2
Fixed sw idden land	1,464.4	2,056.9	878.8	520.5
Rotated sw idden land	1,606.8	1,691.2	427.7	607.1
Paddy field	218.3	221.1	500.7	322.6
Other	1,758.6	945.3	515.7	589.7



From the information in Table 19 and the two diagrams, it can be seen that there are positive and negative changes occurring between 1989 and 1999:

- In the 10 year period, the area of forest (including natural forest and planted forest) both within and outside MRDP-supported communes areas, generally increased, even if some forest areas also were lost:
 - + Forest area in the project area fell by 797.1 ha, compared with 1220 ha in non-project areas
 - + The area of forest that was added in the project area was 9,419 ha compared with 6368 ha in non-project areas
- The area of forest garden in the project area was 116.6 ha, compared to 78,5 ha outside.
- The area of industrial and fruit trees decreased more in the project area, but there have also been more hectares planted. Up to the present time, this area is 3,037.4 ha, and in non-project areas 1,441.8 ha.
- The area of barren land, bushes and scattered trees in the project area is decreasing at a faster rate when compared with those in non-project areas. This is the vegetation type where land use changes occur most frequently; for reforestation, industrial plantation, fruit trees, forest garden and a large area for forest rehabilitation.

Part 3. Conclusion and recommendations

3.1 Conclusion

1. In 1999, in the 20 communes that were surveyed, there were 26,013.6 ha of forest (or 44.74 % of total natural area). Natural forest accounted for 14,345.4 ha and planted forest for 11,668.2 ha. If forest garden, industrial and fruit trees were included the area would be 30,687.9 ha (52.78 % of total natural area).
2. The vegetation cover (including natural timber forest, planted forest, long-term industrial trees, forest garden, and bushes & scattered trees), excluding short-term agriculture crops, was 37,600.3 ha (60.46 % of total natural area).
 - Natural vegetation cover (natural forest, bushes & scattered trees) was 21,257.8 ha (36.55 % of total natural area)
 - Man made vegetation (planted forest, long-term industrial and fruit trees) was 16,342.5 ha (28.11% of total natural area)
3. In 1999, in the 20 communes there were 195.1 forest gardens. The main species are Mangletia, Eucalyptus, palm, bamboo and some fruit and industrial species such as custard apple, plum, peach, orange, mandarin, and tea. Some farms were established to produce forest, agriculture, aquacultural products.
4. In the survey area there were 4,479.2 ha of industrial and fruit trees mainly, plum, orange, mandarin, and tea.
5. During the 10 year time period the forest area increased with 15,280 ha - an increase of more than 50 %.. The average annual increase of forest area was 1,528 ha/year or 5 %/year.
 - Planted forest was 10,195 ha, a seven fold increase of the amount in 1989
 - Natural forest increased by 5,085 ha (54.9 % compared with the amount in 1989).
6. The area of forest in the project communes increased more than in non-project areas - increasing by 860 ha/year in the project area and 666 ha/year outside the project area.
7. The increase in area of forest garden in the project area is 11.6 ha/year, and 8 ha/year in non-project areas.
8. The area of industrial and fruit trees and forest gardens in the project area is growing by 170 ha /year, outside the project area at 110 ha /year. A similar situation exists for paddy field, growing

by 28 ha /year in project areas and by 18 ha /year in non-project areas.

9. In the 10 years from 1989 to 1999, the area of existing forest decreased by 2,017 ha in total, of which 797 ha in the project area, and 1220 in the surveyed non-project communes. The area of forest increased by 17,297 ha in total (through new plantation and natural rehabilitation) of which 9,419 ha were in project areas, and 7,878 ha in non-project areas.
10. The natural timber forest available in 1989 decreased more than the other forest types (with in total 997 ha – or 49.4 % of total reduction area). This area has mainly been transformed into bamboo forest and bushes
11. The area of planted forest was increasing at a very fast rate.
12. The barren land with scattered trees and bushes was where the greatest vegetation changes were taking place. The major changes being for reforestation, industrial and fruit trees, forest gardens and considerable part being naturally regenerated.

3.2 Recommendation

Through the integrated effects of the work being carried out in the northern provinces as resulted in several changes, including improved living conditions of the people in rural mountainous areas and increased awareness. This has resulted in the quick development of forest coverage, especially of planted forests. The results of the study is based on a calculations from a limited. Further, it is a possibility that many of the newly established plantations could easily be overgrown with grass or by destroyed by forest fires. To maintain the existing forest area, these following recommendations need to adhered to:

- Continued investment should be made to forestry extension programmes in order to increase knowledge of people on intensive agriculture and forestry production in the area
- Priority should be given to natural regeneration rather than new planting programmes
- Loan should be given by the government to pay for:
 - + Protection of existing forest areas
 - + Establishment of industrial and fruit trees, and for intensive rice production. This will be the main source of income for the people and the forest will be protected as pressure upon them is reduced.
 - + Diversified production
- The repayment period should depend upon species, but generally, they should extend up to the harvesting time.
- Periodical checks and monitoring should be undertaken, so that adjustments of technical advice can be made increasingly suitable

for local field conditions. This will enhance the effectiveness of agriculture and forestry.