

3.7 Methods for specifying areas for forest operations

Following the rules of forest management described in the previous section, target areas for operation have been estimated for each forest management body by applying specific macroscopic analyses of forests in the Study Area. The estimation has been obtained solely from macroscopic analyses, therefore the precise allocation of land, e.g. to paddy field establishment support, agroforestry support and the protection of water resources for daily use in the Villager Support Program should be determined at the stage of discussions for management plans with the respective management entities, following the principles of the estimation method shown here, after a full assessment of specific communities or actually used paddy fields or upland fields, or grasslands left unmanaged.

The essential points of the process and results of this estimation process are shown below. The detailed estimation work and results are shown in Volume III. 16.

(1) Forests for which watershed conservation, soil conservation and land conservation should be taken into consideration

The objective of conducting sound forest operations while at the same time considering water resources, and soil and land conservation will be fulfilled by specifying places where logging is likely to produce negative impacts on these functions, and by avoiding logging in such places. In the case of a forest assumed to be in a near climax state, the forest itself is thought to be the most appropriate vegetation cover for that location. Differences in forest quality can reflect differences in the underlying soils. Accordingly, in cases where the forest cover is eliminated, the degree of impact which results is inextricably bound up with the local conditions.

In this paragraph, negative impacts on such forest functions produced by logging are evaluated to identify forests where logging should be avoided. The forest functions are evaluated by the mesh analysis method. On a topographic map of 1:50,000 scale, a 1 cm mesh is drawn, and for every mesh square, the number of contours (inclination) in the square, the number of streams crossing four sides of the square (topographical complexity) and topographic division are recorded, and then from the set of these three factors, negative effects on water resources and on the conservation of soil and land are evaluated, and ultimately, places where caution should be exercised in logging operations are determined in view of these three functions.

The results of this comprehensive evaluation show that areas without steep contours but with a finely corrugated topography require greater care than areas of generally steep country but a less finely corrugated terrain, or a single flat area with no small streams. In the entire Kon Plong District, there are many steep places under the jurisdiction of the Thach Nham Protection Forest Management Committee for adjoining Quang Ngai Province, although in general they are not finely corrugated in

topographical terms. On the other hand, in the areas of Mang Canh I & II FEs, there are comparatively less steep, finely corrugated areas with many streams, and relatively many meshes (grid squares) have been given a high score. Figure I-3.7.1 and Table I-3.7.1 show the distribution of areas by management unit requiring special consideration in the forestry operation based on the result of the comprehensive evaluation.

From the analysis above, forest stands where logging should be avoided and which should be excluded from the target forest stands for ordinary logging are estimated to amount to about 12,800 ha in the entire Kon Plong District. Although, if limited to the areas under the jurisdiction of the FEs who are planning actual timber production, about 3,900 ha will be excluded from management forests where logging and harvesting are planned.

Among these data, the forest areas with high stand volumes suitable for logging are shown in Table I-3.7.2 for each forest management body. Because logging is planned only in areas under the jurisdiction of the FEs, forests with high stand volumes excluded from the target areas for logging for reasons of water, soil and land conservation within the FE areas have been estimated at 3,900 ha in total. About 1,000 ha of grasslands are included, for which afforestation plans or the Villager Support Program are expected to be given a high priority and result in the recovery of vegetation.

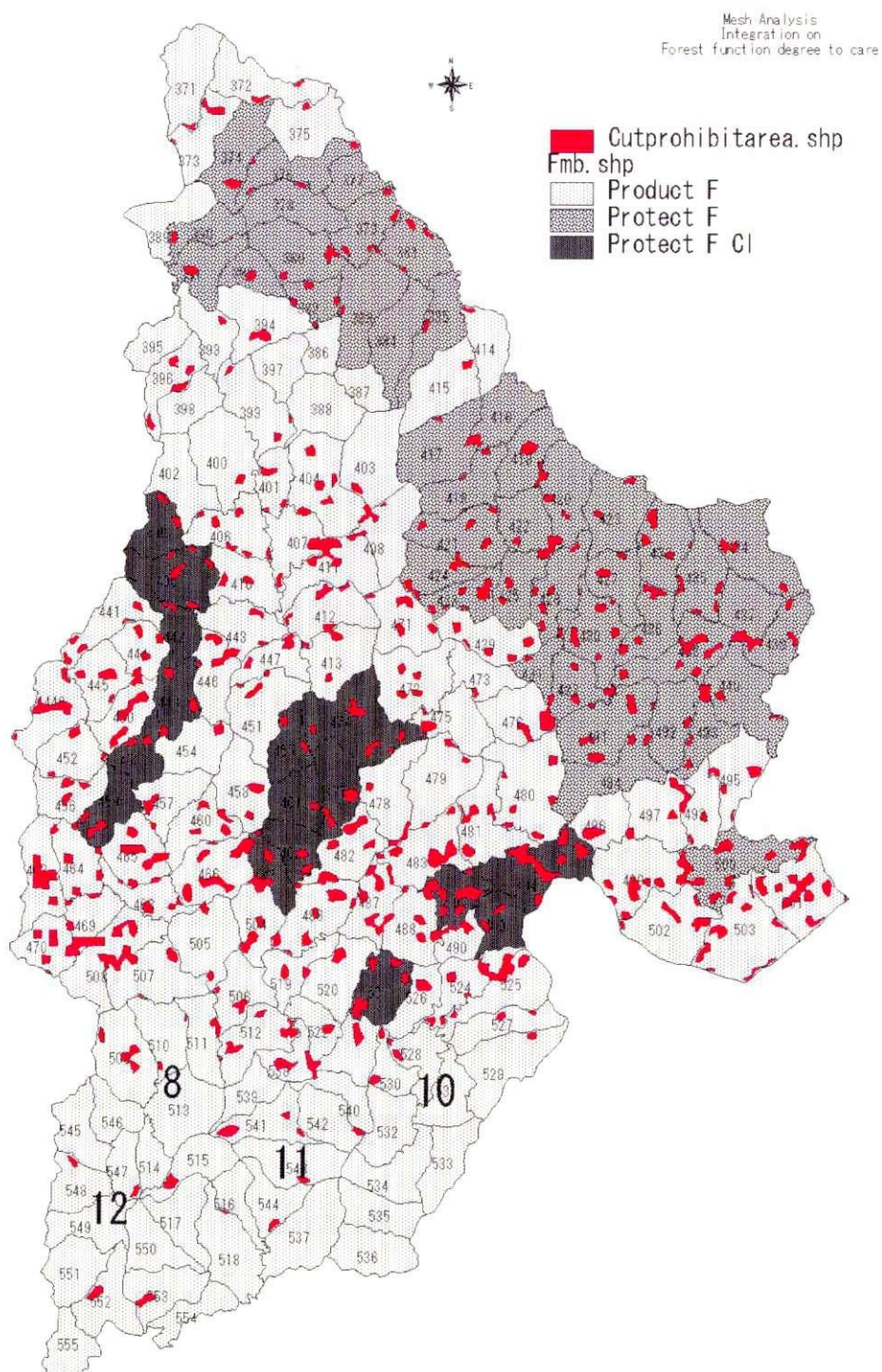


Figure I-3.7.1 Location of places prohibited logging for watershed, soil and land conservation by management body and forest classification

Table I-3.7.1 Area of places prohibited logging for watershed, soil and land conservation by management body and forest classification (unit: ha)

	Protect	Crucial	Product	Total
01PFM Area P Ver.	1,859.85			1,859.85
02Dak Ring C	366.70		76.89	443.59
03Ngoc Tem C			126.34	126.34
04Mang But C		116.30	264.09	380.39
05Dak Koi C		123.47	1,870.14	1,993.61
06Dak Ruong C			829.17	829.17
08Tan Lap C			30.30	30.30
09Dak Tre C			40.36	40.36
10Tan Lap			597.42	597.42
11Mang Canh II		167.46	730.23	897.69
12Mang Canh I		699.29	1,454.52	2,153.80
13Dak Ruong		291.57	798.09	1,089.66
14Mang La	530.52		1,202.07	1,732.59
15Mang Den		117.14	485.72	602.86
Total	2,757.07	1,515.22	8,505.31	12,777.61

Table I-3.7.2 Forest area of FEs excluded from logging operation for forest conservation functions

Management Unit	Production	Primary F	EG Second 1	EG Second 2	Total
10Tan Lap	Product F	288.97	262.99	0.10	552.05
11Mang Canh II	Product F	167.93	281.46	30.92	480.31
12Mang Canh I	Product F	131.65	380.57	0.74	512.96
13Dak Ruong	Product F	103.72	195.11	7.67	306.50
14Mang La	Product F	495.30	642.03	11.30	1,148.63
15Mang Den	Product F	148.39	15.79	96.25	260.43
Sub total		1,335.95	1,777.96	146.97	3,260.89
11Mang Canh II	Protect F Cr	88.92	39.27	7.60	135.79
12Mang Canh I	Protect F Cr	159.66	68.53	59.17	287.36
13Dak Ruong	Protect F Cr	39.22	88.84	46.54	174.60
15Mang Den	Protect F Cr	0.00	1.70	41.92	43.61
Sub total		287.80	198.34	155.22	641.36
Grand Total		1,623.75	1,976.30	302.20	3,902.25

(2) Steep areas difficult for logging operation

In steep places, current log hauling techniques will require many skidways and threaten to disturb large areas of the forest floor. Because of this, it is desirable to avoid logging operations in places where the inclination exceeds 30 degrees. Many such steep places are to be found in the Thach Nham protection forest, protection forest managed by Dak Ring Commune, Mang La and Mang Den FE areas. The distribution of steep areas is shown in Figure I-3.7.2, areas for each management body in Table I-3.7.3. Places to be excluded from logging operations will be steep areas within the production forests of the FEs. Areas within this category are limited to about 1,200 ha out of a total of 2,133 ha of steep areas.

Table I-3.7.3 Area excluded from logging operation due to steep slope by forest function classification

Management unit	Total area	Steep area to be excluded from logging operation (ha)			Total	Area (%)
		Product F	Protect F	Protect F Cr		
01PFM Area	33,469		1,372.87		1,372.87	4.1%
02Dak Ring C	23,647	155.72	426.89		582.61	2.5%
03Ngoc Tem C	4,004	204.14			204.14	5.1%
04Mang But C	10,945	3.71			3.71	0.0%
05Dak Koi C	19,381	75.21			75.21	0.4%
06Dak Ruong C	18,148	82.50			82.50	0.5%
07Con Plong C	2,986	18.28			18.28	0.6%
08Tan Lap C	4,263	105.95			105.95	2.5%
09Dak Tre C	11,139	89.97			89.97	0.8%
10Tan Lap	16,123	312.51			312.51	1.9%
11Mang Canh II	13,894	20.61			20.61	0.1%
12Mang Canh I	16,924	35.64			35.64	0.2%
13DaK Ruong	14,266	70.54		48.45	119.00	0.8%
14Mang La	18,055	452.41	333.69		786.10	4.4%
15Mang Den	21,393	904.23		12.53	916.76	4.3%
Total	228,638	2,531.42	2,133.45	60.98	4,725.85	2.1%

Table I-3.7.4 Area of forests excluded from logging operation due to steep slope by forest type

Prod/prot	Primary F	EG Second1	EGSecond2	Total
Protect Cr	5.24	13.15	5.86	24.26
Product F FE	474.74	306.25	385.83	1,166.82
Total	479.98	319.40	391.69	1,191.08
Areas by forest enterprises				
10Tan Lap	133.76	71.54	4.74	210.04
11Mang Canh II	11.03	4.69	0.00	15.72
12Mang Canh I	0.00	5.00	0.00	5.00
13DaK Ruong	1.43	31.53	19.45	52.42
14Mang La	250.10	82.18	63.98	396.26
15Mang Den	78.41	111.32	297.66	487.39
Total	474.74	306.25	385.83	1,166.82

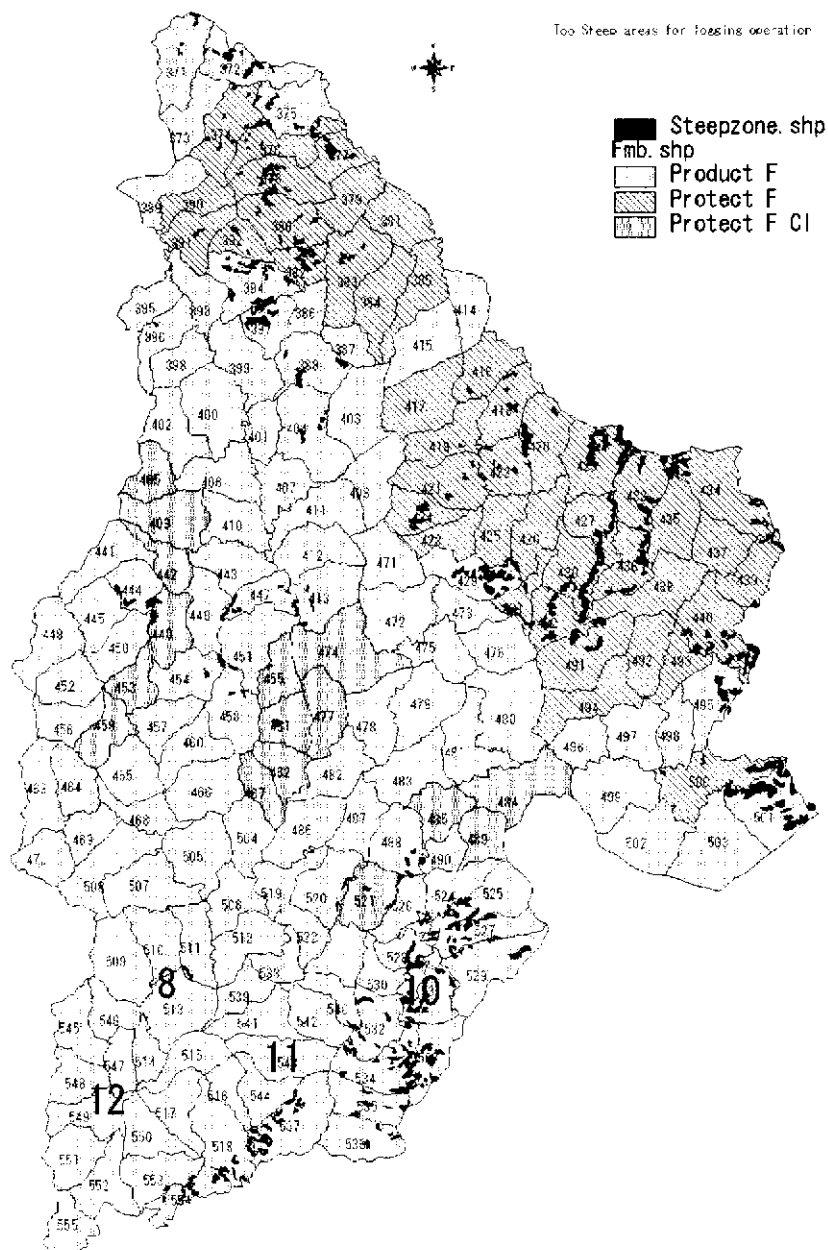


Figure I-3.7.2 Location of places excluded from logging operation due to steep slope

(3) Water source security for local people

Mountainous communities requiring secure water supplies often lack the resources and funds for construction of communal wells. In this situation, villagers have to rely on rivers for daily potable water. They have small paddy fields in valley areas among the mountains, and reliable sources of water for rice cropping are critical for their existence. Forest administrators are constantly involved in administrative activities to identify such communities or secure water supplies for them. The increase in water supplies required for paddy field cultivation in small communities remote from public roads has been estimated. Table I-3.7.5 shows the compiled results for each forest management body. In total, about 3,200 ha of closed natural forest stands have been designated for protection along mountain

streams. As a result, areas available to the FEs' logging operations have been reduced by about 700 ha. This is an approximate figure based on certain assumptions, therefore it is necessary to identify in practice areas and streams which are important for each community and take measures to avoid damage to water supplies during logging operations.

Table I-3.7.5 Required forest area for daily water source in small villages (unit: ha)

Forest management unit	Protect	Hamlet	Hamlet	Needed
		Total	River water	Water reserve
01PFM Area	Protect F	321	218	513.87
02Dak Ring C	Protect F	279	276	650.59
14Mang La	Protect F	127	116	273.44
	Sub total	727	610	1,437.89
04Mang But C	Protect F Cr	9	8	18.86
05Dak Koi C	Protect F Cr	55	0	0.00
11Mang Canh II	Protect F Cr	13	12	28.29
12Mang Canh I	Protect F Cr	110	15	35.36
13DaK Ruong	Protect F Cr	12	12	28.29
15Mang Den	Protect F Cr	11	0	0.00
	Sub total	210	47	110.79
02Dak Ring C	Product F	66	66	155.58
03Ngoc Tem C	Product F	50	50	117.86
04Mang But C	Product F	155	154	363.01
05Dak Koi C	Product F	141	60	141.43
06Dak Ruong C	Product F	342	64	150.86
08Tan Lap C	Product F	58	0	0.00
09Dak Tre C	Product F	129	0	0.00
	Sub total	941	394	928.74
10Tan Lap	Product F	112	111	261.65
11Mang Canh II	Product F	217	52	122.57
12Mang Canh I	Product F	359	61	143.79
13DaK Ruong	Product F	24	3	7.07
14Mang La	Product F	64	28	66.00
15Mang Den	Product F	346	59	139.07
	Sub total	1,122	314	740.16
Total		3,000	1,365	3,217.58

(4) Bio-corridor

The location of the bio-corridor has been proposed in the previous Section 3.3. Bio-corridor area has been selected with the objective of minimizing effects on timber production activities, according to the following principles:

- a. To arrange the bio-corridor through the primary forest zone within existing protected areas as far as possible
- b. In the event that the bio-corridor has to pass through production forest areas, to tie it in as far as possible with forest being excluded from logging for other reasons, e.g. steep topography,

etc.

- c. To avoid positioning bio-corridor in areas of open forests created by human activities, including villages or agricultural land, as far as possible.

The area of natural forests in the bio-corridor and that of forests excluded from logging plans has been calculated through the GIS, with an overlaying of the vegetation map. Table I-3.7.6 and I-3.7.7 show the results. The overall area of the bio-corridor is 14,526 ha. In this area, 5,300 ha of production forests are included. In view of timber production, 3,500 ha of primary forests of Mang La FE and Tan Lap FE are also included.

Table I-3.7.6 Area of bio-corridor by forest management body

Management unit	Product F	Protect F	Total
01PFM Area		5,846.06	5,846.06
02Dak Ring C	490.32	2,534.28	3,024.60
03Ngoc Tem C	603.65		603.65
10Tan Lap	2,575.23		2,575.23
14Mang La	1,630.79	846.37	2,477.16
Total	5,299.99	9,226.71	14,526.70

Table I-3.7.7 Forest area excluded from logging operation due to bio-corridor by forest management body

Management unit	Prod/Prot	Primary	EG S-I	EG S-II	EG-SIII	Others	Total
02Dak Ring C	Product F	291.54	196.98	0.00	0.00	0.00	488.52
03Ngoc Tem C	Product F	183.52	286.19	62.87	12.83	0.00	545.41
10Tan Lap FE	Product F	891.29	922.59	88.24	184.91	296.12	2,383.17
14Mang La FE	Product F	523.22	500.70	38.75	42.58	17.88	1,123.13
01PFM Arca FE	Protect F	1,904.98	2,636.49	360.14	216.32	98.28	5,216.20
02Dak Ring C	Protect F	1,456.01	795.75	110.20	31.48	3.15	2,396.59
14Mang La	Protect F	175.35	423.20	0.00	115.82	0.00	714.38
Total		5,425.92	5,761.90	660.20	603.94	415.43	12,867.39

(5) Target forests for timber production

Based on the rules described in Subsection 3.4.1, commercial logging operations should be conducted by only six FEs and only for forests exceeding a certain stand volume. Accordingly, forests available for logging were identified as: 1) primary forests and evergreen secondary forest I/II (stand volumes of these forests exceed 150 m³ per ha and selective cutting operations are possible); 2) forests other than very crucial protection forests; 3) forests other than those administered by commune personnel in charge of forests; and 4) forests other than those for which special consideration should be taken for the above-stated reasons of watershed, soil and land conservation, areas other than steep places where felling work is difficult, forests other than those necessary for securing water sources for mountain

villages, and forests other than those for bio-corridor. Table I-3.7.9 and Figure I-3.7.4 show the areas by forest stand excluded from target forests for logging operations within high stand volume forests for the reasons outlined above.

As a result, ultimately, target areas for commercial logging have been estimated to be about 44,200 ha for production forest and about 7,400 ha for crucial protection forests (protected forests not defined as very crucial protection forest). Table I-3.7.8 shows the calculation results for each forest type exceeding a stand volume of 150 m³ per ha by the FEs.

Figure I-3.7.3 shows the degrees of impact on the scale of logging operations resulting from the areas excluded from target forest stands, comparing crucial protection forest areas plus entire high stand volume forests in production forest areas with target areas for logging operations.

Table I-3.7.8 Target area for logging operation by forest enterprise

FEs	Prod/prot	Forest area (ha)				Logging area (ha)				Logging rate (%)			
		Primary F	EG Second I	EG Second 2	Total	Primary F	EG Second I	EG Second 2	Total	Primary F	EG Second I	EG Second 2	Total
11Mang Canh II	Protect Cr	1,305	748	80	2,133	1,188	709	73	1,969	91%	95%	91%	92%
12Mang Canh I	Protect Cr	1,412	541	235	2,188	1,217	472	176	1,865	86%	87%	75%	83%
13DaK Ruang	Protect Cr	1,076	1,868	637	3,581	1,003	1,766	585	3,354	93%	95%	92%	94%
15Mang Den	Protect Cr	0	38	210	248	0	36	168	204	-	95%	80%	82%
Sub-Total		3,793	3,195	1,162	8,150	3,408	2,983	1,001	7,393	90%	93%	86%	91%
10Tan Lap	Product F	5,978	7,018	266	13,262	4,412	5,751	173	10,337	74%	82%	65%	78%
11Mang Canh II	Product F	3,191	4,730	714	8,635	2,889	4,444	683	8,016	91%	94%	96%	93%
12Mang Canh I	Product F	2,073	3,739	327	6,138	1,818	3,332	326	5,477	88%	89%	100%	89%
13DaK Ruang	Product F	1,584	2,910	115	4,610	1,479	2,684	88	4,251	93%	92%	77%	92%
14Mang La	Product F	4,626	6,331	287	11,244	3,292	5,106	173	8,571	71%	81%	60%	76%
15Mang Den	Product F	1,727	2,846	3,790	8,362	1,476	2,674	3,356	7,506	85%	94%	89%	90%
Sub-Total		19,179	27,574	5,499	52,252	15,367	23,992	4,799	44,157	80%	87%	87%	85%
Total		22,972	30,769	6,661	60,403	18,775	26,975	5,800	51,550	82%	88%	87%	85%

Table I-3.7.9 Target area for logging operation and excluded area by land use category

	Primary F	EG S-I	EG S-II	Total
Protection forest	17,417	18,864	2,054	38,335
Commune product forest	6,382	13,422	7,488	27,292
Water, soil, land conservation	1,624	1,976	302	3,902
Steep area in production	480	319	392	1,191
Bio-corridor	1,415	1,423	127	2,965
Hamlet water protection	679	75	40	794
Logging operation area total	18,775	26,975	5,800	51,550
Total forest area	46,771	63,055	16,204	126,029

Note: a) The area of 126,029 ha shows the total forest areas fulfilled the criteria for logging (volume /ha, stands size, etc.) as defined three types shown in this table (total area of Kon Plong is 228,646 ha, Table I-2.4.5).

b) The areas of water, soil and land conservation, steep slope, bio-corridor and water source are excluded from areas for protection forests and commune production forest. The area of each column in this table is calculated from previous tables extracting and summing figures on matured forests.

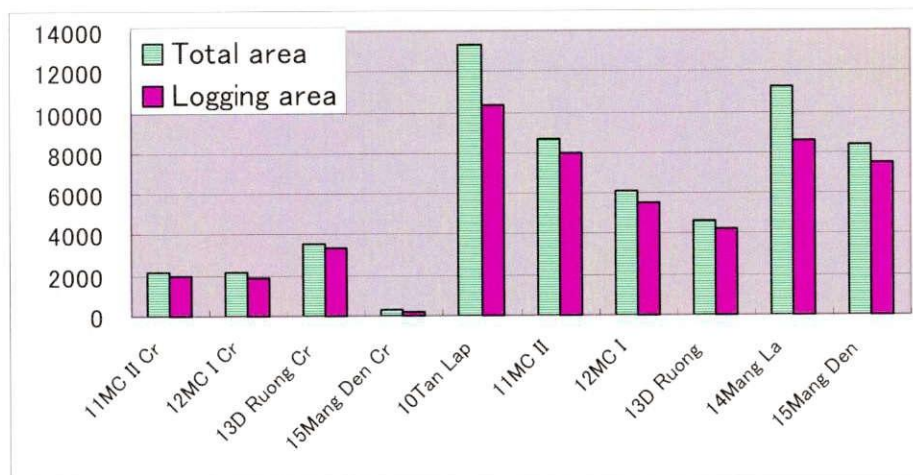


Figure I-3.7.3 Comparison between management area and logging area by forest enterprise

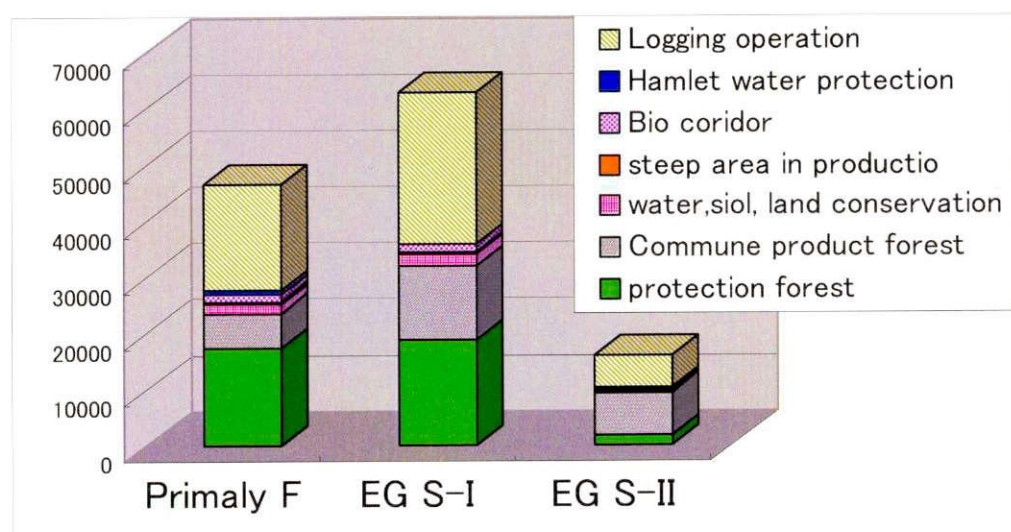


Figure I-3.7.4 Comparison between logging area and other land use category of forest enterprise management area

(6) Target areas for afforestation and natural forest improvement operations

Calculation of the areas involved in afforestation operations proceeds on the assumption that the existing grasslands/bush would be converted as far as possible into highly productive forests according to the principles described in Subsection 3.4.3 above. Firstly, the areas of grasslands and bush will be identified from the GIS database. Then, these grasslands and bush will be divided into primary target areas for the Villager Support Program (assuming that land use rights would be distributed among villagers in some way in future, areas will be divided into forests designated for paddy fields/uplands/lands for agroforestry and those administered by villagers themselves) and other areas (to be restored to forest cover in future). Such divisions are applied to an area within a 1 km radius of the center of the communities taken into the GIS.

As a result, the possible target area for afforestation operations totals 19,000 ha of grassland and 37,000 ha of bush, and among these, the target areas for afforestation or forest stand improvement operations under the authority of the FEs and communes have been calculated to be 8,000 ha of grassland and 19,000 ha of bush (Figure I-3.7.5 and Table I-3.7.10).

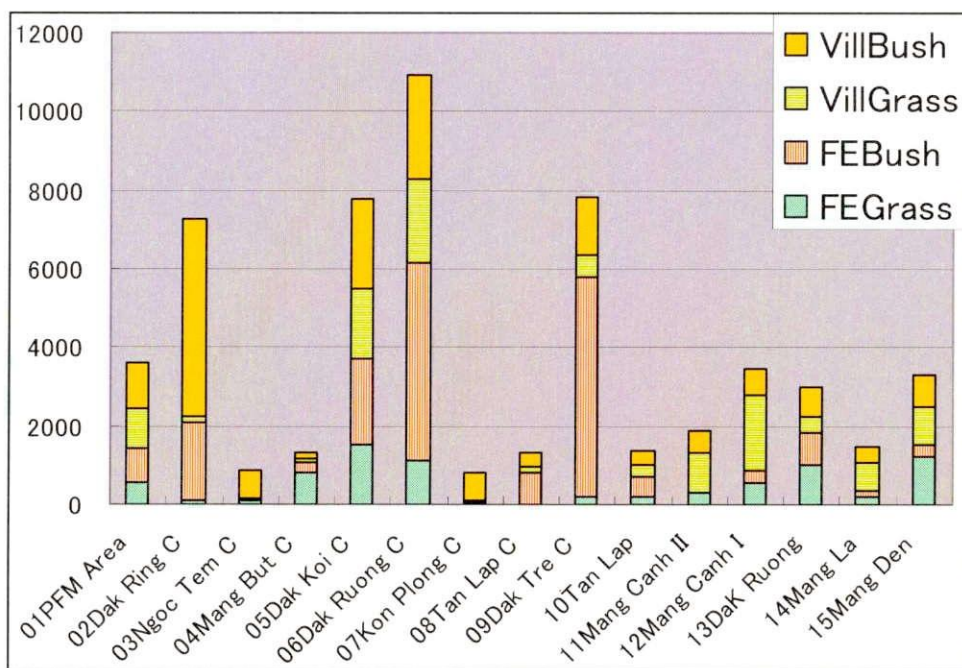


Figure I-3.7.5 Required forest improvement area by forest management body

If such grasslands and bush, spread over the protected forest areas or agricultural areas, are set as the immediate target of an afforestation plan, problems will arise. For this reason, by estimating how much area will be integrated into silviculture plans and how much will be left to natural regeneration in the forest management targets (separately for production forest and protected forest) for the respective afforestation plan zones, and respectively assuming the rate of integration into plans (targets have been set to be 60-80% for grassland and 30% for bush in Zone A Production Forest; for other zones, they are set to be 20-80% for the respective production forest zones and 0-80% for protected forest areas according to the characteristics of the zones and the guidelines for operation), the target areas for afforestation plans have been calculated.

The calculation result showed about 2,800 ha of grasslands available for conversion to forests. Table I-3.7.11 shows the areas of grassland targeted for silviculture by each forest management body. Secondly, the target area for improving existing bush and converting it into productive forests has been estimated to be 7,000 ha. In Zone A, intended for industrial silviculture, 2,040 ha of grasslands and 1,130 ha of bush, (3,200 ha in total) would be targeted for afforestation (for reference, because 5,900 ha is targeted in the industrial afforestation plans within the Villager Support Program, the total area of afforestation sites in Zone A is to be about 9,000 ha). Tables 3.7.13, 3.7.14 and 3.7.15 show these results for each of the respective management bodies' forest operation plan zones.

Table I-3.7.10 Required forest improvement area by forest management body

	FE/Grass	FE/Bush	Vill/Grass	Vill/Bush	Grass total	Bush total
01PFM Area	578.92	864.88	1,019.91	1,127.85	1,598.83	1,992.72
02Dak Ring C	104.06	1,987.58	152.35	5,017.61	256.41	7,005.20
03Ngoc Tem C	77.55	0.00	97.55	700.11	175.10	700.11
04Mang But C	810.86	263.45	114.16	108.18	925.02	371.63
05Dak Koi C	1,502.73	2,216.46	1,767.73	2,294.37	3,270.46	4,510.83
06Dak Ruong C	1,111.97	5,039.37	2,150.00	2,615.51	3,261.97	7,654.88
07Kon Plong C	0.01	42.71	39.40	745.99	39.40	788.71
08Tan Lap C	0.00	829.49	137.50	352.62	137.50	1,182.11
09Dak Tre C	220.60	5,587.96	525.56	1,493.50	746.15	7,081.46
10Tan Lap	218.54	499.28	312.65	367.34	531.19	866.63
11Mang Canh II	301.44	0.00	1,001.46	559.23	1,302.90	559.23
12Mang Canh I	578.15	270.30	1,960.15	667.34	2,538.30	937.64
13DaK Ruong	1,006.19	840.36	409.60	737.57	1,415.79	1,577.93
14Mang La	211.02	147.14	730.52	386.14	941.54	533.28
15Mang Den	1,235.18	273.79	1,001.12	804.87	2,236.29	1,078.66
Total	7,957.21	18,862.77	11,419.65	17,978.24	19,376.86	36,841.00

Table I-3.7.11 Target afforestation area by forest management body

FMU	Plantation on grass land				Plantation on Bush land				Grand total
	Product	PTF Vc	PTF Cr	Total	PDF	PT Vc	PT Cr	Total	
01PFM Area	0.00	38.26	0.00	38.26	0.00			0.00	38.26
02Dak Ring C	8.28	0.00	0.00	8.28	0.00			0.00	8.28
03Ngoc Tem C	30.20	0.00	0.00	30.20	82.99			82.99	113.19
04Mang But C	7.57	0.00	0.00	7.57	359.88		1.28	361.17	368.73
05Dak Koi C	541.71	0.00	0.00	541.71	57.38		607.66	665.04	1,206.76
06Dak Ruong C	511.09	0.00	0.00	511.09	0.00			0.00	511.09
07Kon Plong C	0.00	0.00	0.00	0.00	0.00			0.00	0.00
08Tan Lap C	0.00	0.00	0.00	0.00	0.00			0.00	0.00
09Dak Tre C	176.48	0.00	0.00	176.48	0.00	11.19		11.19	187.66
10Tan Lap FE	28.44	0.00	0.00	28.44	0.00			0.00	28.44
11Mang Canh II FE	105.11	0.00	0.00	105.11	0.00	7.92		7.92	113.03
12Mang Canh I FE	349.55	0.00	0.00	349.55	0.00			0.00	349.55
13DaK Ruong FE	3.53	0.00	0.00	3.53	0.00			0.00	3.53
14Mang La FE	0.00	29.16	0.00	29.16	0.00			0.00	29.16
15Mang Den FE	965.04	0.00	0.00	965.04	0.00			0.00	965.04
Total	2,726.99	67.42	0.00	2,794.42	500.26	19.11	608.94	1,128.32	3,922.73
Total for FEs	1,451.67	29.16	0.00	1,480.83	0.00	7.92	0.00	7.92	1,488.75

Table I-3.7.12 Target areas for reforestation by zone (ha)

Zone	Grass land				Bush land				G total
	Production	Protect Cr	Protect Ver	Total	Production	Protect Cr	Protect Ver	Total	
A	2,040.10	0	0	2,040.10	1,128.32	0	0	1,128.32	3,168.42
B	452.05	0	0	452.05	0	0	0	0	452.05
C	32.29	0	0	32.29	0	0	0	0	32.29
D	0	0	0	0.00	0	0	0	0	0
E	0	39.67	0	39.67	0	0	0	0	39.67
F	67.01	0	0	67.01	0	0	0	0	67.01
G	0	27.75	0	27.75	0	0	0	0	27.75
H	135.55	0	0	135.55	0	0	0	0	135.55
Total	2,726.99	67.42	0	2,794.42	1,128.32	0	0	1,128.32	3,922.74

Table I-3.7.13 Forest operation plan by forest management body

Management unit	Plant/Grass	Plant/Bush	Plant total	Rehabilitation	Natural regeneration
01PFM Area	38.26	0.00	38.26	53.69	554.96
02Dak Ring C	8.28	0.00	8.28	363.07	101.40
03Ngoc Tem C	30.20	82.99	113.19	0	0.00
04Mang But C	7.57	361.17	368.73	0	659.60
05Dak Koi C	541.71	665.04	1,206.76	813.78	817.05
06Dak Ruang C	511.10	0.00	511.10	2,232.93	470.79
07Kon Plong	0.00	0.00	0.00	14.63	0.00
08Tan Lap C	0.00	0.00	0.00	365.24	0.00
09Dak Tre C	176.48	11.19	187.66	2,388.87	88.24
10Tan Lap	28.44	0.00	28.44	249.63	201.48
11Mang Canh II	105.11	7.92	113.03	0	0.00
12Mang Canh I	349.55	0.00	349.55	77.26	289.08
13DaK Ruang	3.53	0.00	3.53	256.85	790.33
14Mang La	29.17	0.00	29.17	50.69	186.00
15Mang Den	965.04	0.00	965.04	131.61	488.04
Total	2,794.43	1,128.32	3,922.75	6,998.26	4,646.96
FE Total	1,480.84	7.92	1,488.76	766.04	1,954.92

Table I-3.7.14 Forest operation plan by planning zone

Plant zone	Plant on Grassland	Plant on Bush land	Plant total	Rehabilitate on bush land	Natural regeneration
A	2,040.10	1,128.32	3,168.42	1,128.32	1,278.54
B	452.05	0.00	452.05	21.47	1,281.05
C	32.29	0.00	32.29	385.90	278.49
D	0.00	0.00	0.00	412.04	180.16
E	39.68	0.00	39.68	53.69	23.91
F	67.01	0.00	67.01	0.00	959.39
G	27.75	0.00	27.75	4,457.40	428.32
H	135.55	0.00	135.55	539.45	217.1
Total	2,794.43	1,128.32	3,922.75	6,998.26	4,646.96

Table I-3.7.15 Afforestation and forest improvement plan by planning zone

Plant zone	Plantation			Rehabilitation				
	Product	PTF Vc	PTF Cr	Total	Product	PT Vcr	PT Cr	Total
A	3,168.42	0.00	0.00	3,168.42	1,128.32	0.00	0.00	1,128.32
B	452.05	0.00	0.00	452.05	21.47	0.00	0.00	21.47
C	32.29	0.00	0.00	32.29	385.90	0.00	0.00	385.90
D	0.00	0.00	0.00	0.00	412.04	0.00	0.00	412.04
E	0.00	39.67	0.00	39.67	0.00	0.00	53.69	53.69
F	67.01	0.00	0.00	67.01	0.00	0.00	0.00	0.00
G	0.00	27.75	0.00	27.75	4,457.40	0.00	0.00	4,457.40
H	135.55	0.00	0.00	135.55	539.45	0.00	0.00	539.45
Total	3,855.31	67.42	0.00	3,922.73	6,944.57	0.00	53.69	6,998.26

(7) Land for Villager Support Program

The Villager Support Program is mainly divided into i) support to alleviate food shortages, ii) support to help control the expansion of shifting cultivation, iii) support for income enhancement and technical support to assist indirectly with such activities, and iv) support for improving the BHN for isolated communities in the hinterlands. In this subsection, estimation of land areas that would be a target for utilization in the programs is to be made.

In the program to alleviate food shortages, households in each commune who are chronically short of food are targeted. It is assumed that land would be prepared to facilitate the increase in food production, and the necessary land would be distributed progressively to the participants in the plans. Such portions of land would be selected from grasslands and bush within 1 km of communities excluded from forestry production areas and designated as areas for the Villager Support Program. Plans to alleviate food shortages would begin with households lacking food being allowed to cultivate a new piece of agricultural land (mainly paddy fields) and provided with support. The necessary land area for a household of six (average) to produce food equivalent to 350 kg of rice per capita has been estimated. By making a dam in a gentle slope besides a mountain stream and opening a channel, land can be converted into paddy fields. Areas that are appropriate for this form of land use have been marked on a GIS map incorporating three factors, namely contour, streams and vegetation. Average production from paddy fields is assumed to be 2.0 t/ha based on statistical data. The area of paddy field necessary to feed households who are short of food has been totaled from all communities and communes. Comparing these areas with the land available for conversion to paddy fields by each community, it is assumed that if the area required is less than the amount of available land, then this land area will be set as a target for the establishment of paddy fields. If insufficient land were available, an area of grassland or a grove would be converted into an upland field. In permanent uplands, the average yield for maize is converted into a rice equivalent. Given that maize requires 1.6 times as much area as rice, the area required for upland fields can then be estimated.

Plans to reduce levels of shifting cultivation involve the introduction of agroforestry. It is assumed that in the areas still practicing shifting cultivation, 30% of households, excluding those involved in the food shortage alleviation plans, would participate; each household would be allocated 2 ha of land. Although identified as agroforestry units, most of the land is expected to be used for a combination of perennial crops such as fruits from mainly woody plants, and some cash crops. For some ethnic groups, a combination of forage crops/forage trees and the feeding of livestock would be considered.

The income enhancement program comprises many proposed activities including beekeeping, animal husbandry, etc., although here it is assumed the main aim will be to encourage the introduction of agroforestry to households with below average incomes in each community. The program assumes that, as above, 2 ha of land for agroforestry would be distributed per household. The aim of the program is to involve 20% of all community households.

In Zone A, 50% of grasslands and bush within 1 km of villages other than lands to be distributed for the above three programs is to be allocated as sites for industrial silviculture. The afforestation involves a contract between villagers and a pulp production and plantation company, and the production forests are to be administered by the villagers themselves. Further, in Zone A, grasslands more than 1 km from villages are proposed for industrial plantation, and by actively engaging villagers in afforestation work to be administered by the FEs or the commune members in charge of the forest, it is expected that afforestation would be one of the villager support activities.

Grasslands or bush still remaining in the target areas of these villager support activities are reverting naturally to woodlands for the time being. However, these places are, in a sense, areas held in reserve to meet changes in social conditions or future community developments, and are expected to be administered cooperatively by each community. The target areas for the Villager Support Program are to be officially administered by the communes or the FEs, although, in the long term, administration of the program will ideally be transferred to the communities.

Target areas for the Villager Support Program (grasslands and bush within 1 km of the village) are occupied by about 12,000 ha of grassland and about 18,000 ha of bush in the entire Kon Plong District, totaling about 30,000 ha. The Table below shows areas of grasslands and bush by zones.

Table I-3.7.16 Area of grasslands and bush located in the target area (1 km) for the Villager Support Program

	A	B	C	D	E	F	G	H	Total
Grass	5,350.61	911.93	567.18	2,515.77	379.80	356.94	827.61	892.03	11,801.86
Bush	6,626.59	570.88	5,452.89	1,166.56	490.18	1,029.18	1,262.43	1,379.53	17,978.24
Total	11,977.20	1,482.80	6,020.07	3,682.33	869.98	1,386.11	2,090.05	2,271.56	29,780.10

The above results are shown in Table I-3.7.17. The food shortage alleviation program will result in the establishment of about 1,000 ha of paddy fields and about 3,100 ha of upland fields in peripheral areas around villages.

The area of grasslands and bush assigned to the program for the reduction of shifting cultivation has been estimated to be about 800 ha of grassland and about 150

ha of bush respectively. The income improvement plans are to be mainly achieved through the introduction of agroforestry; the target areas have been estimated to

Table 3.7.17 Target area of villager support program in grasslands and bush

	Food		Agro S&B	Income	Industry P
	Paddy	Farm			
Grass	666.82	1,595.69	807.48	1,502.40	3,035.58
Bush	339.37	1,483.74	154.73	1,285.60	2,839.55

be 1,500 ha of grassland and 1,300 ha of grove, totaling 2,800 ha. The target amounts for the income enhancement program are not

covered by the master plan stage because of variations in products, production expectations, prices and market access conditions according to the socioeconomic and natural conditions where the respective communities are located. The industrial plantation plans are to be executed in Zone A. The area required for these plans has been assumed to be 3,000 ha of grassland and 2,800 ha of bush, totaling 5,800 ha, through calculation from the remaining area from grassland and bush used for the formerly stated three plans in Zone A. Table I-3.7.18 shows the target areas by each management body. Table I-3.7.19 is inserted again to show these figures by each zone for the plans. In addition, Table I-3.7.20 shows the figures by ethnic groups most likely to benefit from these plans.

Table I-3.7.18 Target area of the Villager Support Program by program and forest management body (ha)

Management unit	Target area total		Food shortage reduction					
	Grass	Bush	Grass	Bush	Total	Grass	Bush	Total
			Paddy	Paddy	Paddy	Farm	Farm	Farm
01PFM Area	1,019.91	1,127.85	174.15	35.24	209.39	148.48	284.19	432.67
02Dak Ring C	152.35	5,017.61	49.36	146.09	195.45	63.54	384.32	447.86
03Ngoc Tem C	97.55	700.11	21.96	21.10	43.06	72.15	40.62	112.77
04Mang But C	114.16	108.18	2.58	36.17	38.74	81.65	13.64	95.29
05Dak Koi C	1,767.73	2,294.37	10.01	0.00	10.01	36.27	0.00	36.27
06Dak Ruong C	2,150.00	2,615.51	0.00	0.00	0.00	231.69	77.96	309.64
07Con Plong C	39.40	745.99	0.00	0.00	0.00	0.00	126.61	126.61
08Tan Lap C	137.50	352.62	0.00	0.00	0.00	63.97	0.00	63.97
09Dak Tre C	525.56	1,493.50	0.00	0.00	0.00	359.55	167.60	527.15
10Tan Lap	312.65	367.34	26.66	19.60	46.27	77.90	172.92	250.82
11Mang Canh II	1,001.46	559.23	70.79	8.79	79.58	47.53	0.00	47.53
12Mang Canh I	1,960.15	667.34	97.49	2.79	100.28	182.25	0.00	182.25
13DaK Ruong	409.60	737.57	0.00	0.00	0.00	0.00	191.54	191.54
14Mang La	730.52	386.14	142.44	42.83	185.27	58.05	0.00	58.05
15Mang Den	1,383.33	804.87	71.39	26.76	98.15	172.66	24.34	197.00
Total	11,801.86	17,978.24	666.82	339.37	1,006.19	1,595.69	1,483.74	3,079.44

Management unit	Slash & burn reduction			Income generation			Industrial Plantation		
	Grass	Bush	Total	Grass	Bush	Total	Grass	Bush	Total
	Bush	Bush	Agro F	Agro F	Agro F	Agro F	Forest	Forest	
01PFM Area	63.33	0.00	63.33	108.10	139.50	247.60	0.00	0.00	0.00
02Dak Ring C	0.00	72.17	72.17	26.99	241.81	268.80	0.00	0.00	0.00
03Ngoc Tem C	0.00	0.00	0.00	3.44	50.56	54.00	0.00	0.00	0.00
04Mang Bui C	19.87	0.00	19.87	8.99	37.20	46.19	0.00	0.00	0.00
05Dak Koi C	214.18	0.00	214.18	206.80	0.00	206.80	942.16	591.03	1,533.19
06Dak Ruong C	189.02	0.00	189.02	230.80	185.60	416.40	1284.54	1,057.33	2,341.86
07Con Plong C	0.00	0.00	0.00	0.00	148.40	148.40	0.00	26.00	26.00
08Tan Lap C	0.00	0.00	0.00	68.00	27.20	95.20	5.53	162.71	168.23
09Dak Tre C	55.19	32.26	87.44	62.09	165.51	227.60	48.72	564.07	612.79
10Tan Lap	44.90	50.31	95.21	100.00	103.20	203.20	0.00	0.00	0.00
11Mang Canh II	10.04	0.00	10.04	70.00	0.00	70.00	0.00	0.00	0.00
12Mang Canh I	0.00	0.00	0.00	154.57	32.23	186.80	0.00	0.00	0.00
13DaK Ruong	0.00	0.00	0.00	39.41	48.00	87.41	97.70	132.47	230.17
14Mang La	41.02	0.00	41.02	110.80	0.00	110.80	0.00	0.00	0.00
15Mang Den	169.93	0.00	169.93	312.40	106.40	418.80	656.94	305.95	962.88
Total	807.48	154.73	962.21	1,502.40	1,285.60	2,788.00	3,035.58	2,839.55	5,875.13

Table I-3.7.19 Target area of the Villager Support Program by program and planning zone

	Food shortage reduction	Slash & burn reduction	Income generation	Industrial Plantation
A	1,335.81	613.13	1,462.00	5,875.13
B	365.66	57.07	290.80	0.00
C	1,208.22	72.16	465.60	0.00
D	364.72	10.04	233.20	0.00
E	144.10	37.15	48.00	0.00
F	91.17	27.43	23.20	0.00
G	228.33	56.11	141.20	0.00
H	347.60	89.11	124.00	0.00
Total	4,085.63	962.21	2,788.00	5,875.13

Table I-3.7.20 Target area of the Villager Support Program by program and ethnic group

	Food shortage reduction	Slash & burn reduction	Income generation	Industrial Plantation
Ethnic	Paddy/Farm	Agro F S&B	Agro F Income	Reforestation
Ba Na	98.15	386.62	444.40	1,176.56
He Le	79.87	0.00	66.80	0.00
Kinh	0.00	0.00	717.20	818.29
Ko Dong	101.44	0.00	148.00	0.00
Mo Nam	436.26	114.40	541.81	0.00
Xe Dang	290.47	401.42	724.99	1,982.80
X ra	0.00	59.77	144.80	1,897.49
Total	1,006.19	962.21	2,788.00	5,875.13

3.8 Outlook of forest management operations

The following is an outlook of forest management and operations for the future 10 years based on the master plan.

3.8.1 Forest production estimation

Logging operation is planned in the Master Plan for only the area under the jurisdictions of the FEs, while silviculture operation such as afforestation and rehabilitation is planned for the areas under jurisdictions of whole forest management units such as FE, PFMC and commune. Regarding logging and silviculture operation estimation, an annual cutting volume by the FEs and afforestation and rehabilitation volume by the FEs, the PFMC and the communes for the future 10 years in the Study Area were estimated.

(1) Annual cutting volume

Firstly, The annual cutting volume is estimated in the light of supply side based on the preconditions as follows. All logging shall be practiced by selective cutting operations on conditions that average yield percentages per ha are to be 30% and 20% for production forest and crucial protection forests respectively, and a cutting cycle is to be 35 years. The target forests, on account of having a sufficient stand volume for the selective cutting, shall be limited only to those categorized as the primary forest and the evergreen secondary forest I. Table I-3.8.1 shows target logging areas by the FEs, forest type, and forest function (a production forest or a crucial forest).

Table I-3.8.1 Target logging area

unit: ha

FES	Forest category	Product F	Protect F Cr	Total
Tan Lap	Primary forest	4,412.21		4,412.21
	Evergreen secondary forest I	5,751.45		5,751.45
	Sub total	10,163.66		10,163.66
Mang Canh II	Primary forest	2,889.32	1,187.85	4,077.17
	Evergreen secondary forest I	4,443.87	708.72	5,152.59
	Sub total	7,333.19	1,896.57	9,229.76
Mang Canh I	Primary forest	1,818.45	1,216.76	3,035.21
	Evergreen secondary forest I	3,332.35	472.47	3,804.82
	Sub total	5,150.80	1,689.23	6,840.03
Dak Ruong	Primary forest	1,478.94	1,003.44	2,482.38
	Evergreen secondary forest I	2,683.84	1,766.20	4,485.87
	Sub total	4,162.79	2,805.47	6,968.25
Mang La	Primary forest	3,291.66		3,291.66
	Evergreen secondary forest I	5,106.13		5,106.13
	Sub total	8,397.79		8,397.79
Mang Den	Primary forest	1,476.31		1,476.31
	Evergreen secondary forest I	2,673.92	35.83	2,673.92
	Sub total	4,150.23	35.83	4,150.23
Grand total		39,358.45	6,391.27	45,749.72
Total : Primary forest		15,366.89	3,408.05	18,774.94
Total : Evergreen secondary forest I		23,991.56	2,983.22	26,974.78

In these target forests, when applying respective average stand volumes per ha to each forest type (320 m³/ha for primary forest and 266 m³/ha for evergreen secondary forest I) and calculating a current stand volume for each forest type, the current total stand volume of the target forests amounts to 13,183,000 m³.

On the other hand, based on the FIPI's data, suppose that annual increment rates are 1.5019% of state IV and 1.8938% of state IIIb+IIIa3 according to the general categorization in Vietnam for the primary forest and the evergreen secondary forest I respectively, and that an annual logging is performed in 1/35 of target logging areas. If adding total increments calculated at the respective times of logging, a total stand volume of the target forests for logging is calculated at 17,073,000 m³. Based on this total stand volume of the target forests for logging, a total potential cutting volume for 35 years, in accordance with the yielding percentages of the production forests and the crucial protection forests as the operational standards mentioned above, is calculated at 4,879,000 m³. The division of this figure by a cutting cycle of 35 years gives the annual potential cutting volume of 139,000m³ on a stem volume basis. The annual cutting volume is allocated on a log volume basis in Viet Nam. If 65 %, which is normally applied in Kon Tum Province as ratio of log volume against stem volume, is applied, this 139,000 m³ on a stem volume basis is calculated to 90,350 m³ on a log volume basis. Further, from the perspective of "no more cutting than an annual increment," which is a concept of selective cutting, the annual increment of the target logging areas based on the above increment rate calculates at 226,000 m³, which is to be the annual potential cutting volume on a stem volume basis from the perspective of forest productivity. Likewise, 65 % of 226,000 m³ is 146,900 m³ in terms of log volume. The annual potential cutting volume of 90,350 m³ calculated based on the above-stated operational standards is lower than the annual potential cutting volume from the perspective of forest productivity of 146,900 m³, and does not exceed the range of the productivity. Therefore, this 90,350 m³ shall be the annual cutting volume calculated in the light of the supply side.

The annual cutting volume, in addition, should be examined in the light of a demand side. In consideration of the possible contribution to the Kon Tum Province economy from now on, and on the postulates of "no supply out of the province with the form of round wood having only lower added value" and "no sawing of round woods produced in Kon Plong District by sawmills in other than Kon Plong District and Kon Tum Town," the annual round wood demand shall be calculated. Suppose that: all sawmills in Kon Plong District shall use the round woods produced here; and the sawmills in Kon Tum Town shall continue to use round woods of Kon Plong in the rate of round woods from Kon Plong against total round woods sawn (actual use amounts in 1999 and 2000). Based on these, the annual demand is calculated using the capacity of each sawmill's machinery, and then an annual potential sale volume of round wood (i.e. annual cutting volume) of 6 FEs in Kon Plong District is calculated. The target sawmills in the district shall be Tan Lap FE and Mang Canh II FE. The capabilities of the annual production of their sawmill machinery in terms of round wood are: 7,200 m³ for Tan Lap FE and 9,000 m³ for Mang Canh II FE, with a total of 16,200 m³. On the other hand, the

only sawmill in Kon Tum Town is owned by KOTIMEX, and they have the capability of annual production of 30,000 m³ in terms of round wood. If multiplying this figure by 55%, the average actual use rate of round wood from Kon Plong in 1999 and 2000, results in 16,500 m³. Accordingly, the potential sawing volume in Kon Tum Province of round wood produced in Kon Plong District, is to be 32,700 m³, which is obtainable by adding the above 16,500 m³ and 16,200 m³ of Kon Plong District. This figure, 32,700 m³, is the annual round wood sale of FEs, i.e. annual cutting volume, in the light of the demand side.

Comparing the above annual cutting volume calculated in the light of the supply side to this volume calculated in the light of the demand side, the figure of the demand side is less than a half of the figure of the supply side. However, even the calculated figure of the demand side, if compared to 14,000 m³ of the average round wood production from natural forests in Kon Plong District in 1994 to 1999, is larger by 18,700m³. Therefore, even in the case that the cutting volume calculated in the light of the demand side is designated to be the annual cutting volume for Kon Plong District, it is necessary to consume the increased portion of 18,700 m³ from present supply with a demand increase included in the sales out of the province of sawn timbers or even more processed products such as refined wood. Although, it depends on the trend in the market and is difficult to predict. In addition, presently, it is too large a figure, if taking into consideration their potential demand, to apply the annual cutting volume calculated in the light of the supply side to be the same for Kon Plong District.

Consequently, it is practical to yearly determine the annual cutting volume for Kon Plong District as the minimum volume of 14,000 m³ of the current practical wood production and the maximum volume of 32,700 m³ calculated in the light of the demand side. Table I-3.8.2 shows the figures of annual cutting volumes allocated to the each FE based on each total potential cutting volume from supply side of the respective FEs. The annual allocated volumes in order of the largest numbers are: Tan Lap FE, Mang Canh II FE, Mang La FE, Mang Canh I FE, Mang Den FE, and Dak Ruong FE. Incidentally, as described above, because even now the production capability of sawmills is more than is being used, it is anticipated that at least 10 years after this, the incentive of the investment for a new sawmill facility would remain low.

Table I-3.8.2 Allocation of annual cutting volume to each FE

FEs	Volume (m ³)	
	Minimum	Maximum
Tan Lap	3,294	7,693
Mang Canh II	2,781	6,495
Mang Canh I	2,024	4,728
Dak Ruong	1,906	4,452
Mang La	2,684	6,270
Mang Den	1,311	3,062
Total	14,000	32,700

Next, a goal to aim for practical application of the obtained annual cutting volume to the selective cutting operations, and the method for its materialization is described. Firstly, the selective cutting operation should be, in consideration of efficient economy for the construction of forest road network etc., executed through the equal division of area over the entire area. With the cutting cycle being 35 years, each of 1/35 divisions into which the respective entire target logging area of each FE is divided shall be the target logging area per year. Although, the above described annual cutting volume is calculated in the light of the demand side, and is largely lower than the calculation result in the light of the supply side, if equally selecting the target cutting trees within every annual target logging area per year, yield percentages per ha results to be very low. By a simple calculation using approximately 36%, the rate of the maximum annual cutting volume calculated in the light of the demand side against the annual cutting volume calculated in the light of the supply side, the yield percentages per ha for the production forests and the crucial protection forests are 11% and 7% respectively. Therefore, it is apprehended that the production efficiency would become worse. Accordingly, it is practical to select parts of higher stand volume within target logging areas of the year, and practice logging in such areas only. For this reason, in the forests of 320 m³/ha stand volume (the average stand volume per ha of the primary forest) and over, the areas reaching the annual cutting volume shall be the target logging areas, with application of the maximum yield percentages of 30%(including approximately 5 % of yield percentage for trees to be cut as obstacle of trees marked for the cutting in the cutting operation or road construction) for the production forest and 20%(the same as production forests) for the crucial protection forest. By repeating this method for a number of cutting cycles, the stand with a low volume will be preserved and grow, and those with a high volume will be adjusted with logging. Then, the goal as a whole is to achieve the stands of natural forest equally structured in terms of forest condition such as the stand volume and density. With regard to cutting cycle, 35 years has been applied in this plan and the cutting cycle can be 35 years if the entire area of the 1/35 division is for logging area in this term. However, as mentioned above, the entire area of the 1/35 division is not for logging area in this term. In this case, it is high possibility that area, which is not for logging in this term logging within the 1/35 divisions, will be for logging in the next term 35 years later. In other words, it is expected that the area for logging in this term will not be for logging in the next term 35 years later but will be for logging in the third term 70 years later. Therefore, most of the area, which was logged in this term, will be logged 70 years later and small portion of the area will be logged 35 years later.

In addition, the important point is that the allocation of timber volume to each forest enterprise is to be determined based on Table I-3.8.2 but is not to be allocated to a few certain forest enterprises as is currently carried out. This is because the current method causes a situation that some forest enterprises have no income from timber logging in a certain year and will cause another situation that management of forest enterprises will be devastated when the Program 187 is applied in the future. Furthermore, it is important to allocate cutting volume to every forest enterprise for leveling financial conditions.

Furthermore, regeneration in logged-over area should be confirmed with observation of the area for about 15 years after logging. It should be better to decide whether it is necessary to implement forest cleaning as well as forest maintenance to facilitate the regeneration after 10 years later. Since this section provides outlook of forest management operation for the next 10 years, outlook of operation for forest cleaning as well as forest maintenance is not described.

(2) Silviculture operation volume

1) Silviculture operation volume by the FEs

The silviculture operation volume that should be carried out by the FEs for the period of the next 10 years is calculated based on the estimated target afforestation volume by forest function and target volume of rehabilitation on bush lands mentioned in Section 3.7 (6).

This estimated target afforestation volume is a total of 1,489 ha, consisting of 1,481 ha for existing grassland and 8 ha for bush land as shown in Table I-3.7.11. A characteristic of the estimated target afforestation volume is that it is clustered in the production forests and the area covers 1,452 ha, 98% of the total target afforestation volume. This means that the afforestation is out of the range of that which will be practiced with governmental budgets in the form of afforestation management within the protection forests with the application of Decision 661. Consequently, in the production forest areas, the FEs should squeeze the project management costs out of their own income and practice their own afforestation work. In addition, examining afforestation volume by the FEs, it is concentrated in the production forests of two FEs: 350 ha is for Mang Canh I FE and 965 ha is for Mang Den FE.

Among these target afforestation areas, in Zone A, the FEs shall lease lands to plantation companies and the companies are to carry out industrial afforestation. The area conducted by this contract accounts for 954 ha of grasslands and 8 ha of bush land. The practical afforestation area by the FEs will be 527 ha of grasslands deducting the area conducted by the companies from the total target area. All of the grassland area for industrial afforestation is situated in Mang Den FE, the target afforestation area by this FE will be only 11 ha of grasslands.

Regarding the rehabilitation projects, the estimated target volume is 766 ha within only the production forest as shown in Table I-3.7.13. Therefore, this project is also out of the range of those that will be practiced with governmental budget by the application of Decision 661. The largest target area is 257 ha for Dak Ruong FE and smallest target area is 0 ha for Mang Canh II FE.

Regarding the afforestation cost, calculated by adding an extra amount to the average unit cost for the actual results of the afforestation activities by the FEs of the Study Area in 1999, the combined costs for nursery work, planting, and weeding in the first year are estimated at 2,300,000VND/ha, and that

for the second year and subsequent weeding costs are estimated at 700,000VND/ha. Assuming that weeding will be carried out until the third year, the total cost of afforestation will be 3,700,000VND/ha. The total cost will be 74,000,000VND for 20 ha afforestation annually.

Regarding the cost for rehabilitation works for bush land, the cost including enrichment planting and clearing is estimated at 900,000VND/ha on the basis of the Mang La FE's Forest Management Simple Plan (period 2001-2005) and past performance records. Assuming that rehabilitation projects of 25 ha will be annually carried out for next 10 years considering 257 ha of the largest rehabilitation areas by Dak Ruong FE, the annual cost is estimated at 22,500,000VND.

On the other hand, with regard to revenue, it can be calculated based on the lowest allocated cutting volume of 1,300 m³ in Mang Den FE as shown in Table I-3.8.2. Assuming that the volume to be equally distributed among group III to VIII indicated in Table I-2.5.1 constitutes 80 % for 50 cm or more of DBH and 20 % for 25-50 cm and is sold by standing tree sales, it will be approximately 293,000,000 VND. Based on this revenue and silviculture cost, even if the silviculture cost should be covered by the revenue, the revenue can bear indirect costs such as salary of staff in the FEs, and the revenue and expenditure will be balanced. Besides, costs needed for silviculture operations in protection forests shall be born by the fund provided from Decision 661.

Accordingly, assuming that the afforestation volume to be achieved by one FE is 20 ha/year and 200 ha for 10 years, all the target area will be reforested in 10 years by FEs except for Mang Canh I FE whose target area exceeds 200 ha.

However, for Mang Canh I FE which has a fragile income foundation, this will possibly be a great burden on them especially now and during the period until profitable business goes well with the application of Decision 187 in future. Therefore, in the area exceeding 200 ha, afforestation shall be carried out taking revenue and expenditure in Mang Canh I FE into consideration.

Regarding the rehabilitation projects, 766 ha which includes all target areas will be implemented since it is considered that it is feasible for all of the target areas, even by Dak Ruong FE, which has the largest target areas among all FEs.

The volume estimation of silviculture operation for the next 10 years by each FE is shown in Table I-3.8.3. As the target afforestation volume is arranged only for Mang Canh I FE, the total afforestation volume comes to only 377 ha to 527 ha for the 10 years, on average 38 ha to 53 ha per year.

Table I-3.8.3 Silviculture volume for the 10 years by each FE

FES	Afforestation (ha)			Rehabilitation (ha)
Tan Lap			28	250
Mang Canh II			105	0
Mang Canh I	200	—	350	77
Dak Ruong			4	257
Mang La			29	51
Mang Den			11	132
Total	377	—	527	767

2) Silviculture operation volume by the Thach Nham PFMC and each FE

The afforestation volume to be independently managed by the Thach Nham PFMC and each commune in the Study Area was estimated. The total afforestation volume is 227 ha except for the volume of industrial afforestation by plantation company in A zone within the afforestation target areas shown in section 3.7 (6). The afforestation to be implemented by each commune except for 38 ha by the PFMC will be conducted in the production forest.

Regarding the rehabilitation projects, the total target area is 6,218 ha, while the target area by the PFMC is 54 ha. The target area by the communes within the production forest is the same as target areas of afforestation by the communes mentioned above.

The silviculture plans by the communes in this Master Plan are designed mainly for the afforestation to be performed with the Villager Support Program. Therefore, in silviculture activities of the communes, a priority shall be given to activities which guide the Villager Support Program to success, e.g. technical support for the afforestation through agroforestry activities within the Villager Support Program. This means that it is difficult for implementation of the silviculture project by the communes themselves considering weakness of capacity of the commune organization. From these points of view, the silviculture projects to be managed by the communes shall not be implemented during the next 10 years. The silviculture projects by the communes shall be gradually spread after the permeation of afforestation through agroforestry activities by the Villager Support Program and technology transfer to the villagers through on the job training in the rehabilitation projects by the FEs.

The afforestation project of 38 ha and the rehabilitation project of 54 ha to be independently managed by the PFMC should be conducted during the next 10 years by using the fund for Decision 661.

Furthermore, those silviculture projects by the communes, which are within production forest, are out of the range of those that will be practiced with governmental budgets through the application of Decision 661. Consequently, in the production forest areas, the communes should squeeze the project

management costs on their own and practice their silviculture programs. However, it is noted that this will be a great burden on them and it is essential to introduce external funds/budgets.

3.8.2 Forestry infrastructure

In the forest management plan, it is vital to build the infrastructures required for proper forest management as well as forest development. This section describes the planning standard for road network construction including public roads, forest roads, spur roads and skidways. It also refers to standards for nursery preparation, location of logging yards in forests and construction of field offices to store and repair heavy equipment.

(1) Road network

The road network for access to all forest blocks is the most important aspect of these infrastructures for forest management. Road network construction must be made in logging planning areas taking into consideration the topography, and environmental conditions. Therefore, for environmental protection, it is necessary to minimize vegetation destruction such as wild plants or animals and their habitats. High-pitched areas or geologically weak areas should be avoided, and where possible ridge ways should be selected for road network construction. The most direct route is necessary for cost reduction. For environmental protection, it is also essential to avoid or to be located as far as possible from bio-corridors.

The road network is composed of:

- 1) public roads and/or forest roads for hauling felled and collected logs to National Highway 24
- 2) spur roads for hauling felled logs to public roads and/or forest roads
- 3) skidways for hauling felled logs to spur roads.

Based on the FIPI standard, the road network for felling logs shall target the road network density of 50 m/ha.

1) Public roads and/or forest roads

Public roads are defined as roads connecting National Highway 24 with communities situated in applicable areas. It is appropriate to construct them from the government's road budget. Basically, these public roads shall be used for hauling logs from the origin of spur roads. Thus, roads for accessing unconnected communities shall be constructed as public roads based on this concept, and logging operation sites will be allocated for these areas. Figure I-3.8.1 indicates the situation of desired public road construction by extending existing public roads. The total distance of desired extensions is

to be 47 km.

Forest roads shall be constructed when it is decided that semi-permanent use of these roads in addition to public roads is effective in light of the felling and planting operations scale in the applicable area. They shall meet the requirements shown below for construction from the forestry-related government budget.

For the construction standard of forest roads, the street width shall be 4-5m. Both sides of the road shall have drainage ditches and will be maintained with gravel to function as all weather roads.

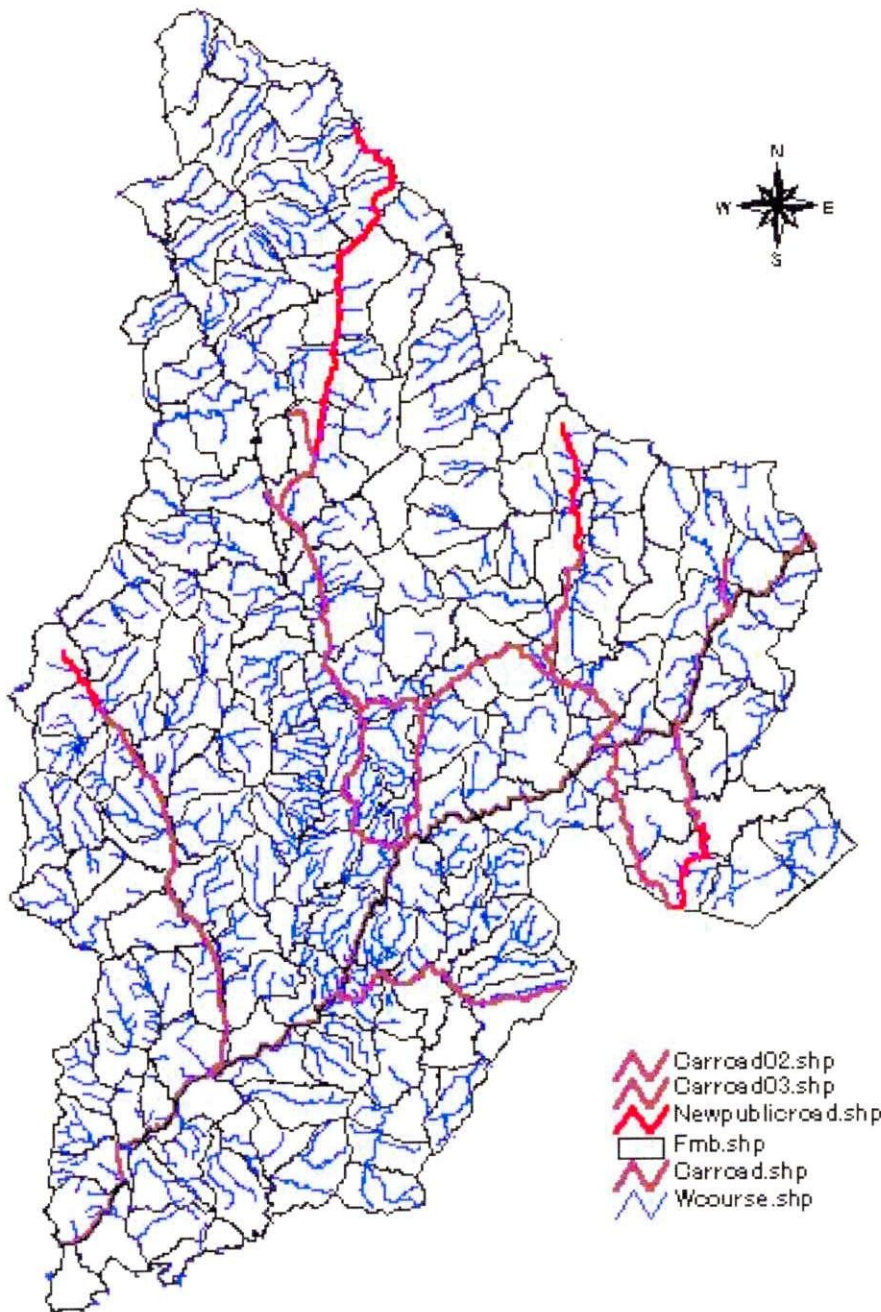


Figure I-3.8.1 Proposed public road network

2) Spur roads

Spur roads are defined as roads for hauling logs felled in each block from the origin of skidways to public roads and/or forest roads. Road network density of public roads and/or forest roads and the distance for collecting logs using skidways determines the spur road network.

For the construction standard of the spur roads, the street width shall be wide enough for hauling trucks to pass. Spitals shall be constructed every several kilometers or as topography permits to allow hauling trucks to pass each other. Gravel operations shall not be carried out. Spur roads shall be constructed to allow four-wheel vehicles to pass in the dry season. They shall not be semi-permanent, nor be particularly maintained or repaired.

3) Skidways

Skidways are defined as roads for hauling felled logs in logging areas to spur roads using tractors. For the construction standard of the skidways, vegetation shall be minimally removed so it can recover promptly after the logging operation is completed. The skidways shall be constructed to reach the felling sites using the most direct route, but shall not pass near stands for the next harvest after the cutting cycle.

Figure 3.8.2 indicates an image of the planning for road network construction using block 413 as an example. As mentioned above, if the road network density is 50 m/ha, the total distance of road network extensions in block 413, with an area of 1416.8 ha, is 70 km. The total distance of extensions of spur roads is 22 km. Then, the total distance of extensions of skidways is about 33 km calculated by subtracting about 15 km of public roads and 22 km of extensions of spur roads from 70 km. The figure indicates public roads and spur roads, but not skidways.

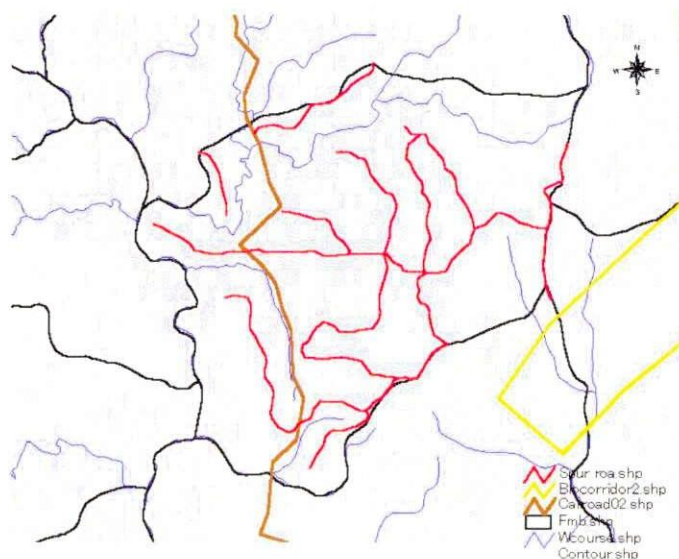


Figure I-3.8.2 Road network planning image

(2) Nursery

Nurseries shall be temporary and small, and not permanent. Nursery sites are recommended to be located along roadsides for the convenience of receiving soil and tubes for potting, or other materials. Nurseries should also be near a water source for watering, and in as close proximity as possible to planned areas for reforestation to transport the seedlings. It is recommended that reforestation carried out by local people indicated in the previous sections be operated at their compound for convenience of management. The scale of nurseries shall correspond with the seedling production numbers based on the reforestation plan.

In the case of reforestation to be managed by FEs, they shall make an employment or contract with mainly local people on a piecework basis or in procuring. In case of reforestation by local people themselves, they shall grow seedlings by their own management. The provincial governments will supply seeds only. In the case of reforestation by the Villager Support Program, local people shall also grow seedlings. The provincial governments will supply seeds and all materials to grow seedlings.

(3) Logging yard

Logging yards in forests are defined as facilities normally built near spur roads within felling areas, in order to store logs until felled logs are transported to distribution areas. Scaling and grading of logs shall be generally carried out in these logging yards. For the construction standard of logging yards in forests, flat land shall be selected, to prevent sediment discharge. The area shall be minimal in light of vegetation conservation. When a logging yard in a forest is larger than 1,500 m², it is necessary to replant trees after leaving the yards subject to the governmental regulations.

(4) Field office

Field offices are defined as facilities with combined functions of bases for advancing forest development of distant places and forest administrative offices of the applicable area. Staff of FEs stay resident there to solely carry out management work. Utility workers stay resident there to solely facilitate all forest development work. Facilities are also equipped for storing and repairing heavy equipment necessary for forest development. Therefore, mechanics for solely repairing heavy equipment shall also stay resident there. Radio communication equipment shall be installed for regular ongoing communication with the head office.