2). In the case of man power felling, bucking, man power logging and loading to trucks ;

If man power felling-logging is executed three times a day and at one time 0.5 m^3 logs are carried by 6 workers;

productivity per man.day : 1.5 m^3/6 = 0.18m^3/man.day

It means employment of 5.55 man.day/m^3.

The wage of the worker is : 5.55x600 = 3330 Rp/m^3.

These values are changeable by the conditions of working area, especially logging distance.

3). We get our result as follows;

logging method	productivity	employment/m^3	income of the local community
skyline logging	1.47m^3/man.day	0.68 man.day/m^3	199 Rp/m^3
man power logging	0.18m^3/man.day	5.55 man.day/m^3	3330 Rp/m^3

This table shows the character of both loggings i.e. skyline logging has high productivity, but relatively small employment and small income to the local community. Man power logging has low productivity, larger employment and larger income to the local community.

From the view point of management economy, the skyline logging is more effective, although we must consider the depreciation cost and maintenance cost of machinery.

According to the Article of Mr. Bambang Soebagyo in "Proceeding Lokakarya Logging Kayu Pinus", published by Perum Perhutani in 1980, machinery cost including depreciation account but excluding personal cost is 1911 Rp/m^3.

It means logging cost from the viewpoint of management financial economy is 1911 + 199 = 2110 Rp/m^3 by skyline logging, whereas 3,330 Rp/m^3 by man power logging.

IV. .....

3. If these value are multiplied by the planned cutting volume, creation of employment and income can be estimated each method respectively.

Year	Planned cutting volume m^3	Employment(man.day)		Income(B_t)	
		Table logging	Man power logging	Cable logging	Man power logging
	①				
1985	278,000	189,040	1,542,900	55,322,000	925,740,000
1986	379,000	257,720	2,103,450	75,421,000	1,262,070,000
1987	427,000	290,360	2,369,850	84,973,000	1,421,910,000
1988	440,000	299,200	2,442,000	87,560,000	1,465,200,000
1989	463,000	314,840	2,569,650	92,137,000	1,541,790,000
Total	1,968,000	1,338,240	10,922,400	391,632,000	6,553,440,000
Remarks	540,000	367,200	2,997,000	107,460,000	1,798,200,000
		① × 0.68	① × 5.55	① × 199	① × 3,330

* Supposing annual working day is 250 days real number of the necssary workers can be calculated.

Year	Cable logging		Man power logging	
	Man day	Real number	Man day	Real number
1985	189,040	756	1,542,900	6,171
1986	257,720	1,030	2,103,450	8,413
1987	290,360	1,161	2,369,850	9,479
1988	299,200	1,196	2,442,000	9,768
1989	314,840	1,259	2,569,650	10,278
Total	1,338,240	5,352	10,922,400	43,689
Remarks	367,200	1,468	2,997,000	11,988

IV. [illegible] AND CONCLUSION

In the practical forest management, when deciding how much area is allotted to mechanical logging and how much to man power logging, consideration should be given not only to the creation of employment and income but also to the other economic and technical factors such as forest management finance, sustained yield, topography and so on.

Plantation, weeding, tending and also forest road construction as well as production work are considered to contribute to the creation of employment and increase the income of the local community (Figure 1).

However, for the production of the huge quantity of wood which is planned as 2100 m^3/day, effective use of mechanical logging is indispensable.
So, the actual logging production will be done by the combination of man power logging and mechanical logging.

It is highly expected that the transferred mechanical logging technology will take root and develop in the actual wood production in the mountain regions in Java, which will eventually contribute to the development of forestry in Indonesia.

V. A Supplementary Study on Desa Bumijawa

Desa Bumijawa where the Mountain Logging Operation Forest is located has the biggest population and the second largest land area in Kecamatan Bumijawa.

Land area of Desa Bumijawa is 1,033 ha, the population 7931. The population density is 766/km^2. As for the land use, rice paddy occupies 141.3 ha, crop field 435.1 ha, forest 430 ha and others 26.7 ha.

From the conparison of dynamic statistics in 1976 and in 1981 as illustrated in Table 5, some trends are seen as follows;

---- Total population increased, on the other hand occupational population decreased.

---- The number of births decreased, yet still ~~bigger~~ greater than the number of deaths.

---- Radio possession decreased but television possession increased.

---- Bicycle possession decreased although possession of other vehicles increased.

---- Number of public officials and merchants in Desa Bumijawa is larger than in another Desa, because Desa Bumijawa is a political and trade center in Kecamatan Bumijawa.

Decrease of the number of land-owning farmers and increase of agricultuaral workers is noteworthy in another statistics as shown in Table 6. This phenomenon is distinguished especially in Desa Bumijawa. This is probably explained by the employment enlargement created by the forest exploitation in Desa Bumijawa. By the employment enlargement for forest work, a number of land-owning farmers were converted to agricultural workers without losing their land ownership.

They.....

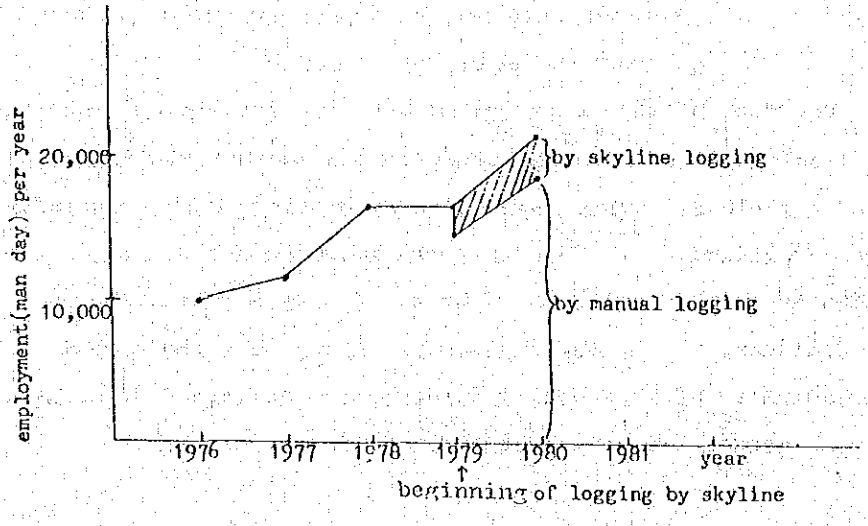
They earn wages as agricultual workers, while their families still get income from their crop fields. In the Table 4, some examples of this kind are shown.

In general, industrial revolutions in the world history were forwarded by the introduction of capital intensive and labor saving method which usually entails the use of machines with high productivity, in which process generated lots of unemployment. Of course, it will be a serious problem if the large scale introduction of highly productive skyline logging system to the densely populated Central Java causes a lot of unemployment.

The following part deals with this problem taking actual record in Desa Bumijawa as an example.

Since 1979, skyline system using modern machinery has been employed in the logging work in Bumijawa. The employment of logging workers temporarily declined in 1979, but increased again in 1980 as illustrated in Figure 2.

Figure 2 Employment of logging worker in BKPH Bumijawa



Increase .....

Increase of logging volume is considered to be the cause of employment increase in 1980. Annual logging volume in BKPH Bumijawa is as shown in Table 7.

Table 7 Logging volume of wood in BKPH Bumijawa (m^3)

	1976	1977	1978	1979	1980
Skyline logging	--	--	--	2817	3963
Manual logging	3624	4546	5862	5171	6818
Total	3624	4546	5862	7988	10781

Since log production of 278,000 m^3 is planned in 1985, generation of unemployment is not ~~worried~~ a worry.

Total income earned by the logging workers in BKPH Bumijawa is as shown in Figure 3. In this culculation, the daily income is assummed to be Rp.600, which is considered as standard wage of manual laborers today. In reality, actual income befor 1979 ~~is~~ was less than the caluculated one on accont of devaluation of rupiah.

As mentioned before, the decline of total income in 1979 is explained by the decrease of employment but it rises again in 1980.

Figure 2 Total income of the logging workers in BKPH Bumijawa

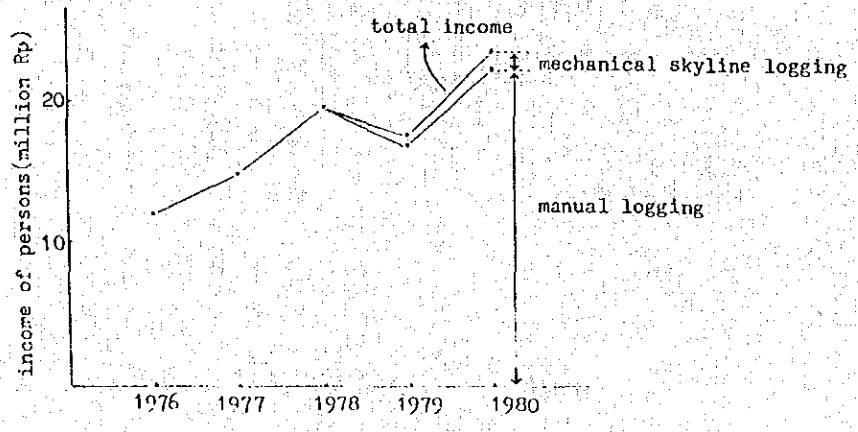


Table 1 Land use of Kecamatan Bumijawa (Jan.1,1981)

I T E M	AREA(ha)	%
Rice paddy	3,059.376	34
Crop field, Building, Farm, Pond	3,033.055	35
Forest, Park	2,421.030	31
River, Road, Cemetery, etc.	286.926	3
Total	8,855.887	100

Table 2 Comparison of statistics between Jan.1981 and Oct.1981 in Kecamatan Bumijawa

Table 2-1 Population by age & sex

AGE	Jan.1981			Oct.1981			DIFFERENCE (Oct-Jan)	REMARKES
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL		
0 - 4	4,798	4,749	9,547	4,907	5,013	9,920	+ 373	
5 - 9	4,480	4,765	9,245	4,120	4,455	8,575	- 670	
10 - 14	3,561	3,353	6,914	3,659	3,615	7,274	+ 360	
15 - 19	2,555	2,920	5,475	2,664	3,071	5,735	+ 260	
20 - 24	2,478	2,952	5,430	2,468	2,901	5,369	- 61	
25 - 29	2,846	3,358	6,204	2,909	3,324	6,233	+ 29	
30 - 39	2,889	3,267	6,156	2,883	3,265	6,148	- 8	
40 - 49	2,581	2,958	5,539	2,612	2,998	5,610	+ 71	
50 - 59	1,767	2,141	3,908	1,835	2,239	4,074	+ 166	
60 Over	1,096	1,267	2,363	1,129	1,335	2,464	+ 101	
Total	29,051	31,730	60,781	29,186	32,216	61,402	+ 621	
10 - 60	18,677	20,949	39,626	19,030	21,413	40,443	+ 817	*Labor force

Table 2-2 Population by occupation (Over 10 yrs)

I T E M	Jan.1981	Oct.1981	Difference(Oct-Jan)
Agricultural land owner	14,665	14,652	- 13
Agricultural worker	13,990	14,455	+ 465
Business man	392	391	- 1
Factory worker	168	168	0
Construction worker	999	1,105	+ 105
Merchant	3,534	4,045	+ 551
Transport business	833	882	+ 43
Public official	394	408	+ 10
Pensioner	111	103	- 8
Others	6,503	6,698	+ 195
Total	41,589	42,907	+1,318

Table 2-3 Population change

I T E M	Jan.1981			Oct.1981			DIFFERENCE
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	
Moving-out	46	58	104	-	-	-	-
Moving-in	1	-	1	5	1	6	+ 5
Birth	49	44	93	36	39	75	- 18
Death	14	20	34	13	14	27	- 7

Table 3 Comparison of statistics between Dec.1,1976 and Oct.1,1981 in Kecamatan Bumijawa

Table 3-1 Population by age & sex

AGE	Dec.1976			Oct.1981			Difference(1981-1976)		
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
0 - 4	3,519	4,115	7,634	4,907	5,013	9,920	+ 1,388	+ 898	+ 2,285
5 - 9	3,225	3,590	6,815	4,120	4,455	8,575	+ 895	+ 865	+ 1,760
10 - 14	3,441	3,659	7,100	3,659	3,615	7,274	+ 218	- 44	+ 174
15 - 24	3,791	4,374	8,165						
25 - 34	3,503	4,109	7,612						
35 - 44	3,276	3,579	6,855						
45 - 54	2,562	3,021	5,583						
55 - 64	2,193	2,452	4,645						
65 Over	930	1,058	1,988						
Total	26,440	29,957	56,397	29,186	32,216	61,402	+ 2,746	+ 2,259	+ 5,005
10 - 54	16,573	18,742	35,315	*Labor force					

Table 3-2 Population by occupation (Over 10 yrs)

I T E M	1976	1981	Difference
Agricultural land owner	13,581	14,652	+ 1,071
Agricultural worker	13,088	14,455	+ 1,367
Business man	234	391	+ 157
Factory worker	60	168	+ 108
Construction worker	419	1,105	+ 686
Merchant	2,284	4,045	+ 1,761
Transport business	50	882	+ 832
Public official	723	408	- 315
Pensioner	74	103	+ 29
Others	10,835	6,698	- 4,137
Total	41,348	42,907	+ 1,559

Table 3-3 Population change

I T E M	Dec.1976			Oct.1981			DIFFERENCE
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	
Moving-out	5	7	12	-	-	-	-
Moving-in	9	5	14	5	1	6	- 8
Birth	38	51	89	36	39	75	- 14
Death	38	36	74	13	14	27	- 47

Table 3-4 Durable consumer goods

I T E M	1976	1981	DIFFERENCE
Radio	585	421	- 164
Television	10	178	+ 160
Bicycle	38	54	+ 16
Motorcycle	37	68	+ 31
Car	4	8	+ 4
Taxi	-	-	-
Bus	-	-	-
Micro bus	12	37	+ 25
Truck	4	3	- 1

Table 4

Results of the questionnaire

Person / Item	A	B	C	D	E	F	G	H	I	J
Age	45	45	50	50	41	42	35	47	51	28
Family Male	2	3	2	2	1	1	3	2	5	2
Family Female	2	1	2	2	2		2	2		1
House (m^2)	35	24	35	35	24	35	35	35	15	35
Rice paddy (m^2)	-	-	-	-	-	-	-	-	-	-
Crop field (m^2)	500	800	17.50	500	2500	500	2000	1700	500	250
Cattles	-	-	2	4	7	8	4	2	-	4
Annual income from the crop field (RP)	8000	16000	20000	8000	20000	8000	24000		12000	8000
(Monthly)	(666)	(1333)	(1666)	(666)	(1666)	(666)	(2000)		(1000)	(666)
Rising time	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Breakfast time	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Lunch time	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Dinner time	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Working hour	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Working day per month	13.00 26	13.00 26	13.00 26	13.00 26	13.00 26	13.00 26	13.00 26	13.00 26	13.00 26	13.00 26
Daily wage (Rp)	500	500	500	500	500	500	750	500	600	500
Monthly income from wage labor	13000	13000	13000	13000	3000	13000	19500	13000	15600	13000
From other sources	7500	6000	6000	6000	6000	7500	6000	15000	8000	
Total (Rp)	20500	19000	19000	19000	19000	20500	25500	28000	23600	13000
Manthly expense										
①Food	15000	15000	15000	15000	15000	15000	22500	15000	18000	12000
Engel's coefficient	(73%)	(78%)	(78%)	(78%)	(78%)	(73%)	(88%)	(53%)	(76%)	(92%)
②Clothing					1500					
③Education		250								
④Deposit										
⑤Tax	50						50	50		
⑥Medicare		1000		1000		1000		2000	1500	
⑦Others	2000	2000	2000	2000	2000	2000	2000	2000	2000	1500
Total	17050	18250	17000	18000	18500	16000	24550	19500	21500	13500
Education			Elementary 3rd grade		Elementary 3rd grade		Elementary 3rd grade		Elementary 4th grade	
Tumpangsari (HA)						0.25	0.25	0.25		

Figure 1

Employment enlargement and income increase by other forestry activities

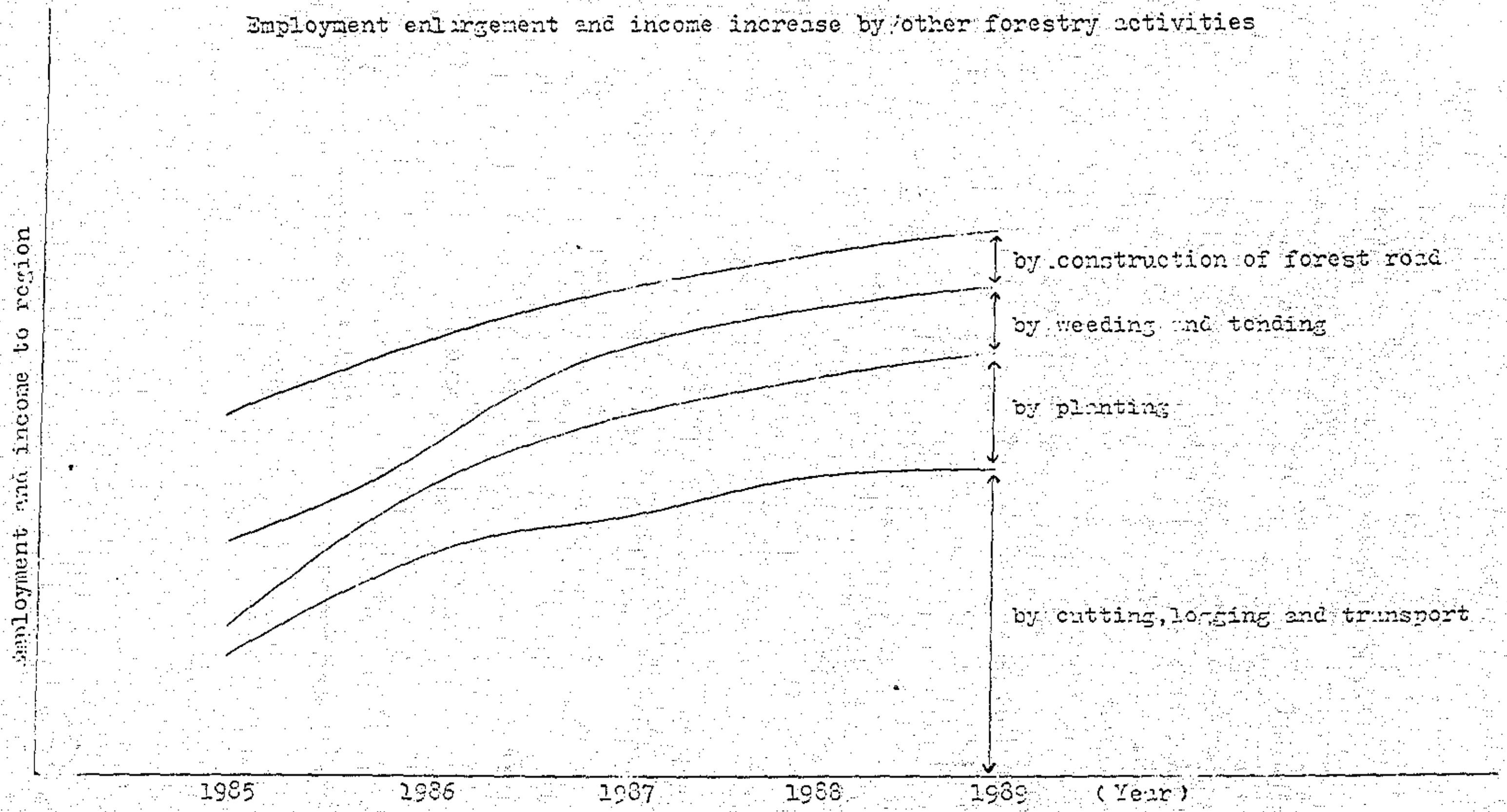


Table 5 Population & Consumer goods in Desa Bumijawa

Item	Dec.1976	Oct.1981	Difference
Total population	6,961	7,931	+ 970
Population by occupation			
Agricultural land owner	1,109	617	- 492
Agricultural worker	530	1,479	+ 949
Business man	-	-	-
Factory worker	-	-	-
Construction worker	85	98	+ 13
Merchant	1,621	1,765	+ 144
Transport worker	7	9	+ 2
Public official	545	204	- 341
Pensioner	36	50	+ 14
Others	1,440	1,106	- 334
Total	5,373	5,328	- 45
Population change			
Moving-out	3	-	- 3
Moving-in	4	3	- 1
Birth	12	3	- 9
Death	10	-	- 10
Durable consumer goods			
Radio	128	60	- 68
Television	5	101	+ 96
Bicycle	48	15	- 33
Motorcycle	12	25	+ 13
Car	4	8	+ 4
Taxi	-	-	-
Bus	-	-	-
Micro bus	7	25	+ 18
Truck	5	2	- 3

Table 6 Number of land owning farmers and agricultural workers

	1976		1986		Difference	
	Land-owning Farmer	Agricultural Worker	Land-owning Farmer	Agricultural Worker	Land-owning Farmer	Agricultural Worker
1. Bumi jawa	1109	530	617	1479	-437	+949
2. Gunung Agung	924	841	725	1124	-437	+283
3. Gintamanik	1500	500	1550	1228	+ 50	+728
4. Guci	527	695	540	645	+ 13	- 50
5. Sigedong	873	652	1440	702	+567	+ 50
6. Pegawat	775	649	756	1265	- 19	+616
7. Batumerah	565	467	665	753	+100	+286
8. Gempaka	948	1015	1445	470	+497	+545
9. Jejeg	165	361	389	361	+224	0
10. Muncang Larang	602	1100	631	1772	+ 29	+672
11. Traju	575	875	482	785	- 93	- 30
12. Pagerkasih	168	402	321	551	+153	+144
13. Cawitali	980	390	470	430	-510	+ 40
14. Carul	90	120	190	211	-100	+ 91
15. Sokatengah	753	970	744	992	- 9	+ 22
16. Sumbega	968	964	811	84	-157	-880
17. Sokasari	659	946	1521	412	+862	-534
18. Dukuh Benda	1400	1671	1400	1675	0	+ 4

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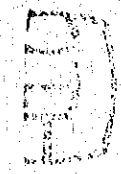

PERUM PERHUTANI

ASSUMING THE EXTRACTION OF THE PINE FOREST IN PEKALONGAN BARAT

by

Mochamad Rochmadi

BIRO PERENCANAAN
UNIT I PERUM PERHUTANI JAWA TENGAH

ASSUMING THE EXTRACTION OF THE PINE FOREST
IN PEKALONGAN BARAT.

Table of Content :

1. INTRODUCTION.

This paper is written in relation to the letter from the Perum Perhutani Board of Directors dated December 1, 1981 with the number 006.8/Dir. The letter states that a seminar called "Roving Seminar on Mountain Logging" will be held. The seminar is aimed at reaching some more quantitative alternatives concerning the logging system in relation to the wood supply of a paper factory in Cilacap.

It is to support the aims of the seminar that the Perum Perhutani Unit I of Central Java provides this paper, which is entitled "Assuming the Extraction of the Pine Forest in Pekalongan Barat".

A plan to set up a paper factory with the basic material taken from the areas nearby Mount Slamet was made arround 1954. There have always been, however, some difficulties so that for a long time no actions to carry out the plan could be done.

It was only in 1975 that the carrying out of the plan was started with first, holding an orientation system of stand inventory, later taking aerial photography, and in 1980 an inventory was done through a census of the trees.

Besides, a feasibility study was held by both Perum Perhutani itself and the Finland consultants. Where as the logging plan, which is still in the form of a draft, is

poured in two papers. They are "Logging Plan", a paper written by Ir. Moch Rochmadi and Ir. Soenarto; and a report written by Jica "Report on the Forest Inventory for Management and Logging in Central Java". It is clear , therefore, that an "Operation plan" for the area is terribly needed before the factory is established.

After a tree census in Pekalongan Barat, Banyumas Barat and Banyumas Timur Forest District, all are supplier areas of the raw material, was done, it was proved that no problems will raise as long as the potency of raw is concerned. What needs to be considered in the coming days is to change the distance of trees in order to increase the wood volume.

The present distance, i.e 3 X 2 should be change into 3 X 1. This means narrowing the area which will be decided as the supplier area of the paper factory.

From the socio-economic data of the area, it is known that the labours, in general, area farmers, estate - workers, and those taking a part time job in tapping. Besides working at their rice fields, the farmers also, raise cattles such as cows and goats. The standard wage ranges from Rp. 500,- to Rp. 1.000,- per day.

The manpower/labour force in Pekalongan Barat Forest - District is centralized in the regencies of Tegal and Brebes.

The Regency of Tegal : 296 villages with 178.023 adult male labours.

The Regency of Brebes : 290 villages with 318.429 adult male labours.

Where as for the centers of forest workers, the data are as follows : Bumijawa (10,000), Lebaksiu (9,000), Bojong (10,200), Salem (23,000), Bantarkawung (19,700), Bumiayu (16,500), Paguyangan (13,200), Sirampok (14,300).

In a glance it might seem that there is no problems concerning the labour force. Nevertheles, it cannot be denied that to work in the field of forestry, the labours need some skills. They need to make themselves get used to livin in forests which apparently differs from living as farmers. Therefore, a special training is needed for the labours besides for sure an attractive wage should be offered.

The topography varies. Below 15° ± 24%; between 15° - 20° ± 13%; above 20° ± 63%; while those above 30° amount to 25%.

Besides the topographical problem, there is also a problem due to the location of the felling compartments. They are close to rice fields and other dry fields so [illegible] special arrangement is needed in order to prevent [illegible] from watershed aspect or soil erosion [illegible]. Therefore a possibility of separete exploi- [illegible] regarding the economic and financial

considerations is needed to be thought of.

Viewing the facts about the potency of the forest, the topography, the labour source, and the great need for wood from the paper factory, the followings used to be well arranged :

a. The felling plan during rotation.

b. The first 5 year felling plan, the second 5 year and so on.

c. The planning of forest roads.

d. The felling patterns.

e. The yarding patterns.

f. The bucking patterns.

g. The scalling and grading patterns.

h. The wagoning patterns.

i. The replanting patterns.

And last but not least, a calculations of the production cost should be made.

2. EXTRACTION POLICY OF PINE FOREST.

2.1. General Policy.

The general policy of pine forest extraction can be viewed through some aspects, namely labour force, watershed management system, effective usage of soil, and financial considerations :

a. Concerning the labour force, the extraction of forest products should absorb as many labours as possible, starting from the felling up to the providing of means of forest road / yarding. There are, however, some obstacles to the idea above, such as considerations of the topography and the field, the problem of skilled labours, the lack of labours in a certain district due to the availability of other jobs, competition in the wage and other benefits system, and also the existance of the local traditions/customs.

b. The felling is done in such a way so that it does not destroy the watershed management system and doesn't create a soil erosion. It can be done either by means of separate fellin compartments or the mostly suggested "Alternate Strip Felling".

c. The choosing of the area to be used as the supplier area to the paper factory should be as effectively as possible. It should be seen from

the distance to the factory, the possibility to increase the volume produced per hectare, and the total amount of the area provided.

d. The last one is financial considerations. It is to decide whether a certain extraction system is suitable or not. The financial considerations cover calculating the costs per compartment up to the whole forest district as the unit.

2.2. Operational Policy.

Besides the general policy, an operational policy is needed, it covers :

a. Forest Extraction Plan during Rotation.

This plan needs to be made in order to know whether the existing planting area can supply sufficiently the need of the paper factory during the already decided rotation time of pine, that is 20 years.

The following is scheme of the planting conditions in Unit I Central Java :

1.	Forest District	Pekalongan Barat	: 22,688 ha
2.	" "	Banyumas Barat	: 15,332 "
3.	" "	Banyumas Timur	: 14,764 "
4.	" "	Pekalongan Timur	: 19,704 "
5.	" "	Kedu Selatan	: 16,859 "
6.	" "	Magelang	: 12,836 "

7. Forest District Surakarta : 7,118 ha
8. " " Pati : 1,000 "

Whereas the areas chosen as the supplier areas within 10 years are :

1. Forest District Pekalongan Barat : 9,436 ha
2. " " Banyumas Barat : 31,565 "
3. " " Banyumas Timur : 6,155 "
4. " " Kedu Selatan : 9,594 "

Further, to serve as the permanent areas, the followings are chosen :

1. Forest District Banyumas Barat : 31,565 ha
2. " " Banyumas Timur : 6,155 "
3. A part of Forest District Kedu Selatan : 9,594 "

b. The Plan for the First five Year Felling, The Second etc.

The plan for the five year felling states the process of managing the felling, compartment by compartment following the decided time of felling. Felling is also arranged in accordance to the distribution of transportation areas and the distribution of felling centers.

Forest District Pekalongan Barat is divided into 3 Sub Districts (according to the ways/directions of the transportation) and each sub-district is divided into 4-6 felling centers.

The divisions are as follows :

1. The Sub-district Bumijawa with fellin centers I, II, III, IV, V and VI.
2. The Sub-district Bumiayu with felling centers I, II, III and IV.
3. The Sub-district Bantarkawung with felling centers I, II, III, IV, V and VI.

c. The Plan of Forest Roads.

A plan of forest road should be made to decide the roads which will be used to transport the wood from the forest to the village roads or the nearby public road. For this purpose, a classification of forest road is needed :

1. Main Road.
2. Side Road.
3. Skidding road.

A main road, is a road capable of transporting 40,000 m3 per year, or 150 m3 per day.

A side road, is a road capable of transporting 10,000 m3 per year, or 50 m3 per day.

A skidding road, is a road for tractors in helping either the cable yarding or transport the product down either to the temporary or permanent log yard.

For Forest District Pekalongan Barat the plan for the main road, including the budgeting, has

been made. The step by step carrying out of the plan will be started in 1982. Whereas for the side road, no plans have been made. It waits until the logging planning team starts their work.

d. Logging Planning.

The plan is made in details for each felling compartment, covering the following points :

1. The logging system, such as using cable, tractors or manual labour.
2. The amount of equipment and labours needed.
3. Deciding the side road, the skidding road etc.
4. Deciding the temporary log yard, the log yard itself, the location of the logistics, and the workshop.

The logging plan for Forest District Pekalongan Barat has not been made yet, and it is expected to be made in early 1982.

The working instructions of the logging plan is enclosed.

e. The Felling Pattern.

As long as the conditions permit, all the felling will be done manually. Chainsaw felling will only be done in an emergency situation resulting from the lack of labour force or when the time to supply the wood is pressing.

The payment of the felling product should be considered. Will it be in the forest, in the temporary log yard or in the log yard after the skidding and the bucking.

The unit of the payment should also be a point of consideration. Will it be in m2, or m3 / sm.

As long as possible, the labours work in the felling should own the felling equipment themselves.

f. Yarding Pattern.

The yarding system can be very simple using manual labours or mechanical means (cable - yarding and tractors).

As far as possible, manual yarding is preferable. This system of yarding, however, is very limited due to the difficult topography.

The payment of the wood after the yarding should be in the bucking place, and the unit used is m3 or sm.

Yarding equipments should be lent to the wood-cutters with certain conditions. Since a stem with a diameter of 7 cm is accepted by the paper factory as the raw material, the yarding of the whole part of trees is recommended.

g. The Bucking Pattern.

Since quality is not the main concern on the paper

factory, the bucking is only determined by whether or not the transportation by trucks to the factory faces difficulties. A stem with a length of 3 - 4 meters will therefore meet the requirements. Bucking is done manually by the truck road. The payment of the products after being bucked is done using m3 as the measurement unit.

h. The Scaling and Grading Patterns.

The decay of the stem is a point used to decide the grade of the pine stem, whereas the form of the stem doesn't determine the grade. Therefore, great attention to and good arrangement of the speed of the wood transportation to the factory should be given.

Since a stem with a diameter of 7 cm can be accepted, some considerations should be made. Those having a diameter of 7 - 14 cm should be measured with kg or sm as the unit of measurement. While for those having a diameter of 15 cm or more can use cubic measure with the help of a special table (the table of the volume of the stem including the bark).

i. The Wagging Pattern.

The recomended wagging system for this area is the contract system for the felling, yarding and the bucking as well. The standard wage in felling,

yarding and bucking should be kept in balance to prevent the labours from moving to another job. As a guide, the figures of balance below can be studied :

Felling (chainsaw)	= 0.25.
Skyline yarding	= 1.00.
Highlead yarding	= 1.00.
Tractor yarding	= 0.50.
Gravity skyline yarding	= 0.90.
bucking	= 0.15.

j. Replanting Pattern.

The stand condition in the year 1980 in Pekalongan Barat shows the following figures :

The wood volume	= 216 m3/ha
The number of trees	= 336 / ha
The volume per tree	= 0.6 m3

The planting distance in the beginning 3 X 2 m or N = ± 1500 trees / ha.

It is seen, then, that the number of trees at the end of the rotation (20 years) has decreased down to 20% of the whole number. Therefore, if effective usage of area is aimed at, a change in the planting distance is needed. It should be change from 3 X 2 m to 3 X 1, which means increasing the volume per hectare from 216 m3 to 396 m3.

3. ASSUMPTION OF LOGGING SYSTEM AND ITS EQUIPMENT.

Since the logging planning team has not started working yet, an assumption of the logging system and the amount of equipment needs to be made.

The determination is done based on the followings :

a. Using the topograpical features, the inclination of the five year felling areas are divided into :

- below 15°
- between 16-20°

Based on the above division, means of yarding can be decided. In the areas below 15° manual and tractor yarding can practised. While in the areas between 16 to 20° tractor and gravity skyline yarding can be used. For areas above 20° cable yarding is recommended.

b. With the table of volume per compartment and the topography, the logging system, amount of equipment and man-days can be decided.

c. To decide the amount of equipment, the following achievement data can be used :

Felling (cahinsaw)	= 40 m3/day
Tractor yarding	= 20 m3/day
Skyline yarding	= 15 m3/day
Highlead yarding	= 20 m3/day
Gravity yarding	= 20 m3/day
Bucking	= 30 m3/day
Manual felling (hand saw)	= 3 m3/day with 4 - 5 working hours per day.

(see appendix 2)

4. CONCLUSIONS AND SUGGESTIONS.

a. Mechanical system is needed as reserve factor.

b. Training for the mechanics is needed to maintain or make better the achievement.

c. A balance in wagging should be an important point of consideration.

d. Further thought is needed in the scaling and grading.

e. A logging planning team needs to be formed immediately.

A P P E N D I X 1

The Objectives/Working Instruction Of the Logging Planning Team In Forest District Pekalongan Barat.

1. Some Concepts :

1.1. Logging : The process of making trees into logs, ready to be transported by trucks. It covers the process of felling yarding, bucking and gathering in the log yard.

1.2. Scope : Each compartment / sub compartment has its own difficulties in the techniques of felling, labour force, wagging and ecological aspects. Therefore, the team has the task to decide the logging system for each compartment / sub compartment seen through the aspects of technical problems, socio-economic, finance and ecology.

The team is expected to be able to present a book on "Logging Planning" for the whole forest district of Pekalongan Barat by the end of 1982.

2. Technical Instructions:

2. Technical Instructions

2.1. Felling : The felling system highly recommended is one absorbing as many manual labours as possible. Exceptions are when there is a lack of labours or a lack of skilled labours, and when there is a time preasure in the supply of wood.

2.2. Skidding : The same as in the felling, manual yarding is preferable. When mechanical equipment is used, attention should be given to the determinants :

a. Scope : If 45% of the yarding need to be done with mechanical equipment, tractors can be used.
If it is more than 45%,

b. The stems/trees which are going to be extracted are not determined by the kinds of the stems, but by the diameter. All having a diameter of 7 cm or more are accepted. Therefore a consideration should be made when manual labours are used. The team should decide what sorting is done by the manual labours.

2.3. Bucking : Again the making use of manual labours is emphasizes. The determinants are :

- The labour, both the source and the skills.
- The amount of wood which should be available in the given time.

2.4. Two points should be well thought of in the felling yarding and bucking.

- a balance in the volume of wood to prevent an over stock of wood.
- a balance in the wagging system so that labours in the felling area do not move to other activities and vice versa.

2.5. After the logging system has been decided, to decide the log yard, the temporary log yard, the location of the logistics both for the spareparts and the workshop, should be made.

2.6. In deciding the yarding system, the availability of the skidding road and the side road have been thought of. Whereas for the main road, its plan has been made by the Planning Bureau, complete with its budget. Only it needs some corrections to make it better. The present criteria are as follows :

Main Road : It is a road capable of transporting 40,000 m3/year or ± 150 m3/day.

Side Road : It is a road capable of transporting 10,000 m3/year or ± 50 m3/day.

Skidding Road : It is a road used by tractors either to help the cable yarding or to transport the wood directly to the log yard or the temporary log yard.

2.7. Before deciding the above system, the following data should be considered :

a. the volume of wood / the number of trees per compartment.

b. the plan for the main road.

c. the data of labour source, labour transportation and also the skill of the labours.

d. a large scale topographical map, with a minimum of 10,000 or aerial photography.

The data a and b are available in the Planning Bureau except the aerial photography.

2.8. Before carrying out the field work, the followings need to be well arranged in the topographical map :

a. The directions of the transportation.

b. Means of transportations.

c. The log yard and the temporary log yard.

After this is done, there should be a field checking/ trial of this plan.

2.9. As the last point of the field work, the team will estimate the production cost for each area unit or compartment.

Therefore some concept of the expense components need to be known :

a. Regular Expenses :

1. Depreciation.
2. Expenditures (capital and investment).
3. Overhead / general expense.

b. Variable Expenses :

1. Materials :
   - Stumpage (seedlings and the arrangement).
   - Fuel and lubricant.
   - Spare parts.
2. Wages :
   - Operation felling and bucking.
   - Operation tractors and yarder.

Whereas for the cost estimation of each unit of mechanical equipment, the following points should be considered :

1. The depreciation of the equipment.
2. The maintanance.
3. The fuel and lubricant.
4. The salary/wages of the workers.
5. The expenses needed in making the strip road (the trail road).

2.10. The supporting data that need some attention :

a. Work Achievement.

a. Work Achievement.

Felling (chain saw)	: 40 m3/day.
Tractor yarding	: 20-25 m3/day.
Skyline yarding	: 15-20 m3/day.
Highlead yarding	: 25 m3/day.
Gravity skyline yarding	: 20 m3/day.
Bucking	: 30 m3/day.
Manual Felling (hand saw)	: 2-3 m3/day with 4-5 working hours.

b. Wages. Figures of balance among the various kinds of work as follows need to be considered :

Felling (chain saw)	: 0.25
Skyline yarding	: 1.00
Highlead yarding	: 1.00
Tractor yarding	: 0.50
Gravity skyline	: 0.90
Bucking	: 0.125

SALATIGA, November 26, 1981.
Head of the Planning Bureau,

(Ir. Moch Rochmadi).-
NIP. : 080013294.

Appendix 2

ASSUMPTION OF LOGGING SYSTEM IN PEKALONGAN BARAT.

Slope Area			Volume of standing stock with in slope area				Assumption of logging system by		
≤ 15° (%)	15°-20° (%)	> 20° (%)	< 15° (m3)	15°-20° (m3)	> 20° (m3)	Total (m3)	Manual	Tractor	Yarder
2	3	4	5	6	7	8	9	10	11
100	-	-	973	-	-	973	1	-	-
100	-	-	7.256	-	-	7.256	48	-	-
100	-	-	2.620	-	-	2.620	17	-	-
100	-	-	4.328	-	-	4.328	29	-	-
-	100	-	-	4.424	-	4.424	-	1	-
45	-	55	6.087	-	7.431	13.518	41	-	2
-	61	39	-	23.847	15.247	39.094	-	4	3
25	-	75	1.296	-	3.888	5.184	9	-	1
100	-	-	750	-	-	750	5	-	-
22	65	13	2.720	8.036	1.607	12.363	18	1	1
84	-	16	14.297	-	2.723	17.020	95	-	
78	-	22	25.966	-	7.041	33.007	173	-	2
-	-	100	-	-	21.233	21.233	-	-	
-	-	100	-	-	20.550	20.550	-	-	5
-	-	100	-	-	1.773	1.773	-	-	
-	-	100	-	-	22.746	22.746	-	-	5
-	-	100	-	-	34.065	34.065	-	-	7
-	-	100	-	-	19.164	19.164	-	-	7
-	-	100	-	-	13.801	13.801	-	-	
24	13	63	66.293	36.307	171.269	273.869	441 -	6 1	37 1

Manual = 150 m3/th.

Tractor = 6000 m3/th

Yarder = 4500 m3/th

PERUM PERHUTANI UNIT I
JAWA TENGAH

SOME NOTE ON VARIOUS LOGGING TRIALS AND PRACTICIES AND THEIR APPLICATION POSSIBILITY FOR SUPPLYING RAW MATERIAL OF PAPER MILL (CILACAP)

BY

BUREAU OF PRODUCTION.

C O N T E N T S

==========M/S==========

SOME NOTE ON VARIOUS LOGGING TRIALS AND PRACTICIES AND THEIR APPLICATION POSSIBILITY FOR SUPPLYING RAW MATERIAL OF PAPER MILL (CILACAP)

I. INTRODUCTION.

Based on Letter of Decision No. 11/Perum Perhutani/I/1975 on planing of Raw Material Supply for a Paper Factory in Central Java, deliberate preparations should be made for the success of the establishment of the above paper mill for which the required raw material is approximately 1,500 m3 daily. (The abovementiened preparations include the following fields).

Production area assignment.

According to inventory data of 1978, the existing pine stand assigned for supplying raw material are as follows :

Pakalongan Barat, Banyumas Barat/Timur, Kedu Selatan Forest Districts.

Age class	Area Extent	AVERAGE			PRODUCTION	
		Site quality	Basal area	Age	1 Ha. (m3).	Total (m3.)
VIII	291.9	3	0.7	37.5	207.2	60,482
VII	279.4	3	0.7	32.5	207.2	57,892
VI	1,103.1	3	0.7	27.5	186.2	205,397
V	2,586.9	3	0.7	22.5	159.9	413,783
IV	2.377.1	3	0.7	17.5	121.4	409,980
III	3.544.9	3	0.7	12.5	121.4	430,357
II	8.764.3	3	0.7	7.5	121.4	1,063,992
I	33,178.3	3	0.7	2.5	121.4	4,027,946
Total	53,125.9					6,669,729

As shown in the table the age classes are distributed unevenly where young age classes (i.e. I and II).
Consequently, the execution of felling needs more accurate assignment.

In this calculation the potency that will be extracted only from the four Forest Districts, where the Kedu Selatan Forest District is considered as a reserve.

Total of 4 Forest District 53.126 Ha production 6.669.729 m3.
Kedu Selatan Forest District 8.770 Ha production 1.064.678 m3.

Remainder 44.356 Ha production 5.605.051 m3.

So, annual cutting = $\frac{44,357 \text{ Ha}}{20}$ = 2,218 Ha per year.

volume = $\frac{5,605,051}{20}$ x 80% = $\pm$ 224,200 m3 per year.

(Rotation is determined for 20 years).

II. FELLING SYSTEMS.

A fairly accurate execution of felling is needed, in Order to reach optimum efficiency of exploitation without damaging environments, particularly in hydro and orological aspects.
The following division of forest use has been sugested to determine the felling systems;

* a. Absolute protection forests : 2,000 meters above sea-level, or with an elevation of 55° and up.
* b. Limited protection forests : 500 - 2,000 meters above sea-level or with an elevation between 45° - 55°.
* c. Production forest : 500 meters above sea-level and an elevation of less than 55°.

These outlines necessitate a division of the assigned areas according to their related functions. Point a) should absolutely be excluded from the production calculation, while for point b) limited felling is still possible by selection, strip system or chasbeard folling. Clear felling may be performed for point c) by placing prohibition marks on the side of existing ravines.

III. SKIDDING ACCORDING TO ELEVATION.

Timber Skidding from filling compartments to transportation reads needs energy and thoughts.some Skidding methods have been attempted of which the data are as follows :

3.1. Skidding or carrying on shoulders for elevations of 1 - 10°

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Timber Skidding from filling compartments to transportation reads needs energy and thoughts.some Skidding methods have been attempted of which the data are as follows :

3.1. Skidding or carrying on shoulders for elevations of 1 - 10°

3.2. Trucks or unimogs can be utilized for elevations of 15° - 25° (resource : The forest inventory for management and logging in Central Java);

3.3. For greater elevations or elevations more than 25° Yarders and/or gravity skylines can be used.

IV. VARIOUS FELLING AND BUCKING METHOD.

Felling preparations, among others division of blocks, control-shelters and logyards, will not be discussed here since they belong to routine work without many problems.
The discussion will be limited to the felling system. As previously explained in the preface, the required raw material supply for the Cilacap paper factory is approximately 1,500 m3 daily and estimated at 540,000 m3 annualy = 90,000 tons of pulp.

It is not easy to meet this requirement; accurate calculations with all considerations supported by past experiences and experiments are therefore needed in order to achieve what has been planned, through efficient quantity and time determinations.

Several felling methods can be explained as follows :

4.1. Manual felling and bucking.

Experiences in manual felling and bucking by using handsaw show that each pair (two persons) can produce 3-4 m3 daily, so that if a daily labourer earns Rp.750.- per day the intake price will be Rp.375.- - Rp.500.-/m3. Teh required number of labourers will be $\frac{1,500}{4} \times 2 = 750$ to $\frac{1,500}{3} \times 2 = 1,000$.

4.2. One man chain saw.

If the number of labourers is considered excessive or the speed of time is not in accordance with the requirement, utilization of chain saws may be considered.

According to the report on the working tour to Japan (R. Djumadi & Karjadi) the ability of chain saws is as follows :

*- Quantity of Bucking :

- conifer : 8 to 12 m3/day.
- broad leaf : 10 to 14 m3/day.

*- Sawing efficiency of conifer :

- 60 cc : 50 Cm2 - 60 Cm2 / second.
- 100 cc : 60 Cm2 - 80 Cm2 / second.

*- Life time and purchasing price of chain saws.

Engine displacement	Life time	Price
50 cc	3 years	Y 100,000 to Y 210,000
60 cc	3 years	Y Y 220,000
80 cc	3 years	Y Y 230,000
100 cc	3 years	Y Y 240,000

Source : Report on working tour to Japan, Mr. Djumadi & Mr. Karjadi.

Training in the use of this equipment might be performed, since there are no past experiences.

V. VARIOUS SKIDDING METHOD.

Since the location of the pine timber exploitation is generally to be found in mountainous areas, this work is an activity that having the most problems and needs a great investment. The longer the transportation roads the shorter the skidding distance, or reversely, the longer the skidding distance, the shorter the required transportation distance. Selection of both systems is dependent on the economic calculation. Several skidding methods had been done and tried are among other :

5.1. Manual yarding.

On gently sloping terrains of $\geq 10^{\circ}$ yarding is done by using man power; resulted ability : 0,32 m3 one person daily, covering distance of 3 km, required cost for each m3 for 3 km is 3 x Rp.750 = Rp.2.250,-/m3.

Logging by using man-power is suggested for gently sloping terrains as this work can absorb many labourers at relatively low costs. If logging animals are utilized the results will increase with 1 m3 daily covering a distance of 3 km.

5.2. Skidding by Unimog/tractors.

According to "The forest inventory for management and logging in Central Java" for skidding on elevations of 10° - 25° it is desirable to utilize tractors or unimogs. The most optimal distance is 400 meters so that the capacity will be as follows : 4,680 kg or aproximately 3,90 m3 (6 x 0.65 m3) will be conveyed each time or daily in 6 hours : $\frac{60 \text{ minutes}}{40 \text{ minutes}}$ x 6 (hours) x 3,90 m3 = 35 m3.

Costs for each m3:

1. Depreciation : $\frac{\text{Rp.22.000.000 - Rp.2.200.000 (residue)}}{\text{5.000 (lifetime hours)}}$

$$\frac{\text{Rp.3.960/hour}}{\text{5,8 m3/hour}} = \text{Rp.683,-/m3.}$$

2. Maintenance is very dependent on the way of using and work-site.

$$\frac{\text{Rp.22.000.000 x 0,48}}{\text{5.000 (lifetime haurs)}} = \frac{\text{Rp.2.112 (hours)}}{\text{5,8/m3.}} = \text{Rp.364,-/m3.}$$

3. Fuel/oil = $\frac{\text{Rp.225/hour}}{\text{5,8 m3}}$ = Rp.43,-/m3.

4. Labour :

   Driver Rp.1.000/day = Rp.1.000/6 hours.

   2. loading-unloading Rp.600,- each = Rp.600/6 hours.

   Total = Rp.1.600/6 hours/35 m3 = Rp.46/m3.

5. Strip road 10 m/ha = 10 m/125 m3 or $\frac{\text{10 m x Rp.5.000,-}}{\text{125 m3}}$ = Rp.400/m3.

Total amount (point 1, 2, 3, 4 and 5) = Rp.1.535,-

The abovementioned calculations area based on the situation in 1978, it can be carried out if the execution is in accordance with the outlines and field conditions similar to the situation in Japan.

Experiences in East Java show that utilization of Unimog on elevations of 15 - 40° the required costs are Rp.1.000 - Rp.1.800/m3 for an average distance of 500 meters.

5.3. Cost-price calculation.

*- Utilization of Yarder.

According to the Forest inventory for management and logging in Central Java.

The price of one Yarder unit is Rp.26.000.000,-

with several Yarder lifetimes and artificial spartrees;each m3 is charged with Rp.1.806,- excluded the price of the cale (prices attached) with a cable span of 400 m, each day working for produc ing 6 hour x 5 rit x 0,65 m3 = 19,5 m3.

*- Engine maintenance/repairation :

a. $\frac{1.166.900 \times 0,45}{6.000 \text{ hours}}$ = Rp.875/hour : 3,3 (m3) = Rp.262,45.

b. Artificial spartree + telephone .:

$\frac{3.134.000 \times 0,1}{6.000 \text{ hours}}$ = 52 hours : 3,3 (m3 = Rp.15,60.

c. Fuel + oil = Rp. 44,70.

d. Labour costs :

- Yarder driver 1 person Rp.1.000 = Rp.1.000,-
- Loading labourere 2 persons Rp.600 each = Rp.1.200,-
- Unloading labourer 1 person Rp.300,- = Rp.300,-

Charge for each m3 = $\frac{\text{Rp.2.500,-}}{6 \text{ (hours)} \times 3,4 \text{ (m3)}}$ = Rp.125,-.

Costs for fitting the skyline.

35 man day are required for the fitting at Rp.300 each=Rp.10.500,-

I yarder unit can cover 65 km.

Average production of each ha is 115 m3. Total production is 6,5 x 115 = 747 m3, so the charge for the fitting is for each m3 = $\frac{\text{Rp.10.500}}{747}$ = Rp.14,-

Cost for strip road construction.

According to calculations each ha needs a strip road of 5 m at the cost of Rp.5.000.000/km, so that each ha need a cost of $\frac{5 \times 5.000.000}{1.000}$ = Rp.25.000,- and each m3 is charge with $\frac{25.000}{115}$ = Rp.218,-

The cost for each m3 will become ;

Rp.1,806,06 + Rp.262,45 + Rp.15,60 + Rp.44,70 + Rp.125 + Rp.14,- + Rp.218 = Rp.2.485,81. This calculation is based on the situation of 1978.

5.4. According to experiences in executing MLP by the Pekalongan Barat Forest District in 1981.

Distance approximately 800 meters.

Working time 4 hours each day, 20 working days each month.

Production :

June	147,037 m3,	expenses Rp.	299,182,80
July	147,725 m3,	expenses Rp.	346.762,89
August	73,275 m3,	expenses Rp.	341.308,90
September	203,586 m3,	expenses Rp.	450.694,60
October	228,550 m3,	expenses Rp.	1.175.585,22.
Total	800,117 m3		Rp.2.613.534,41.

392 Sm of firewood is added to the abovementioned production.

If 2 Sm is equal to 1 m3, the average cost will be :

Rp. $\frac{2.613.534,41}{996.197\ (m3)}$ = Rp.2.623,50, depreciation cost net included.

The abovementioned calculation shows that the execution in Pekalongan Barat is higher than the existing outlines, because the transportation distance is twice the outline and working time is only 4 hours a day. If the execution is conformed with working time and the distance with the outline, the result will be : $\frac{4}{6}$ x Rp.2.623.50 : 2 = Rp.874,50/m3.

This amount is added with the cost for spillage of Rp.1.806,06 + Rp.874,50 = Rp.2,680,56. It must be noted that the spillage cost is based on calculation of 1978.

The purpose of executing the MLP by Perhutani is to utilize MLP graduates whose number will be 60 at the end of mid 1982. For the time being 4 persons are used out of 36 MLP graduates.

It is intended to utilize 32 (36 - 2) graduates in phases, including 24 persons who have not yet graduated, with intervals of 4 months. After being employed the 36 persons are expected to be more prepared in facing the paper factory in the future.

They will be employed not only in the Pekalongan Barat Forest Dis - trict, but also in other Pine Forest Districts, certainly in accordance with the allocation of the pine felling fixed Felling Plan in the abovemontioned Pine Forest Districts.
Beside employeing those MLP graduates, local manual labourers will be practically taught in the use of skyline equipments.
Thus, when felling time comes in the framework of the operation of the paper factory, we already have a number of manual labours having practical knowledge in the use of skyline equipments.

According to reports of the MLP project, the following are available at present :

*- 18 yarders complete with equipments.
*- 4 tractors.
*- 2 truck cranes.
*- 14 transportation vehicles complete with spareparts.

5.5. Utilization of gravity skyline.

The following experiences are obtained by the Forest Districts in using the gravity skyline :

*- Sliding/logging distance = 600 m.
*- Price per unit in 1976 : Rp.1.259.000,-
*- Operators and assistants :
2 operators Rp.1,000/day each.
6 assistants Rp.300/day each.
Fitting cost for 15 days by 4 persons = 60 man days at Rp.300 each. (converingdistance aboutl,5 Ha).
Expenses to be paid for each m3/600 = are.

- Labour cost : $\frac{2 \times Rp.1,000 + 6 \times Rp.300}{15\ m3.}$ = Rp.253,30
- Fitting cost : $\frac{60 \times Rp.300}{(1,5\ ha \times 115\ m3) = 172}$ = Rp.106,65

Rp.359,95.

- Cost of spillage cannot to calculated yet as lifetime is not yet fixed.

Since the abovementioned equipments are relatively cheap, consideration of use can be made for high and level terrains.

VI. CONCLUSIONS.

6.1. Forest potency.

- The Pine forest potency does not include the Kedu Selatan Forest District which have 44,357 Ha = 5,605,051 m3 at mean annual cutting = $\frac{44.357}{20 \text{ years}}$ = 2,218 ha, while volume etat is $\frac{5.605.051}{20 \text{ years}}$ = 280,253 m3 = approximately 1,120 m3/day.

- If the Kedu Selatan Forest District is not a reserve, the Pine forest potency for paper purposes is 53 127 Ha with an estimated volume of 6.669.729 m3. Extent etat become $\frac{53,127}{20 \text{ years}}$ = 2,669 35 m3. volume etat become $\frac{6.669.729}{20 \text{ years}}$ = 333,487 m3 = 1,334 m3/day. (one year = 250 working days).

- The above potency extent must be reduced with areas of absolute protection forests. Field inventory should be made for that purpose.

- If the requirement of the paper factory is 1.500 m3/day or yearly (250 days) = 375.000 m3, the existing potency will not be sufficient; the requirement is suggested to be less than 1.500 m3/day.

6.2. Felling and bucking.

- Tree felling echievement by man power : 3 - 4 m3/2 persons.
- Felling and bucking by using chain saws : 8 - 12 m3/day for pine timber, while for broad leaf 10 - 14 m3/day.
- Sawing efficiency of conifer.
  energy 60 cc : 50 Cm2 - 60 Cm2/second.
  energy 100 cc : 60 Cm2 - 80 Cm2/second.
- Life time and purchasing price of chain saws :

Engine displacement	Life time	Price
50 cc	3 years	Y 160.000 to Y 210.000
60 cc	3 years	Y 190,000 to Y 220.000
80 cc	3 years	Y 200.000 to Y 230.000
100 cc	3 years	Y 210.000 to Y 230.000