In the field of land use and vegetation, discussions were held on the finalisation of land use criteria while OJT was provided on the site investigation method to prepare a land use and vegetation map.

In the field of soil, OJT was provided on the method to select soil profile survey sites, methods to observe and describe soil profiles and the method to prepare a base soil map.

In the field of environmental impacts, OJT was provided on the initial environmental evaluation (IEE) method.

In the field of surveying and mapping, OJT was provided on the surveying of orientation points, levelling surveying and photographic field surveying, etc. Furthermore, the principles and utilisation of the GPS, essential for a field survey, was explained using portable equipment. As part of the transfer of technology programme, lectures on the present state of social forestry in Indonesia, social forestry in the world, outline and basic principles of the present Study, reforestation and agroforestry, watershed conservation and initial environmental evaluation (assessment), etc. were done on October 9, 1995 in a seminar held in Kupang.

IX-2 Transfer of Technology in Japan

Lectures and practical training were conducted in Japan for Mr. Johny J. Kawulusan of Sub Bali RLKT Benain Noelmina on such issues as forestry and the forest products industry in Japan, forest planning system, erosion control and reforestation, aerial forest surveying, remote sensing, GIS and surveying techniques, etc.

In regard to aerial forest surveying, the lecture and practical training included the interpretation and mapping of land use and vegetation using aerial photographs and tree height measurement, etc. on aerial photographs. In addition, training on the on-site interpretation of aerial photographs was conducted at a national forest located in Takao, Tokyo. A lecture and practical training on the basic operation of the ERDAS, a lecture and practical training on the basic operation of the Arc/Info of the GIS and a lecture on aerial triangulation and GPS surveying techniques were also provided.

Furthermore, the counterpart visited an example of Japanese forestry practices at Kitayama, Kyoto and also visited a hydrological observation and research site and a hillside work site in the Aichi Demonstration Forest of Tokyo University in Seto. The training schedule in Japan is summarised below.

Date	Training Subject(s)	Venue(s)	Location
Mar. 3	Briefing	JICA	Shinjuku-ku, Tokyo
	Courtesy visit to Ministry of Agriculture, Forestry and Fisheries	Ministry of Agriculture, Forestry and Fisheries	Chiyoda-ku, Tokyo
Mar. 6 - 10	Remote sensing, GIS, surveying	Pasco International	Setagaya-ku, Tokyo
Mar. 13 - 17	Japanese forestry and forest products industry, forest planning system, erosion control and reforestation, aerial forest surveying	Japan Forest Technical Association (JAFTA)	Chiyoda-ku, Tokyo
Mar. 20 - 24	General forestry study	Forestry and Forest Products Research Institute	Inashiki District, Ibaragi
	Timber tree breeding	Timber Tree Breeding Centre	Mito City, Ibaragi
Mar. 27 - 30	Man-made forest operation	Kato Forest Products Co., Ltd.	Kyoto City, Kyoto
	Forest conservation	Kansai Branch, Forest and Forest Products Research Institute	Kyoto City, Kyoto
	Forest (land) rehabilitation and hydrological research	Aichi demonstration forest of Faculty of Agriculture, Tokyo University	Seto City, Aichi
	Evaluation meeting	JICA Tokyo International Training Centre	Shibuya-ku, Tokyo

The counterpart Mr. Stefanus M. Saek who visited Japan between October 24 and November 21, 1995 been briefed in Japanese forestry and forestry industry, forestry planning, afforestation, watershed conservation, GPS, aerial surveying, etc. through lectures and actual practice, A summary of his schedule is as follows.

Date	Subject of Training	Trainer	Location
Oct. 25-27	Briefing	JICA	Shinjuku-ku, Tokyo
	Visit to the Ministry of Agriculture, Forestry and Fisheries	Ministry of Agriculture, Forestry and Fisheries	Chiyoda-ku
	Japanese forestry and forestry industry, forestry planning, afforestation watershed conservation	Japan Forest Technical Association (JAFTA)	Chiyoda-ku
Oct. 30-Nov. 2	Overview of GPS	Pasco International Co., Ltd.	Setagaya-ku, Tokyo
	Observation of watershed conservation works	Maebashi Regional Forestry Office	Maebashi, Gunma
	Observation of man-made and natural forests	Ose Ringyo Co., Ltd.	Maebashi Gunma
	Disaster Prevention Forests	Gunma Prefecture Forest Conservation Division	Maebashi Gunma
Nov. 6-10	General forestry training	Forestry and Forest Products Research Institute	Inashiki District, Ibaragi
	Water and soil conservation and disaster prevention research	Forestry and Forest Products Research Institute	Inashiki District, Ibaragi
	Aerial forest surveying	JAFTA	Chiyoda-ku, Tokyo
Nov. 13-17	Hydrology, observation of hillside works	Aichi demonstration forest of Faculty of Agriculture, Tokyo University	Seto City, Aichi
	Observation of soil erosion tests	Aichi demonstration forest of Faculty of Agriculture, Tokyo University	Seto City, Aichi
	Observation of watershed conservation works	Kinki Regional Construction Bureau, Ministry of Construction	Otsu City, Shiga
Nov. 20	Evaluation meeting	JICA Tokyo International Training Center	Shibuya-ku, Tokyo

CHAPTER X

RECOMMENDATIONS

CHAPTER X RECOMMENDATIONS

(1) The Land Rehabilitation Plan presents itself as a master plan for land rehabilitation programmes in the Study Area and is judged appropriate from the technical and social points of view. Accordingly, the implementation of the Plan without delay is desirable.

(2) The implementation of the Plan will involve a number of government ministries and agencies, not least the Ministry of Forestry. The establishment of close cooperation and coordination between these organizations is essential from the preparatory stages of planning and detailed design for the smooth implementation of the Plan. In addition to the establishment of an appropriate implementation system at the national level, prior coordination in regard to the Plan's implementation is also highly desirable at the provincial and kabupaten levels.

(3) As implementation of the Plan will result in land use changes, affecting the lives of local inhabitants, it is essential that the Plan implementation body obtain the understanding and cooperation of local inhabitants. In addition, to fully publicising the principles of the Plan's implementation adopted by the central, provincial and kabupaten authorities, the participation of local inhabitants in the Plan's implementation process from the preparatory stage should be secured with the provision of clear incentives for local inhabitants, taking the local conditions into consideration.

(4) For the smooth progress of the Plan's implementation and also to obtain useful data in preparation for the possible application of a similar plan in other watersheds, active monitoring with the participation of local inhabitants is proposed for such subjects as soil loss, harvest changes and impacts on those people living in the Study Area.

(5) Given the prime objective of the Plan, the forest development of state forest land in the Study Area is important. The highest priority should be given to the development of protection forests where forests are encouraged to perform their functions to the highest standard and to protection zones.

(6) Due to the severe environmental conditions in the Study Area, there are many unsolved technical issues relating to forest development, farming, grazing and soil and water conservation, etc. It is, therefore, necessary to rapidly expand the scope of research and surveys on reforestation techniques using local species, agroforestry and silvopastural techniques and the realities of soil erosion and hydrology, etc. for the future socioeconomic development of the Study Area.

Appendixes

A. Dispatch of the Study Team, Advisory Team, list of Main Counterparts

B. Natural Environment

C. Socio-economic Environment

D. Forestry

E. Watershed Conservation

F. Land Rehabilitation Plan

A-1 Dispatch of the Study Team

(1) Fiscal 1993 Study Team (Phase I First Term)

Responsibility	Name	Field Survey Period
Team Leader	Kazuaki Fushimi	15th - 29th March, 1994 (15 days)
Deputy Team Leader/Social Forestry and Extension	Ryoya Shimada	15th - 29th March, 1994 (15 days)
Reforestation and Agroforestry	Jun Kajigaki	15th - 29th March, 1994 (15 days)
Watershed Conservation, Forestry Infrastructure	Mohammed Osman Atif	15th - 29th March, 1994 (15 days)
Surveying Supervisor	Kiyofumi Tamari	15th - 29th March, 1994 (15 days)

(2) Fiscal 1994 Study Team (Phase I Second Term)

Responsibility	Name	Field Survey Period
Team Leader	Kazuaki Fushimi	25th July - 13th August, 1994 (20 days)
Deputy Team Leader/Social Forestry and Extension	Ryoya Shimada	25th July - 7th September, 1994 (45 days)
Reforestation and Agroforestry	Jun Kajigaki	25th July - 7th September, 1994 (45 days)
Watershed Conservation, Forestry Infrastructure	Mohammed Osman Atif	25th July - 7th September, 1994 (45 days)
Local Inhabitants Survey	Tomoo Mochida	25th July - 22nd September, 1994 (60 days)
Land Use and Vegetation Survey	Kozo Kato	1st August - 14th October, 1994 (75 days)
Soil Survey	Tetsushige Kubo	1st August - 19th September, 1994 (50 days)
Surveying Supervisor	Kiyofumi Tamari	23rd May - 5th August, 1995 (75 days)
Mapping Supervisor	Kozo Yamaya	6th July - 20th August, 1994 (46 days) 29th August - 18th September, 1994 (21 days)

(3) Fiscal 1994 Study Team (Phase II)

Responsibility	Name	Field Survey Period
Team Leader	Kazuaki Fushimi	20th October - 5th November, 1994 (17 days) 12th - 28th December, 1994 (17 days)
Deputy Leader/Social Forestry and Extension	Ryoya Shimada	20th October - 28th December, 1994 (70 days)
Reforestation and Agroforestry	Jun Kajigaki	20th October - 28th December, 1994 (70 days)
Watershed Conservation and Forestry Infrastructure	Mohammed Osman Atif	20th October - 28th December, 1994 (70 days)
Local Inhabitants Survey	Tomoo Mochida	19th November - 28th December, 1994 (40 days)
Environmental Impact	Namio Ohyama	19th November - 28th December, 1994 (40 days)

(4) Fiscal 1995 Study Team (Phase III)

Responsibility	Name	Field Survey Period
Team Leader	Kinji Hachiya	5th - 19th June, 1995 (15 days)
		3rd - 14th October, 1995 (12 days)
Deputy Team Leader/Social Forestry and Extension	Ryoya Shimada	5th June- 4th July, 1995 (30 days)
		3rd - 14th October, 1995 (12 days)
Reforestation and Agroforestry	Jun Kajigaki	5th June - 4th July, 1995 (30days)
		3rd - 14th October, 1995 (12 days)
Watershed Conservation, Forestry Infrastructure	Mohammad Osman Atif	5th June - 4th July, 1995 (30 days)
		3rd - 14th October, 1995 (12 days)
Environmental Impact	Namio Ohyama	3rd - 14 th October, 1995 (12 days)

A-2 Advisory Team

(1) Members of Advisory Team

Responsibility	Name	Affiliation
Team Leader	Etsuzo Uchimura	Professor, Faculty of Science, Osaka City University
Watershed Conservation	Mitsunobu Ohnishi	Assistant Director, Planning Division, Forestry Agency
Social Forestry and Extension	Takashi Kato	Forest Sector Chief, Analysis Laboratory, Forest Management Division, Forestry and Forest Products Research Institute

(2) Members of Field Study Advisory Team (Fiscal 1993)

Responsibility	Name	Study Period
Team Leader	Etsuzo Uchimura	17 - 26th March, 1994
Study Supervision	Akio Kagawa	17 - 26th March, 1994

(3) Members of Field Study Advisory Team (Fiscal 1995)

Responsibility	Name	Study Period
Team Leader	Mitsunobu Ohnish	5th - 14th June, 1995
Study Supervision	Noritaka Asakawa	5th - 14th June, 1995

Responsibility	Name	Study Period
Team Leader	Etsuzo Uchimura	3rd - 14th October 1995
Study Supervision	Hiroyuki Abe	3rd - 14th October, 1995

A-3 List of Main Counterparts

Responsibility	Name	Affiliation
Soil and Water Conservation	Johny Kawulusan	Land Rehabilitation and Soil Conservation Sub-Balai RLKT Benain Noelmina
Soil and Land Use	St.M. Saek	"
Soil and Land Use	Kusnadi	"
Mapping	Lazarus B.	"
Surveying	Soleh Wiji	"
Soil	Jefta B.H. Leoanak	"
Social Forestry and Surveys of Local Inhabitants	Endang S.	"
Environment and General Forestry	Markus M.	"
Soil and Water Conservation	Lambertus Tuka	"
Reforestation and Nurseries	Ahmad D.	"
Soil and Water Conservation	Djoko Y.	"

B-1 Land Area of Soil Mapping Units by Working Area

(Unit : ha)

No.	Soil	No.	Slop (%)	Working Area : OESAO EAST				Working Area : OESAO WEST				Working Area : OLIO				Working Area : OEBELO				Grand Total			
				State Forest Land	Enclave	Privete Land	Total	State Forest Land	Enclave	Privete Land	Total	State Forest Land	Enclave	Privete Land	Total	State Forest Land	Enclave	Privete Land	Total	State Forest Land	Enclave	Privete Land	Total
1	Chromic Luvisols	1	0~8	2,740	388	852	3,980	120	0	156	276	124	0	204	328	384	0	1,004	1,388	3,368	388	2,216	5,972
		2	8~15	908	240	696	1,844	72	0	308	380	60	0	144	204	244	0	264	508	1,284	240	1,412	2,936
		3	15~25	52	16	52	120	4	0	36	40	8	0	24	32	28	0	24	52	92	16	136	244
		4	25~45	4	0	0	4	0	0	4	4	0	0	0	0	0	0	0	0	4	0	4	8
		5	45~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Total	3,704	644	1,600	5,948	196	0	504	700	192	0	372	564	656	0	1,292	1,948	4,748	644	3,768	9,160
2	Eutric Vertisols	1	0~8	108	100	24	232	220	0	1,400	1,620	52	0	660	712	4	0	608	612	384	100	2,692	3,176
		2	8~15	8	8	0	16	0	0	12	12	8	0	8	16	0	0	4	4	16	8	24	48
		3	15~25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		4	25~45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		5	45~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Total	116	108	24	248	220	0	1,412	1,632	60	0	668	728	4	0	612	616	400	108	2,716	3,224
3	Humic Cambisols	1	0~8	56	12	52	120	0	0	0	0	36	8	4	48	88	0	96	184	180	20	152	352
		2	8~15	432	172	396	1,000	40	0	116	156	156	84	104	344	460	12	244	716	1,088	268	860	2,216
		3	15~25	444	124	884	1,452	324	0	456	780	336	288	636	1,260	1,248	76	408	1,732	2,352	488	2,384	5,224
		4	25~45	116	12	764	892	468	0	32	500	172	160	536	868	512	24	224	760	1,268	196	1,556	3,020
		5	45~	0	0	60	60	20	0	0	20	4	0	0	4	0	0	0	0	24	0	60	84
			Total	1,048	320	2,156	3,524	852	0	604	1,456	704	540	1,280	2,524	2,308	112	972	3,392	4,912	972	5,012	10,896
4	Eutric Cambisols, Lithic Leptosols Complex	1	0~8	168	0	24	192	412	0	1,132	1,544	0	0	52	52	0	0	168	168	580	0	1,376	1,956
		2	8~15	396	0	36	432	584	0	492	1,076	0	0	20	20	20	0	400	420	1,000	0	948	1,948
		3	15~25	104	0	8	112	344	0	308	652	0	0	4	4	20	0	308	328	468	0	628	1,096
		4	25~45	0	0	0	0	60	0	20	80	0	0	0	0	0	0	88	88	60	0	108	168
		5	45~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Total	668	0	68	736	1,400	0	1,952	3,352	0	0	76	76	40	0	964	1,004	2,108	0	3,060	5,168
5	Eutric Fluvisols	1	0~8	0	0	0	0	20	0	408	428	20	20	180	220	80	0	272	352	120	20	860	1,000
		2	8~15	0	0	0	0	8	0	0	8	8	12	12	32	36	0	8	44	52	12	20	84
		3	15~25	0	0	0	0	4	0	0	4	0	0	0	0	0	0	0	0	4	0	0	4
		4	25~45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	4	4
		5	45~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Total	0	0	0	0	32	0	408	440	28	32	192	252	116	0	284	400	176	32	884	1,092
6	Mangrove Soils or Swamp Soils	1	0~8	0	0	0	0	0	0	536	536	0	0	104	104	0	0	368	368	0	0	1,008	1,008
		2	8~15	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	4	4
		3	15~25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		4	25~45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		5	45~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Total	0	0	0	0	0	0	540	540	0	0	104	104	0	0	368	368	0	0	1,012	1,012
7	Paddy Soils	1	0~8	36	44	8	88	180	0	1,288	1,468	12	36	124	172	72	0	404	476	300	80	1,824	2,204
		2	8~15	8	28	12	48	32	0	8	40	12	48	24	84	48	4	16	68	100	80	60	240
		3	15~25	0	0	0	0	4	0	0	4	0	4	4	8	16	4	12	32	20	8	16	44
		4	25~45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	4	4
		5	45~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Total	44	72	20	136	216	0	1,296	1,512	24	88	152	264	136	8	436	580	420	168	1,904	2,492
8	Sand, Stone or Rock	1	0~8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	0	0	60	60
		2	8~15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	4	4
		3	15~25	4	0	4	8	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	8
		4	25~45	48	0	4	52	0	0	0	0	0	0	0	0	0	0	0	0	48	0	4	52
		5	45~	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4
			Total	56	0	8	64	0	0	0	0	0	0	0	0	0	0	64	64	56	0	72	128
9	Lands lide	1	0~8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		2	8~15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		3	15~25	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
		4	25~45	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	4	0	0	4
		5	45~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Total	0	0	4	4	0	0	0	0	0	0	0	0	4	0	0	4	4	0	4	8
	Grand Total	1	0~8	3,108	544	960	4,612	952	0	4,920	5,872	244	64	1,328	1,636	628	0	2,980	3,608	4,932	608	10,188	15,728
		2	8~15	1,752	448	1,140	3,340	736	0	940	1,676	244	144	312	700	808	16	940	1,764	3,540	608	3,332	7,480
		3	15~25	604	140	952	1,696	680	0	800	1,480	344	292	668	1,304	1,312	80	752	2,144	2,940	512	3,172	6,624
		4	25~45	168	12	768	948	528	0	56	584	172	160	536	868	516	24	320	860	1,384	196	1,680	3,260
		5	45~	4	0	60	64	20	0	0	20	4	0	0	4	0	0	0	0	28	0	60	88
			Total	5,636	1,144	3,880	10,660	2,916	0	6,716	9,632	1,008	660	2,844	4,512	3,264	120	4,992	8,376	12,824	1,924	18,432	33,180

Note : Land area is the total of meshes (one mesh equivalent to 4 ha)

B-2 Soil Profile Description

Profile number : 5

Soil unit	:	Chromic Luvisol
Date of examination	:	18 Aug. 1994 (Dry season)
Location	:	Ds. FATUKANUTU (Perum Perhutani plantation)
Elevation	:	175m
Land form	:	Raised coral reef terrace
Slope	:	Class 1 (Almost flat)
Land-use	:	Young plantation (*Acacia mangium*, *Tectona grandis* etc.)
Parent material	:	Coralline limestone
Drainage	:	Class 3 (Moderately well drained)
Soil moisture conditions	:	Moist below 20 cm
Depth of groundwater table	:	Unknown
Human influence	:	Ground clearance by tractor

Profile description :

A 0~20cm; Very dark reddish brown (5YR 2/4) wet; silt loam; strong coarse subangular blocky; sticky, plastic wet, firm moist, hard dry; very few subangular limestone gravel; very few fine roots; frequent fragments of carbonized grass on the bottom; abrupt smooth boundary; hardness 15; pH 5.9.

Bt1 20~45cm; Dark reddish brown (2.5YR 3/6) wet; silt loam; moderate very coarse angular blocky; very sticky, very plastic wet, very firm moist, very hard dry; gradual smooth boundary; hardness 28; pH 5.7.

Bt2 45~80cm+; Reddish brown (2.5YR 4/7) wet; silt loam; weak very coarse subangular blocky; very sticky, very plastic wet, very firm moist, very hard dry; hardness 25.

Profile number : 7

Soil unit	:	Chromic Luvisol
Date of examination	:	22 Aug. 1994 (Dry season)
Location	:	Ds. KOTABES, Kp. OEBAKI
Elevation	:	600m

Land form	:	Slightly convex slope on the mountain side
Slope	:	Class 4 (Moderately steep), 12°, Facing the north
Land-use	:	Plantation (Acacia etc.)
Parent material	:	Coralline Limestone
Drainage	:	Class 4 (Well drained)
Moisture conditions in the soil	:	Moist below 20cm
Depth of groundwater table	:	Unknown

Profile description :

A 0~20cm; Very dark reddish brown (5YR 2/3) wet; sandy clay loam; strong fine subangular blocky; slightly sticky, slightly plastic wet, friable moist, slightly hard dry; common fine roots, few medium roots; clear smooth boundary; hardness 22; pH 6.2.

Bt1 20~40cm; Dark reddish brown (2.5YR 3/4) wet; silty clay loam; strong medium angular blocky; sticky, plastic wet, very firm moist, very hard dry; very few fine roots; clear smooth boundary; hardness 30; pH 5.8.

Bt2 40~85cm+; Dark reddish brown (2.5YR 3/5) wet; silty clay loam; weak coarse angular blocky; sticky, plastic wet, very firm moist, very hard dry; very few fine roots; hardness 30.

Profile number : 3

Soil unit	:	Chromic Luvisol (Eroded phase)
Date of examination	:	12 Aug. 1994 (Dry season)
Location	:	Ds. KOTABES
Elevation	:	475m
Land form	:	Raised coral reef terrace. The edge of dissected terrace
Slope	:	Class 4 (Moderately steep), 8°, Facing the north
Land-use	:	Grassland (pasture)
Parent material	:	Coralline limestone
Drainage	:	Class 4 (well drained)
Soil moisture condition	:	Dry throughout
Depth of groundwater table	:	Unknown. However, the water table of a well which is located some 400m away from the profile is 6m in depth.

Presence of surface stones : Very few boulders of limestone

Human influence : Over grazing

Profile description :

A 0~20cm; Dark reddish brown (5YR 3/4) wet; silt loam; strong fine and medium angular blocky; slightly sticky, slightly plastic wet, firm moist, hard dry; few subangular limestone gravel; common fine roots; Clear smooth boundary; hardness 23; pH 6.6.

B 20~60cm; Dark reddish brown (5YR 3/5) wet; silt loam; strong medium angular blocky; slightly sticky, slightly plastic wet, firm moist, very hard dry; frequent angular limestone stones; few fine roots; below 60cm bedrock; hardness 25; pH 6.8.

Profile number : 2

Soil unit : Eutric Vertisol

Date of examination : 10 Aug. 1994 (Dry season)

Location : Ds. OEFAFI

Elevation : 39m

Land form : Raised coral reef terrace

Slope : Class 1 (Almost flat)

Land-use : Orchard (MANGGA and others)

Parent material : Coralline limestone

Drainage : Class 2 (Imperfectly drained)

Soil moisture condition : Dry throughout

Depth of groundwater table : Unknown

Profile description :

Au1 0~15cm; Black (7.5YR 1.7/1) wet; silty clay; strong medium angular blocky; sticky, plastic wet, firm moist, very hard dry; very few rounded gravel; developing cracks (2~3cm wide); few medium and coarse roots; clear smooth boundary; hardness 28; pH 7.1.

Au2 15~90cm+; Black (7.5YR 2/1) wet; clay; strong medium and coarse angular blocky; very sticky, plastic wet, very firm moist, very hard dry ; very few rounded gravel; developing cracks (1cm wide); slickensides on the ped surface; very few fine roots; hardness 26; pH 7.6.

Profile number : 4

Soil unit	:	Humic Cambisol
Date of examination	:	16 Aug. 1994 (Dry season)
Location	:	Ds. BOKONG
Elevation	:	230m
Land form	:	Upper part of the convex steep slope in dissected mountainous area
Slope	:	Class 5 (Steep), 20°, facing the north
Land use	:	Grassland (Scattered small trees)
Parent material	:	Shale, slightly consolidated, (Tertiary)
Drainage	:	Class 4 (Well drained)
Moisture conditions in the soil	:	Dry throughout
Depth of groundwater table	:	Unknown

Profile description :

A 0~26cm; Brownish black (10YR 2/2) wet; clay loam; strong medium crumb and fine subangular blocky; sticky, plastic wet, firm moist, hard dry; few angular gravel; frequent fine roots; clear smooth boundary; hardness 20; pH 7.3.

Bu1 26~50cm; Grayish yellow brown (10YR 5/2.5) wet; clay; strong medium angular blocky; very sticky, very plastic wet, very firm moist, very hard dry; frequent angular gravel; common fine roots; gradual smooth boundary; hardness 20; pH 7.7.

Bu2 50~80cm; Dull yellowish brown (10YR 5/3) wet; silty clay; moderate coarse angular blocky; sticky, plastic wet, very firm moist, very hard dry; very frequent angular gravel; few fine roots; below 80cm bedrock; hardness 25.

Profile number : 8

Soil unit	:	Eutric Cambisol (Eroded phase)
Date of examination	:	1 Sept. 1994 (Dry season)
Location	:	Ds. MERDEKA, Kp. TANAH PUTIH
Elevation	:	60m
Land form	:	Middle part of the convex steep slope in hilly area
Slope	:	Class 5 (Steep), 20°, facing the northeast
Land-use	:	Grassland (Scattered Eucalyptus alba)

Parent material	:	Marl, slightly consolidated, (Pliocene—Pleistocene)
Drainage	:	Class 4 (Well drained)
Soil moisture condition	:	Dry throughout
Depth of groundwater table	:	Unknown
Presence of surface stones	:	Class 3 (Very Stony)
Human influence	:	Over grazing

Profile description :

A 0~16cm; Grayish yellow brown (10YR 4/2) wet; silt loam; strong medium angular blocky; sickly plastic wet, firm moist, very hard dry; very frequent angular gravel; common fine roots; clear smooth boundary; hardness 20; pH 6.4.

BC 16~52cm; Dull yellowish brown (10YR 5/2.5) wet; silt loam; strong medium angular blocky; sticky, plastic wet, very firm moist, very hard dry; extremely gravely; few fine roots; Below 52cm bedrock; hardness 27.

Profile number : 1

Soil unit	:	Rendzic Leptosol
Date of examination	:	8 Aug. 1994 (Dry season)
Location	:	Ds. OEBELO
Elevation	:	110m
Land form	:	Top of the hill
Slope	:	Class 4 (Moderately steep), 12°, facing the northwest
Land-use	:	Natural palm forest (GEWANG)
Parent material	:	Coralline limestone over the marl basement
Drainage	:	Class 5 (Somewhat excessively drained)
Soil moisture condition	:	Dry throughout
Depth of groundwater table	:	Unknown
Presence of surface stones	:	Class 5 (Rubble land)

Profile description :

A 0~55cm; Brownish black (7.5YR 2/1.5) wet; clay; strong fine and medium angular blocky; sticky, plastic wet, very firm moist, very hard dry; very frequent angular gravel; few fine and medium roots; below 55cm bedrock; measurement of hardness was impossible because of stony; pH 7.2.

Profile number : 6

Soil unit	:	Eutric Fluvisol
Date of examination	:	19 Aug. 1994 (Dry season)
Location	:	Ds. OEFAFI, Kp. TASIPA
Elevation	:	95m
Land form	:	Valley bottom lowland
Slope	:	Class 1 (Almost flat)
Land-use	:	Grassland (Scattered GEWANG)
Parent material	:	Fluvial deposit, below 2m debris flow deposit
Drainage	:	Class 4 (Well drained)
Moisture conditions in the soil	:	below 20cm moist
Depth of groundwater table	:	4m (inference based on the relative height to the surface of river

Profile description :

A 0~22cm; Brownish black (10YR 2/2.5) wet; loam; moderate medium subangular blocky; slightly sticky, slightly plastic wet, friable moist, slightly hard dry; few rounded gravel; few coarse roots, common fine roots; abrupt smooth boundary; hardness 24; pH 7.6.

2BC 22~43cm; Dull yellowish brown (10YR 5/4) wet; silty clay loam; weak coarse subangular blocky; sticky, plastic wet, firm moist, hard dry; frequent rounded gravel; few medium roots; abrupt smooth boundary; hardness 25; pH 7.9.

3C 43~80cm+; Grayish yellow brown (10YR 5/2) wet; sandy clay loam; massive; sticky, plastic wet, firm moist, hard dry; very few very fine rounded gravel; very few fine roots; hardness 24.

B-3 Land Area of Land Use – Vegetation Categories by Working Area

(Unit : ha)

Land Use-Vegetation Category	No.	Working Area : OESAO EAST				Working Area : OESAO WEST				Working Area : OLIO				Working Area : OEBELO				Grand Total			
		State Forest Land	Enclave	Privete Land	Total	State Forest Land	Enclave	Privete Land	Total	State Forest Land	Enclave	Privete Land	Total	State Forest Land	Enclave	Privete Land	Total	State Forest Land	Enclave	Privete Land	Total
Mangrove	1	0	0	0	0	0	0	52	52	0	0	24	24	0	0	124	124	0	0	200	200
Low Land Forest (other than Mangrove)	2	0	0	0	0	0	0	60	60	0	0	0	0	0	0	60	60	0	0	120	120
Grassland	3	468	48	436	952	332	0	688	1,020	100	152	384	636	488	44	288	820	1,388	244	1,796	3,428
Grassland with Scattered Palm Trees	4	2,004	324	936	3,264	788	0	1,840	2,628	620	408	660	1,688	1,760	52	1,264	3,076	5,172	784	4,700	10,656
Grassland with Scattered Trees other than Palm	5	528	88	292	908	708	0	400	1,108	124	12	408	544	384	8	700	1,092	1,744	108	1,800	3,652
Shrub and Bush land	6	1,644	316	1,060	3,020	552	0	628	1,180	104	0	604	708	244	0	740	984	2,544	316	3,032	5,892
Bamboo Grove	7	28	0	4	32	28	0	12	40	0	0	24	24	8	0	0	8	64	0	40	104
Natural/Secondry Forest H1C1	8	92	4	424	520	100	0	0	100	12	0	4	16	128	0	252	380	332	4	680	1,016
Natural/Secondry Forest H1C2	9	228	48	156	432	0	0	0	0	0	0	4	4	0	0	0	0	228	48	160	436
Natural/Secondry Forest H2C1	10	44	0	24	68	0	0	0	0	0	0	0	0	0	0	0	0	44	0	24	68
Natural/Secondry Forest H2C2	11	240	0	4	244	0	0	0	0	4	0	0	4	0	0	0	0	244	0	4	248
Man-made Forest H1C1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Man-made Forest H1C2	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Man-made Forest H2C1	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Man-made Forest H2C2	15	92	0	48	140	0	0	0	0	0	0	0	0	0	0	4	4	92	0	52	144
Paddy Field	16	48	72	16	136	228	0	1,328	1,556	16	68	168	252	116	8	464	588	408	148	1,976	2,532
Dry Crop Field	17	64	96	244	404	100	0	436	536	0	4	276	280	72	0	280	352	236	100	1,236	1,572
Mixed Garden (density: <70%)	18	52	20	48	120	44	0	148	192	8	0	72	80	28	0	184	212	132	20	452	604
Mixed Garden (density: >70%)	19	16	8	24	48	0	0	160	160	0	0	16	16	0	0	20	20	16	8	220	244
Salt Field	20	0	0	0	0	0	0	44	44	0	0	0	0	0	0	0	0	0	0	44	44
Industrial Site	21	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	4	4
Seasonal/Temporary Swamp	22	0	0	0	0	0	0	428	428	0	0	76	76	0	0	224	224	0	0	728	728
Water Surface (Pond & lake, etc.)	23	4	0	0	4	0	0	12	12	0	0	0	0	0	0	12	12	4	0	24	28
Quarry and Sand Pit	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Landslide Site	25	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	4	0	0	4
Riverbed	26	0	0	0	0	0	0	0	0	0	4	0	4	8	0	8	16	8	4	8	20
Road	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	4	4
Settlement	28	84	120	164	368	36	0	476	512	20	12	124	156	24	8	364	396	164	140	1,128	1,432
Total		5,636	1,144	3,880	10,660	2,916	0	6,716	9,632	1,008	660	2,844	4,512	3,264	120	4,992	8,376	12,824	1,924	18,432	33,180

Note : 1. Land area is the total of meshes (one mesh equivalent to 4 ha)

2. H1, Tree height less than 15m
   H2, Tree height over 15m
   C1, Tree crown density less than 70%
   C2, Tree crown density over 70%

B-4 List of Main Tree Species and Agriculture Crops Mentioned in This Report

No.	Local Name*	Scientific Name	Family Name
1	Jambu mente	*Anacardium occidentale*	*Anacardiaceae*
2	Kedondong hutan	*Lannea grandis*	*Anacardiaceae*
3	Mangga	*Mangifera indica*	*Anacardiaceae*
4	Sirsak	*Annona muricata*	*Annonaceae*
5	Kapok	*Ceiba pentandra*	*Bombacaceae*
6	Papaya	*Carica papaya*	*Caricaceae*
7	—	*Casuarina junghuhniana*	*Casuarinaceae*
8	Kemiri	*Aleurites moluccana*	*Euphorbiaceae*
9	Ubi kayu	*Manihot esculenta*	*Euphorbiaceae*
10	Gamba grass	*Andropogan gayanus*	*Gramineae*
11	King grass	*Pennisetum purporephoydes*	*Gramineae*
12	Jagung	*Zea mays*	*Gramineae*
13	Apokat	*Persea americana*	*Lauraceae*
14	—	*Acacia auriculiformis*	*Leguminosae*
15	Kabesak	*Acacia leucophloea*	*Leguminosae*
16	Duri putih	*Acacia catechu*	*Leguminosae*
17	Kacang tana	*Arachis hypogaea*	*Leguminosae*
18	Kaliandra	*Calliandra calothyrsus*	*Leguminosae*
19	Johar	*Cassia siamea*	*Leguminosae*
20	Kacang turis	*Cayanus cayans*	*Leguminosae*
21	Centro	*Centrosema pubescens*	*Leguminosae*
22	Flamboyan	*Delonix regia*	*Leguminosae*
23	Sangon buto	*Enterolobium cyclocarpum*	*Leguminosae*
24	Gamal	*Gliricidia sepium*	*Leguminosae*
25	Lamtoro	*Leucaena leucocephala*	*Leguminosae*
26	Siratro	*Mecroptilim atropurpureum*	*Leguminosae*
27	Petai	*Parkia speciosa*	*Leguminosae*
28	Kacang hijau	*Phaseolus radiatus*	*Leguminosae*
29	Kayu merah	*Pterocarpus indicus*	*Leguminosae*
30	Turi	*Sesbania grandiflora*	*Leguminosae*
31	Stylo	*Stylosanthes guianensis*	*Leguminosae*
32	Asam	*Tamarindus indica*	*Leguminosae*
33	Mahoni	*Swietenia macrophylla*	*Meliaceae*
34	Sukun	*Artocarpus altilis*	*Moraceae*
35	Nangka	*Artocarpus heterophyllus*	*Moraceae*
36	Kayu putih	*Eucalyptus alba*	*Myrtaceae*
37	Ampupu	*Eucalyptus urophylla*	*Myrtaceae*
38	Lontar	*Borassus flabellifer*	*Palmae*
39	Kelapa	*Cocos nucifera*	*Palmae*
40	Gewang	*Corypha utan*	*Palmae*
41	Kom	*Zizyphus sp.*	*Rhamnaceae*
42	Jeruk manis	*Citrus aurantiaca*	*Rutaceae*
43	Jeruk nipis	*Citrus aurantifolia*	*Rutaceae*
44	Cendana	*Santalum album*	*Santalaceae*
45	Kesambi	*Schleichera oleosa*	*Sapindaceae*
46	Nitas	*Sterculia foetida*	*Sterculiaceae*
47	—	*Gmelina arborea*	*Verbenaceae*
48	Jati	*Tectona grandis*	*Verbenaceae*

* Local Name in Timor

C-1 Population and Land Area, etc. by Desa Related to the Study

Desa Name	Population	No. of Households	Land Area (km^2)	No. of Persons Younger than 15 Years	Population Density ($/km^2$)	No. of Persons/ Household	No. of Persons Older than 15 Years
Noelbaki*	1,686	344	1,015	963	166	4.9	2.8
Oebelo	2,238	511	1,976	1,417	113	4.4	2.8
Bokong*	1,665	362	3,841	941	43	4.6	2.6
Oelpuah	936	198	2,358	559	40	4.7	2.8
Oelnasi*	140	30	450	84	31	4.7	2.8
Kec. Kupang Tengah Sub-Total	6,665	1,445	9,640	3,964	69	4.6	2.7
Tuapukan	1,019	222	306	595	333	4.6	2.7
Merdeka	2,268	451	1,669	1,450	136	5.0	3.2
Babau	2,057	406	1,491	1,192	138	5.1	2.9
Oefafi	1,103	222	1,537	653	72	5.0	2.9
Oesao	3,957	791	2,122	2,449	186	5.0	3.1
Tuatuka	1,343	263	1,481	778	91	5.1	3.0
Kuanheum*	642	140	964	364	67	4.6	2.6
Fatuknutu*	704	153	1,840	413	38	4.6	2.7
Pukdale Fatuteta	} 360	75	0.50	202	720	4.8	2.7
Kec. Kupang Timur Sub-Total	13,453	2,723	11,460	8,096	117	4.9	3.0
Nonbes	2,636	513	4,252	1,478	62	5.1	2.9
Oesena	1,327	288	1,194	811	111	4.6	2.8
Kotabes	1,526	317	1,266	901	121	4.8	2.8
Ponain	1,735	334	1,914	1,001	91	5.2	3.0
Tesbatan	1,804	389	1,882	1,076	96	4.6	2.8
Apren	1,483	323	898	844	165	4.6	2.6
Oenoni* Tunbaun*	} 371	81	6.9	211	55	4.6	2.6
Kec. Amarasi Sub-Total	10,882	2,245	12,080	6,322	90	4.6	2.7
Total	31,000	6,413	33,180	18,382	93	4.8	2.8

Source: Kantor Statisik Kabupaten Kupang (May, 1994)

Note: The figures for those desas marked with an asterisk are estimates based on the land use and vegetation map as part or most of the administrative area lies outside the Study Area.

C-2 RGDP, Population, RGDP per Capita for Kabupaten Kupang, East Nusa Tenggara Province and Indonesia

Region	RGDP or GDP	Population	RGDP per Capita
Kabupaten Kupang (A)	328 billion Rp	533,000	616,000 Rp
East Nusa Tenggara Province (B)	1,332 billion Rp	3,341,000	404,000 Rp
Indonesia (C)	227,502 billion Rp	182,940,000	1,254,000 Rp
A/B (%)	24.6	16.0	152.5
B/C (%)	0.6	1.8	32.2

Notes : 1) Data are preliminary figures as of 1991 (current prices/preliminary figure) except the population of Kabupaten Kupang which is the 1992 figure.
2) The RGDP figures includes the value of petrol and petroleum products.
3) The RGDP per capita figures are cited from statistical material and are not identical to the calculation results of dividing the RGDP shown above by the population size.

Sources : 1) Nusa Tenggara Timur dalam Angka 1992, Kantor Statistik Propinsi NTT, 1993
2) Statistik Indonesia 1993, Biro Pusat Statistik Jakarta, 1993

C-3 RGDP of Agricultural Sector in Kabupaten Kupang and East Nusa Tenggara Province

(Unit: million Rp)

Contents	Kabupaten Kupang		East Nusa Tenggara Province		(A)/(B)
	RGDP (A)	%	RGDP (B)	%	%
1. Food Crops	21,606	44.9	209,891	56.4	10.3
2. Non-Food Crops	1,355	2.8	37,024	9.9	3.7
3. Estate Crops	-	0.0	624	0.2	0.0
4. Livestock Products	16,796	34.9	85,079	22.9	19.7
5. Forestry	437	0.9	5,780	1.6	7.6
6. Fisheries	7,949	16.5	33,729	9.0	23.6
Sector Total	48,143	100.0	372,127	100.0	12.9
RGDP Total	191,466	–	748,403	–	25.6

Note : All data are provisional figures for 1991 (based on 1983 constant prices).
Source : Nusa Tenggara Timur dalam Angka 1992, Kantor Statistik Propinsi NTT, 1993

C-4 Production Volumes of Main Crops in Three Subject Kecamatans, etc.

(Unit: tons)

Kecamatan, etc.	Paddy Rice (Padi Sawah)	Dry Field Rice (Padi Ladang)	Maize (Jagung)	Cassava (Ubi Kayu)	Sweet Potatoes (Ubi Jalar)	Peanuts (Kacang Tanah)
Kupang Tengah	2,238	–	1,296	4,020	158	239
Kupang Timur	8,335	47	7,138	22,258	373	15
Amarasi	208	618	3,303	65,668	813	26
Total of 3 Kecamatans	10,781	665	11,737	91,946	1,344	280
Kabupaten Kupang	32,150	7,887	34,685	122,567	3,110	1,833
Share of 3 Kecamatans in Kabupaten Kupang	33.5%	8.4%	33.8%	75.0%	43.2%	15.3%
East Nusa Tenggara	249,475	123,331	376,569	840,787	91,219	7,298
Share of Kabupaten Kupang in East Nusa Tenggara Province	12.9%	6.4%	9.2%	14.6%	3.4%	25.1%

Sources : ① Kupang dalam Angka 1993, Kantor Statistik Kabupaten Kupang, 1994
② Nusa Tenggara Timur dalam Angka 1992, Kantor Statistik Propinsi NTT, 1993

C-5 Production Volumes of Vegetables, Fruit and Forest Products in Three Subject Kecamatans

(Unit: tons)

Crop	Kupang Tengah	Kupang Timur	Amarasi
Mustard (Sawi)	120	–	2,380
Cabbage (Kol)	220	–	–
Chickpeas (Kacang Panjang)	58	–	1,116
Tomatoes (Tomat)	10	55	1,715
Cucumbers (Ketimun)	60	66	–
Oranges (Jeruk)	–	–	692
Bananas (Pisang)	2,956	–	8,931
Mangoes (Mangga)	–	–	1,693
Papayas (Papaya)	163	–	4,027
Pineapples (Nanas)	–	–	21
Coconuts (Kelapa)	148	295	1,507
Cotton (Kapuk)	69	40	142
Candle nut (Kemiri)	3	–	158
Betel Palm Trees (Pinang)	12	17	84
Coffee (Kopi)	–	–	1

Source: Kupang dalam Angka 1993, Kantor Statistik Kabupaten Kupang, 1994

C-6 Summary of Fact-Finding Survey on Local Life

CONTENT

Introduction

The Fact-Finding Survey on Local Life (the Survey) was designed to gather socioeconomic data/information relating to the lives of local inhabitants, essential to prepare the Land Rehabilitation Plan, and was subcontracted to a local consultant (P.T. Tri Tunggal Konsultan). The cooperation of NGO staff living in the Study Area to work as interviewers was also obtained. The findings of the Survey, which used a questionnaire, are summarised below.

(1) Survey Items and Number of Interviewees

A total of 502 people (401 household heads and 101 women) were questioned on items relating to "the reality of local life and the socioeconomic awareness of local inhabitants" and 101 household heads were further questioned on items relating to community activities. The geographical distribution of these interviewees is shown in Table 1. The systematic sampling method was used to select the interviewees from the resident register to meet the number of interviewees determined for each village shown in Table 1.

(2) Compilation of Survey Findings

The survey findings were firstly classified by watershed (Oesao, Oebelo and Olio) and elevation (upper reaches: EL 300 m or higher, middle reaches: EL 100-300 m, lower reaches: lower than EL 100 m). In this summary, however, the description of the survey findings, in principle, covers all the interviewees and only significant discrepancies in terms of watershed or elevation are separately mentioned.

(3) Outline of Interviewees

The 502 interviewees consisted of 391 men and 111 women with an average age of 43 years old. The entire number of family members, including the interviewees, is 2,725 (the average number of family members is 5.4 and the average age is 24 years old). By age category, the largest category is less than 15 years old, accounting form some 40% of the total and the ratio of those less than 5 years old is comparatively small. The number of those between 22 and 34 years old is noticeably small. It is uncertain whether such demographic unevenness is the result of a temporary increase of the mortality rate due to famine or migration to Kupang City. (Records on migration/resettlement from the Study Area to other provinces are not kept.)

According to the interviewees, the illiteracy rate among the interviewees and their family members is approximately 5% which is much lower than the provincial or national average. By region, 93% are Protestants and 3% are Catholics, showing the predominance of Christianity. Most people are exclusively engaged in agriculture but the interviewees included some civil servants, merchants and craftsmen.

Table 1 Population, Land Area and Watershed of Surveyed Villages

Kecamatan/ Desa	Population (a)	No. of Households	No. of Interviewees	Land Area (b) (km^2)	Population Density (a/b)	Oebelo and Olio Watershed			Oesao Watershed		
						U/R	M/R	L/R	U/R	M/R	L/R
Kec. Kupang Tengah											
• Noelbaki	2,942	606	30	17.70	166			○			
• Oebelo	2,238	511	30	19.76	113			○			
• Bokong	1,979	430	36	45.63	43		○			○	
• Oelpuah	936	198	11	23.58	40		○	○			
Sub-Total	8,095	1,745	107	106.67	76						
Kec. Kupang Timur											
• Tuapukan	1,019	222	13	3.06	333			○			
• Merdeka	2,268	451	27	16.69	136			○			
• Babau	2,057	406	24	14.91	138			○			○
• Oefafi	1,103	222	14	15.37	72		○	○			
• Oesao	3,957	791	45	21.24	186					○	○
• Tuatuka	1,343	263	15	14.81	91						○
• Kuanheun	1,025	221	14	15.40	67					○	○
• Fatukanutu	1,125	245	14	29.38	38				○	○	
• Nunkurus	2,199	436	27	50.34	44			○			○
Sub-Total	16,096	3,257	193	181.20	89						
Kec. Amarasi											
• Nonbes	2,636	513	31	42.52	62	○	○			○	
• Oesena	1,327	288	19	11.94	111	○				○	
• Kotabes	1,526	317	19	12.66	121	○			○		
• Ponain	1,735	334	20	19.14	91				○	○	
• Tesbatan	1,804	389	23	18.82	96				○	○	
• Oenoni	1,891	405	24	40.77	46				○	○	
• Apren	1,483	324	20	8.98	165				○		
• Nekmese	1,916	412	25	26.95	71				○		
• Tunbaun	2,415	518	21	38.87	62	○					
Sub-Total	16,723	3,500	202	220.65	76						
Total	40,914	8,502	502	508.52	80						

Note: The classification of the watershed in which the villages are located is given by the local consultant.
Source: Kantor Statistik Kabupaten Kupang, May, 1994

1. Agricultural Management and Livelihood

1.1 Agricultural Production

1.1.1 Land Ownership (Land Use Right)

According to the BAPPEDA, there is only a small number of privately-owned land of a minor scale in the Study Area. As land where local inhabitants have customary right of use is called private land, this local custom is accepted in the definition of private land in this summary.

The Survey found that some half of the interviewees have wet fields, the size of which is an average 0.7 ha/owner as shown in Table 2. A total of 70% have dry crop fields, the average size of which is 0.7 ha. Most households have 0.4 ha of domestic garden. Only 5 households have grazing land while 14 households have forest land of an average 0.7 ha each. The size of cultivated land by watershed and site location is detailed in Table 3. In addition to private land, farming is also conducted on rented land or on land which is used security for loans. These types of farming are said to cover some 9% of wet fields and 3% of domestic gardens.

Table 2 Use of Private Land

Use	Oebelo & Olio Watersheds			Oesao Watershed			Total		
	No. of Interviewees	%	Average Size (ha)	No. of Interviewees	%	Average Size (ha)	No. of Interviewees	%	Average Size (ha)
Wet Field	116	53.7	0.68	125	43.7	0.75	241	48.0	0.72
Dry Field	138	63.9	0.58	206	72.0	0.72	344	68.5	0.67
Domestic Garden	210	97.2	0.33	274	95.8	0.39	484	96.4	0.36
Grazing Land	2	0.9	0.53	3	1.0	0.37	5	1.0	0.43
Pond	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00
Forest	2	0.9	0.38	12	4.2	0.71	14	2.8	0.67

Notes

1) The percentage figures indicate the ratio of those using the land for the relevant purpose in the total number of those interviewed in the subject watershed area.
   Oebelo and Olio Watershed : 216
   Oesao Watershed : 286
   Total : 502
2) The average size figures indicate the average land size used for the relevant purpose among those interviewed.

Table 3 Comparison of Size of Cultivated Private Land

(Unit: Number of Interviewees)

Area		≤ 0.5 ha	0.5 ha < & ≤ 1 ha	1.0 ha <	Total No. of Interviewees	Average Area (ha)	(Note 5) (%)
Oebelo and Olio Watersheds	Wet Fields	16	1	0	17	0.28	16.5
	Dry Fields	37	7	1	45	0.39	60.9
	Domestic Gardens	48	0	0	48	0.13	21.7
	Upper Reaches Sub-Total	25	15	8	48	0.60	100.0
	Wet Fields	23	4	1	28	0.41	23.0
	Dry Fields	25	17	0	42	0.60	50.4
	Domestic Gardens	46	4	0	50	0.26	26.0
	Middle Reaches Sub-Total	12	19	19	50	1.00	100.0
	Wet Fields	29	35	7	71	0.88	42.0
	Dry Fields	33	12	6	51	0.74	25.4
	Domestic Gardens	95	14	3	112	0.44	33.1
	Lower Reaches Sub-Total	36	20	55	111	1.34	100.0
Oesao Watershed	Wet Fields	9	5	0	14	0.53	9.1
	Dry Fields	52	34	5	91	0.63	70.6
	Domestic Gardens	97	1	0	98	0.14	16.9
	Upper Reaches Sub-Total	41	24	34	99	0.82	100.0
	Wet Fields	25	5	3	33	0.51	15.8
	Dry Fields	25	31	12	68	0.91	58.0
	Domestic Gardens	72	12	1	85	0.31	24.7
	Middle Reaches Sub-Total	31	3	52	86	1.24	100.0
	Wet Fields	32	32	14	78	0.89	39.9
	Dry Fields	35	10	2	47	0.62	16.8
	Domestic Gardens	45	35	11	91	0.73	38.2
	Lower Reaches Sub-Total	15	16	64	95	1.83	100.0

Notes

1) The sub-total figures include wet fields, dry fields, domestic gardens, pasture, forests and all other forms of the land.
2) While the land areas specified by the respondents may not necessarily be very accurate, they at least show the general tendency in each watershed.
3) The average area is the average of the respondents for each type of land use.
4) While cultivation is also conducted on rented land, etc., the ratio of private land utilisation is high in general terms.
5) The ratio of wet fields, dry fields or domestic gardens in the total cultivated private land.
6) The average size of private land (for 481 interviewees) is 1.21 ha.

1.1.2 Land Registration

Land registration is an important guide to learn about the access of local inhabitants to formal financial institutions. Land registration is said to have been completed for 20% of wet fields, 34% of dry crop fields, 46% of domestic gardens and 1% (7 cases) of forests. What has necessitated people to register their land include loan application (18%) and government instruction (42%).

1.1.3 Land Fertility

A total of 50% of those interviewed consider their wet and/or dry crop fields to have average fertility while 33% consider their farming fields to be quite fertile. The remaining 17% believe that their farming fields are barren. Among the interviewees living in the Oebelo and Olio Watershed, the ratio of those who believe their fields to be barren is 20% which far exceeds the 7% among those living in the Oesao Watershed. The identified sources of land fertility are fertiliser application (18%) and forest conservation efforts (22%) while the causes of barren land include soil erosion, lack of fertiliser application and forest destruction.

1.1.4 Agricultural Tools

Hatchets are the most popular agricultural tool, of which 2-3 are owned by 97% of the households. The next popular tools are hoes and planting poles (two-thirds of the households), followed by sickles, axes and scythes (more than 50% of the households). 17% of the households own a spray for use with agrochemicals. 84% of the households have a grinding stone to grind various tools. In short, few agricultural tools are used. The absence of those using animal power is particularly noticeable.

1.1.5 Types of Agricultural Products and Cultivation Area

The most popular item appears to be maize as it is cultivated by 85% of the households on an average of 0.57 ha of land. The second most popular item is paddy rice (48%; 0.66 ha). Based on these data and the average size of cultivated land, the typical picture of local farming is shown in Table 4.

Table 4 Types of Agricultural Products and Average Field Size

Product	Paddy Rice	Maize	Cassava	Dry Field Rice	Peanuts	Sweet Potatoes	Others	Total
Average Field Size (ha)	0.32	0.49	0.15	0.05	0.04	0.03	0.07	1.15

Note: Others consist of green peas, tomatoes and onions, etc.

Although double cropping is conducted in some areas, the average land size per household for double cropping is as small as 0.06-0.07 ha.

1.1.6 Production Volume (Per beetare)

The estimated unit yields based on the average production volume and size of cultivated land are given in Table 5 together with the relevant average unit yields for Kab. Kupang. Because of the lack of an actual harvesting survey, etc. to confirm the figures, the estimates should be treated as a rough guide.

Table 5 Production Volume and Unit Yield

Item	Production Volume (kg)	Average Unit Yield (A) (kg/ha)	Average Unit Yield for Kab. Kupang (B) (kg/ha)	Comparative Performance (A/B) (%)
Paddy Rice	1,291	1,956	3,289	60
Maize	413	725	2,075	35

1.1.7 Marketing of Agricultural Products

Few local producers of agricultural products actual market items other than grain, presumably because of the fact that many products are consumed at home. The exceptions are soya beans and green peas as more than 80% of the producers (although the number of producers is admittedly small) market these products. More than 70% of tomato and vegetable producers also market these products.

1.1.8 Planting Season

The planting of agricultural products is highly concentrated in the period from December to May. Vegetables and tomatoes are also planted in the dry season which lasts from July to November.

1.1.9 Agricultural Inputs

The most popular agricultural input is urea as 44% of those interviewed use an average of 93 kg/year. The second most popular item is TSP (38%; 63 kg), followed by agrochemicals (35%). These items are usually purchased from either a retailer or the KUD.

1.1.10 Labour

In response to the question of how farming labour was secured, slightly more than 10% of the interviewees stated that they rely on outside labour for land preparation, planting and harvesting, all of which demand a high labour input. In the lower reaches where there are many wet fields, the ratio of dependence on outside labour of 20 - 30% is much higher.

1.1.11 Preferred Products for Cultivation in the Future

The most preferred product for cultivation in the future among the interviewees is bananas (some 30% expressed a desire to grow bananas), followed by coconuts, mangos, peanuts, green peas and tomatoes. Some of the interviewees indicated a willingness to grow jati, kemiri and cashews.

1.2 Stock Raising

The survey items in regard to stock raising were the number of domestic animals raised, the raising methods and the preferred domestic animals to be raised in the future.

1.2.1 Number of Animals Raised

In addition to the raising of horses, broiler chickens, ducks and pigeons by 1 - 2% of the households, many households also keep free range chickens, pigs, cattle and goats as shown in Table 6. The number of households raising more than 10 heads of cattle in the Oebelo and Olio Watersheds is only 2. In comparison, the corresponding number in the Oesao Watershed is 36, underlining the relative popularity of cattle raising in this watershed.

Table 6 Number of Domestic Animals Raised

Type of Animal	Free Range Chickens	Pigs	Cattle	Goats
Ratio of Those Raised	79	74	62	31
Average Number of Animals Raised	8.1	3.4	5.0	4.5

1.2.2 Reasons for Cattle Raising in Sheds

The most popular reason for cattle raising in sheds, selected on a multiple choice basis, is to raise cattle in good conditions (more than 60%). The combined figure of more than 70% of those who selected either "so as not to damage farming land due to free grazing" or "so as not to damage seedlings and/or standing trees in a forest" indicates the common occurrence of damage due to free grazing.

1.2.3 Advice on Sick Animals

When domestic animals are sick, 70% of the owners state that they consult a veterinary doctor. The ratio of those consulting a neighbour with past experience is 40% which is double the ratio of those consulting an extension worker.

1.2.4 Causes of Animal Sickness

70% of the animal owners state that sickness is caused either by infectious diseases or parasites. A shortage of fodder and water is pointed out by 20% of the interviewees, as is a lack of proper knowledge of stock raising. In the Oebelo and Olio Watersheds, both "a shortage of fodder and water" and "lack of basic stock raising knowledge" were selected by 40% of the interviewees which is a rather remarkable contrast to the 10% in the Oesao Watershed.

1.2.5 Preferred Animals for Raising in the Future

In the order of popularity, the preferred animals for raising in the future are cattle, free range chickens and pigs. 80% of those interviewees stated that they would prefer to raise cattle.

1.2.6 Main Sales Outlets

The sales outlets for cattle, pigs and goats are local markets and cattle dealer. Most free range chickens are sold at the local markets.

1.3 Other Production Activities

1.3.1 Production and Sale of Fruit

Popularly grown fruit include bananas, papayas, coconuts, jack fruit, mangoes and oranges. Each of these is grown by more than 20% of the local households. The growers of bananas, coconuts and mangoes market their products but the ratio of own consumption is high for papayas, oranges and jack fruit. Fruit are almost always sold through the local markets.

1.3.2 Forest Products

Only 6 interviewees, i.e. 1% of the total, stated that they produce timber. Apart from timber, the forest products referred to are kemiri, woven fabric and crafts (by some 10% of the interviewees each).

1.3.3 Currently Planted Species and Future Prospects

Popular species for planting are such fruit trees as banana and papaya, cassava and such fodder trees as Lamtoro spp., turi and petail (all of which are planted by more than 30% of those interviewed). Kemiri, gewang and king grass are quite popular (more than 20%). The future preference for species to be planted is almost exactly the same as the current preference.

1.4 Miscellaneous

1.4.1 Saving and Borrowing

Some 10% of the interviewees state that they have experience of cash borrowing. Only 3% have borrowed from the People's Bank of Indonesia or the KUD while 4% have borrowed from a neighbour or from a mutual financing group. The main purposes of borrowing are business funds (an average of Rp 800,000, repayable in 10 months) and education (an average of Rp 200,000, repayable in 8 months). 15% of the interviewees have a savings or deposit account. The People's Bank of Indonesia is a favourite bank. Geographically, the ratio of those who have a savings or deposit account is high in the lower reaches.

1.4.2 Household Expenditure

The household expenditure shows a high ratio for food (51%), followed by transport (10%), housing (7%), clothes (6%) and education (4%).

2. Living Environment

2.1 Awareness of Living Environment

2.1.1 Opinions on Living Environment

A total of 8 items assumed to represent the living environment were selected and the interviewees were asked about their past and present conditions as well as their future prospects. These 8 items were clothing, food, housing, education, medical care, transport, water and firewood. The interviewees were also questioned on their future priorities. For most items, the general opinions indicate improvement compared to the past but little change in the future. Those items for which the situation is said to have worsened or will worsen in the future are listed in Table 7.

Food is at the top of the future priority list as 76% of the interviewees selected food on a multiple choice basis, followed by clothing (55%), education (55%), housing (55%) and medical care (38%).

Table 7 Items Said to Have Worsened or Will Worsen

Reaches	Upper Reaches	Middle Reaches	Lower Reaches
Past - Present	Firewood (69%)	Firewood (64%) Food (49%) Transport (31%) Water (49%)	Firewood (64%)
Future Prospects	Firewood (75%)	Firewood (65%)	Firewood (68%) Water (46%)

2.1.2 Annual Cash Income and Monthly Cash Expenditure

The situation in regard to the annual cash income and monthly cash expenditure of the interviewees is shown in Table 8.

Table 8 Annual Cash Income and Monthly Cash Expenditure

Annual Cash Income			Monthly Cash Expenditure		
Category	No. of Relevant Interviewees	%	Category	No. of Relevant Interviewees	%
Less than Rp 200,000	127	25	Less than Rp 10,000	88	18
Less than Rp 300,000	84	17	Less than Rp 20,000	125	25
Less than Rp 450,000	65	13	Less than Rp 40,000	125	25
Less than Rp 600,000	57	11	Less than Rp 60,000	47	9
Less than Rp 800,000	55	11	Less than Rp 80,000	48	10
Less than Rp 1,000,000	28	6	Less than Rp 100,000	19	4
Less than Rp 1,500,000	33	7	Less than Rp 140,000	15	3
Rp 1,500,000 or more	28	6	Rp 140,000 or more	8	2
No Answer	24	4	No Answer	19	4

2.1.3 Average Gross Income/Household

Table 9 shows the total of the gross agricultural production value and non-agricultural income, living expenditure and cash income and expenditure referred to in Table 8 for each watershed. All the figures are the average per household. Some of the interviewees declined to answer, making the average figures less reliable. Nevertheless, the figures are presented here as they are believed to show the different characteristics of each watershed.

Table 9 Average Gross Income, etc. per Household

(Unit: Rp 1,000/year/household)

Watersheds	Average Gross Income	Living Expenditure	Cash Income	Cash Expenditure
(Oebelo & Olio Watersheds)				
Upper Reaches	1,261	748	305	307
Middle Reaches	901	587	316	313
Lower Reaches	1,720	942	565	614
(Oesao Watershed)				
Upper Reaches	1,367	802	339	394
Middle Reaches	1,252	574	360	314
Lower Reaches	2,419	1,279	835	426

Notes

1) Average gross income = gross agricultural production value (inclusive of cost of agricultural inputs) + non-agricultural income.
2) Living expenditure: the sum of the separate figures for food, electricity, transport, water, kerosene, education, clothing, medical care/drugs, house repair, community charge, taxes, loan repayment and others.

2.1.4 Access to Community Services

Four items were selected to represent community services and the interviewees were asked about their access to such services, i.e. primary schools, clinics, water sources and markets. As Table 10 shows, the interviewees find their access to primary schools and water sources relatively easy. Access to clinics is more difficult and the markets are situated at a much further distance than the others.

Table 10 Access to Community Services

Distance (Accessibility)	Primary Schools		Clinics		Water Sources		Markets	
	No. of Interviewees	%	No. of Interviewees	%	No. of Interviewees	%	No. of Interviewees	%
1. Short	247	49.2	162	32.3	333	66.3	90	17.9
2. Medium	95	18.9	69	13.7	82	16.3	45	9.0
3. Far	103	20.5	266	53.0	78	15.5	342	68.1

2.1.5 Possession of Electrical Goods, etc.

Among various electrical goods, radios are owned by 34% of the households. The figure is 14% for TV sets, 9% for sewing machines, 3% for electric fans and 3% for electric pumps. Of the households in the lower reaches, the possession rate for TV sets, sewing machines and electric fans is high. In the case of transport means, only 1% of the households own a 4-wheel car. The figure improves to 4% in the case of motorbikes and 6% for bicycles. No answer was given for carts drawn by a horse (or ox).

2.1.6 Places of Purchase of Daily Necessities

More than 90% of the interviewees stated that they purchase their daily necessities (sugar, salt, cooking oil and dried fish, etc.) at the market while 60% stated that they also purchase these items from retail shops. Only a small number of the interviewees stated that they purchase these items from peddlers.

As mentioned earlier, the local market is also a place for the sale of local agricultural products. With regard to the frequency of visiting the market, 46% stated once or twice/month while 51% stated 3 - 4 times/month. The most popular mode of access to a market is bus (62%), followed by on foot (48%). Motorbikes and bicycles are also used by a small number of people.

2.1.7 Information Sources

Given the background of a low radio and TV set ownership level, information on government activities appears to reach the public through various local meetings or neighbours. Radio, TV and extension workers are also sources of such information. More than half of those interviewed (52%) obtain technical information on agricultural, forestry and stock raising from extension workers. Other sources of technical information are local meetings, neighbours, radio and group members.

2.1.8 Division of Labour Among Family Members

The questions on the division of labour among family members disclosed no clear division. Both husbands and wives conduct similar work with each playing a more dominant role in certain areas as shown in Table 11. Child labour appears to have some importance in regard to firewood collection, cattle raising, fodder collection, water fetching, planting and harvesting.

Table 11 Division of Labour Between Husbands and Wives

Categories	Type of Work
Almost equal share between husband and wife	Sale of firewood / control of savings / participation in school activities / control of family health / charcoal production / production of crafts / honey collection / crop harvesting
Husband plays a more dominant role	Cattle raising / collection of animal fodder / sale of domestic animals / decision on borrowing / decision of planting time / planting/purchase of farming tools / production control of agricultural products / decision on harvesting time / participation in village events / group activities
Wife plays a more dominant role	Firewood collection / purchase of daily necessities / purchase of durable goods / water fetching / cooking / sale of agricultural products at the market

2.1.9 Desirable Government Assistance

As many as 21 issues were mentioned as desirable subjects for government assistance to improve local life. The items mentioned by 80% of the interviewees or more were as follows: construction or repair of roads, measures to solve the water shortage, construction of domestic water supply facilities, health care, land conservation, agricultural promotion, increase of employment opportunities, forestry promotion and stock raising promotion. The written replies to the question of desirable assistance to improve local life identified 29 issues, including the supply of drinking water (133

interviewees; 27%), improved availability of housing (construction) timber (112 interviewees; 22%), repair of transport facilities (100 interviewees; 20%), cattle raising (97 interviewees; 19%), funding for farming purposes (94 interviewees; 19%) and assistance for the wider use of farming tools and mechanisation (85 interviewees; 17%).

2.2 Collection of Firewood

A total of 98% of the interviewees use firewood for cooking purposes while 29% also use kerosene to light the fuel. Electricity is used by 5% of the interviewees and cinders are used by 6% for ironing or barbecue purposes.

Some 50% of the interviewees collect firewood 4-5 times/week together with the collection of fodder for domestic animals at village and/or private land. Again, half of those interviewed stated that the distance to the collection site is as far as a 5 km walk in the Oebelo and Olio Watersheds and 2 km in the Oesao Watershed.

The question on changes of the firewood availability revealed that an overwhelming number of the interviewees believe that firewood collection has become more difficult because of the deterioration of forests and land productivity due to burning and shifting cultivation. The prediction for the future is similarly bleak. Envisaged methods to solve the present situation are said to be the planting of trees (431 interviewees; 86%), suspension of burning (293 interviewees; 58%) and termination of shifting cultivation (211 interviewees; 42%).

2.3 Burning

Several purposes of burning are emphasised, including preparation for farming on a new site, speeding up of the preparation for farming, labour saving, encouragement of the growth of young shoots to feed cattle and improvement of the soil fertility.

The popular timing and places of burning are from July to October at both private and village land and also at some national land. The frequency is once a year in most cases. Some 78% of those interviewed approve of the practice of burning as an effective means of achieving the stated purposes while 12% disapprove of this practice.

Apart from burning, certain other measures are also considered effective to achieve the stated purposes. These measures include farming preparation based on goton royon, fertiliser application, enlightenment of the public of the adverse impacts of forest deterioration and upgrading of the farming tools used.

2.4 Water Shortage

The water sources for domestic and agricultural water are wells (54%), rivers (32%), fountains (29%), rain (25%), water supply system (15%), check dams (7%) and ponds (2%). The main sources of water by watershed are shown in Table 12.

Table 12 Main Sources of Water in Each Watershed

Usage Rate of Interviewees	Oebelo & Olio Watersheds	Oesao Watershed
60% or more	Wells	
50% or more		
40% or more	Rain	Wells
30% or more		Fountains & rivers
20% or more	Rivers	
10% or more	Supply system, fountains & check dams	Supply system & rain

In regard to the question on improvement of the water supply, more than 60% of those interviewed in the Oebelo and Olio Watersheds stated that the situation has worsened compared to slightly less than 30% in the Oesao Watershed. Taken together, slightly more than 40% of the interviewees stated that the situation has worsened. The perceived causes of the water shortage are low rainfall (88%), forest degradation (38%), population increase (26%) and damage to water storage facilities (14%).

2.5 Flooding

The perceived causes of flooding are downpours (82%), forest degradation (27%), lack of drainage channels (20%) and lack of soil and water conservation facilities (8%). Some 53% of those interviewed stated that they have suffered some damage due to flooding while 33% stated that they have not. A further question on the actual subjects of damage due to flooding revealed that these are crops and vegetables (45%), farmland (33%), roads (10%), houses (6%) and livestock (5%), etc.

3. Planting Expectations

3.1 Planting Expectations

The opinions of the interviewees of the projects promoted by the Ministry of Forestry were asked in order to clarify the willingness of those interviewed to participate in reforestation activities.

3.1.1 Opinions of Projects of Ministry of Forestry

In response to the question on the effectiveness of the projects of the Ministry of Forestry, reforestation and social forestry, etc. in view of land rehabilitation and soil conservation, 50% of the interviewees selected both reforestation and social forestry, followed by demonstration plots (27%), village nurseries (25%) and check dams (19%).

3.1.2 Experience of Participation in Projects of Ministry of Forestry

The ratio of those interviewees with experience of participating in one project or another in the past is 41% for planting on private or village land, 34% for reforestation, 16% for demonstration plots and 10% for village nurseries. The reasons for non-participation are "busy at home" (12%), "did not know" (11%), "project site too far away" (6%) and "not invited by extension workers" (5%).

3.1.3 Benefits of Participation

Some 50% of the interviewees are willing to participate in projects because of the benefits they have obtained through past participation. These benefits are increased agricultural output (43%), learning of forestry skills (40%), increased cash income (15%) and creation of groups (10%). Some of the interviewees are dissatisfied with their experience of participation because of "too much hard work" (10 interviewees), "planted species were unsuitable for the soil conditions at the site" (6 interviewees) and "failure to learn new forestry skills" (5 interviewees), etc.

3.1.4 Types of Work in Which Willing to Participate

The degree of willingness of those interviewed to participate in a land rehabilitation project of the Ministry of Forestry varies from one project stage to another, i.e.

growing of seedlings (58%), planting (45%), land preparation (44%) and site maintenance (33%).

4. Community Activities

4.1 Group Activities

A total of 101 household heads among the interviewees were asked about their current participation in community activities to obtain an idea of how to secure the cooperation and participation of local inhabitants for the implementation of the Land Rehabilitation Plan.

4.1.1 Present State of Group Activities

Popular group activities are religious activities, village meetings, family education and family planning, all of which are participated in by 60 - 80% of the 101 household heads. Some 20 - 40% participate in activities organized by farmers' groups, schools, mutual financing associations, the KUD, youth groups, weaving groups and NGOs, etc.

4.1.2 Participating Family Members

There appears to be a certain division of labour between husbands and wives in terms of the group activities in which they participate although all family members tend to participate in religious activities. Husbands appear to be more active than wives in village meetings, farmers' group meetings, the KUD, school activities and NGO activities while wives appear to be more active in regard to family education, family planning, mutual financing associations and weaving groups.

4.1.3 Types of Group Activities and Number of Participants

The answers to the open question, i.e. items to be chosen from were not given, on the types of group activities and membership strength are tabulated in Table 13.

Table 13 Types of Group Activities and Membership Strength

Group Activity	Number of Participating Interviewees	Ratio (%)	Average Membership (persons)
1. Village Meetings	20	20	75
2. Farmers' Groups	21	21	107
3. Youth Groups	2	2	33
4. Family Education	20	20	19
5. Family Planning	10	10	66
6. Religious Groups	19	19	112
7. KUD	5	5	47
8. School Activities	3	3	87
9. Mutual Financing Associations	18	18	14
10. Weaving Groups	12	12	14
11. NGOs	2	2	26
12. Others	3	3	17

4.1.4 Information Sources for Group Activities

The original sources of information on group activities are group leaders or members (39 interviewees), neighbours (28 interviewees), village leaders (24 interviewees) and NGO members (11 interviewees).

4.1.5 Running of Community Activities

A membership fee is paid for such major activities as village meetings and religious group activities in order to finance refreshments, communal work and the joint purchase of agricultural inputs, etc. In addition to village meetings and religious group activities, regular meetings are also held by mutual financing groups and weaving groups. The decision-making at these meetings/activities is based on a majority vote, unanimous vote or at the discretion of the leader.

4.1.6 Motivation for Participation

By far the most popular motivation for participation is the prompt and economical achievement of the necessary common understanding among local inhabitants (85 out of the 101 household heads interviewed). Eleven of the interviewees stated that they wanted either government assistance or agricultural credit. Three joined for information and one person was unable to refuse the invitation.

4.1.7 State of Activities

Fifty of the household heads interviewed have the opinion that the community activities are generally managed smoothly. Poor management due to a funding shortage was pointed out by 18 interviewees while 5 interviewees pointed out an inadequate membership strength. On the question of past experience of dropping out of a group, 12 interviewees have experience of leaving a farmers' group, 11 of leaving a family education group, 10 of leaving a village meeting and 9 of leaving a weaving group. Popular reasons for this are insufficient funding (20 interviewees) and insufficient membership strength (12 interviewees).

4.2 Activities Relating to Use of Forest Resources

4.2.1 Rules for Use of Forest Resources

Some of the rules for using forest resources, such as the collection of firewood from village forests, are identified as shown in Table 14.

Table 14 Rules for Use of Forest Resources

Rules	Oebelo & Olio Watersheds		Oesao Watershed		Total	
	No. of Interviewees Mentioning the Rule	%	No. of Interviewees Mentioning the Rule	%	No. of Interviewees Mentioning the Rule	%
1. No felling until sandalwood grows to a DBH of 25 cm	9	25.0	20	30.8	29	28.7
2. No felling within a 100 m radius of a water source	19	52.8	28	43.1	47	46.5
3. No trespassing within a forest	6	16.7	9	13.8	15	14.9
4. Planting of the same number of trees which are felled and daily care thereafter	16	44.4	15	23.1	31	30.7
5. Planting of a tree(s) at the time of a wedding and/or funeral	0	0.0	3	4.6	3	3.0
6. Others	0	0.0	9	13.8	9	8.9

Notes
1) Multiple choice.
2) Percentage figures are the ratio of those mentioning each specific rule in the total number of interviewees (36 for the Oebelo and Olio Watersheds and 65 for the Oesao Watershed, totalling 101).

4.2.2 Punishment and Damage

The punishments and/or possible damage as a consequence of the violation of the rules include fines (mentioned by 36 interviewees), village ostracism (3 interviewees) and illness on the part of the offender (30 interviewees). A total of 47 of those interviewed predict a drought for the village of an offender while 14 interviewees also predict adverse effects of forest degradation on the village.

4.2.3 Forestry Group Activities

Many groups related to forestry actually aim at conducting joint planting as a goton royon activity. Descriptions of the motivation for participation in and the management of group activities are omitted here because they are the same as those for community activities.

[Reference Data: Customs Relating to Inheritance]

Table 15 compiles the local customs relating to inheritance based on interviews conducted with village heads and others for reference purposes.

Table 15 Survey on Land-Related Local Customs

(1/2)

Kecamatan/Desa	Inheritance				Possibility of Land Rent Agreement	Communal Land (Village Land)
	Timing	Decision-Maker	Land Distribution	Assets Subject to Distribution		
[Kec. Kupang Tengah] Desa Oebelo	Death of both parents	Meeting of registered married children or brother of late father acting as proxy before registered marriage	Decision by the meeting or by proxy	As left	Possible: 3-way division Tenant: 1/3 Landowner: 1/3 Tractor Owner: 1/3	100 ha (village land: 1 ha)
Desa Bokong	Death of father	Eldest son	- Daughters: 25% - Sons: equal share	House: subject to agreement by heirs No specific rule	Possible: 3-way division	200 ha
Desa Oelpuah	As above	Village elder	- Sons: equal share - Daughters: none	Coconut trees, etc: joint ownership House: Subject to agreement by heirs	- Possible for wet fields: 3-way division - Not possible for dry crop fields	1,877 ha (village land: 4 ha out of which 2 ha are planted with pulses)
[Kec. Kupang Timur] Desa Merdeka	As above	Eldest son and mother	- Eldest son: 50% - Other sons: equal share of remaining assets	House and trees go to youngest child	Possible: 3-way division	None
Desa Oefafi	As above	Village elder	- Sons: equal share - Daughters: minimum	House: subject to discussion	Possible: 3-way division	100 ha
Desa Oesao	Father's decision before death	Father	As father's decision	As father's decision	Possible: 3-way division	Village market (5 ha)
Desa Tuatuka	Death of father	Eldest son; village elder must act as a witness	- Sons: equal share - Daughters: no distribution of farmland	House goes to youngest child	Possible: 3-way division	None
Desa Fatukanutu	As above	Village elder	- Sons: equal share - Daughters: only if sufficient farmland is available	House goes to eldest son	No	None

Kecamatan/Desa	Inheritance				Possibility of Land Rent Agreement	Communal Land (Village Land)
	Timing	Decision-Maker	Land Distribution	Assets Subject to Distribution		
Desa Kuanheum	Death of father	Eldest son	- Sons: equal share	House goes to eldest son; others to be shared	Possible: for 3 years only	450 ha (village office site: 0.05 ha)
[Kec. Amarasi] Desa Nonbesu	As above	Brother of father	- Eldest son gets a higher share - Daughters: 25% if there are only 2 sons	As above	Possible: 3-way division	300 ha (village land: 5 ha)
Desa Oesena	As above	Mother	As above	As above	Possible: 2 or 3-way division	Village land (2 ha)
Desa Kotabes	As above	Mother and eldest son	- Eldest son	- House goes to eldest son - Wet and dry crop fields jointly owned by sons	No	Village land (6 ha)
Desa Ponain	As above	Mother	In principle, equal share, including daughters	House goes to son	No	Village land (1 ha)
Desa Tesbatan	Father's decision before death	Eldest son in case of sudden death	- Eldest son gets larger share - Equal share between other sons - Daughters: none	- House goes to son - Others decided by father or eldest son	No	Village land (5 ha)
Desa Apren	Death of father	Eldest son	- Sons: equal share - Daughters: none	House goes to eldest son	No	None
Desa Nekmese	As above	Eldest son	- Sons: equal share - Daughters: some	House goes to eldest son	No	None
Desa Tunbaun	As above	Mother (eldest son if mother is also deceased)	- Eldest son gets larger share - Daughters: at parent's discretion	House: depends on children's circumstances	Possible: 2-way division, excluding land for seed production	Village land (5 ha)

Source: Mainly village heads, excepting Desa Merdeka (wife of village head), Desa Nekmese, Desa Tunbaun and Desa Tuatuka (secretary of village head)

C-7 Number of Domestic Animals in Three Subject Kecamatans, etc.

(Unit: head)

Kecamatan, etc.	Water Buffaloes (Kerbau)	Horses (Kuda)	Cattle (Sapi)	Goats/Sheep (Kambing/ Domba)	Pigs (Babi)	Chickens (Ayam)	Ducks (Itik)
Kupang Tengah	64	319	15,220	8,362	16,099	146,295	1,680
Kupang Timur	1,108	1,777	49,859	5,518	11,981	67,763	4,833
Amarasi	–	–	25,177	5,519	10,483	62,856	242
Total (1993) of 3 Kecamatans	1,172	2,096	90,256	19,399	38,563	276,914	6,755
Kabupaten Kupang (1993)	25,295	16,892	220,051	247,278	293,711	1,401,418	12,929
Share of 3 Kecamatans in Kabupaten Kupang	4.6%	12.4%	41.0%	7.8%	13.1%	19.8%	52.2%
Kabupaten Kupang (1992)	25,405	16,322	214,700	232,657	283,760	1,614,837	11,395
East Nusa Tenggara (1992)	184,870	167,873	751,687	621,288	1,367,175	6,041,936	168,915
Share of Kabupaten Kupang in East Nusa Tenggara Province	13.7%	9.7%	28.6%	37.4%	20.8%	26.7%	6.7%

Note : The figure for chickens in 1992 for both Kabupaten Kupang and East Nusa Tenggara province is the total of free range chickens (Ayam Kampung) and broiler chickens (Ayam Ras).

Sources : Kupang dalam Angka 1993, Kantor Statistik Kabupaten Kupang, 1994
Nusa Tenggara Timur dalam Angka 1992, Kantor Statistik Propinsi NTT, 1993

C-8 Number of Beef Cattle

Desa Name	Land Area inside Study Area	Number of Beef Cattle
Kec. Kupang Tengah		
NOELBAKI	1,015	1,100
OEBELO	1,976	885
BOKONG	3,841	1,380
OELPUAH	2,358	582
OELNASI	450	198
Total	9,640	4,145
Kec. Kupang Timur		
TUAPUKAN	306	150
MERDEKA	1,669	1,787
OEFAFI	1,537	757
BABAU	1,491	3,248
OESAO	2,122	2,134
TUATUKA	1,481	864
KUANHEUM	964	2,535
FATUKNUTU	1,840	1,584
Others	50	—
Total	11,460	13,062
Kec. Amarasi		
NONBES	4,252	1,359
OESENA	1,194	679
KOTABES	1,266	892
PONAIN	1,914	900
APREN	898	325
TESBATAN	1,882	1,425
OENONI	674	344
TUNBAUN		
Total	12,080	5,924
Grand Total	33,180	23,131
		≠ 23,100

Source: DALAM ANGUKA 1993.
KANTOR STATISTIK KABUPATEN KUPANG

C-9 Number of Beef Cattle in Nusa Tenggara Province (Estimated Data in 1989)

Classification	Number of Owner	Number of Beef Cattle	Average
1-2 Cattle Head	40,000 (55%)	60,000 (8%)	1.5
3-10 Cattle Head	20,000 (27%)	120,000 (17%)	6
11-25 Cattle Head	10,000 (13.5%)	180,000 (26%)	18
26-100 Cattle Head	3,000 (4%)	180,000 (26%)	60
101-500 Cattle Head	300 (0.4%)	120,000 (17%)	400
more than 500	50 (0.1%)	37,500 (5%)	740
Total	73,350 (100%)	697,500 (100%)	9.5

C-10 Productivity of Natural Grassland and Its Grazing Capacity

Category	Contents
Surveyed Site	Desa Raknamo, Kec. Kupang Timur (bordering on the north-eastern Part of Study Area)
Survey Date	Surveyed 12 times at the interval of 3 months from June, 1990 to March, 1993
Species of Grass Dry	*Heteropogan contortus*, *Digitaria sanguanalis* (*Gramineae*), *Alysicarpus vaginalis*, *Glycine* spp. (*Leguminosae*)
Existing Weight (kg/ha)	(March) 2,670 (June) 2,370 (September) 545 (December) 410
Grazing Capacity Cattle (Head/ha)	(March) 4.4 (June) 3.9 (September) 0.7 (December) 0.5

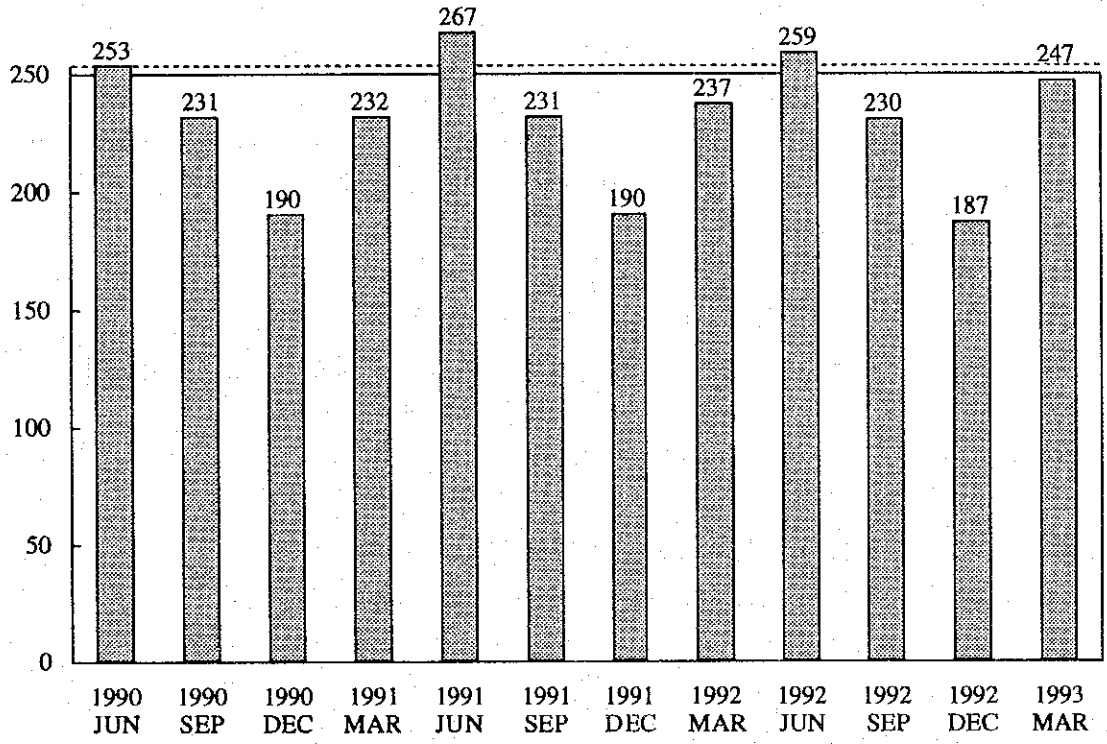
Source: Chaps Book A : Cattle Health & Productivity Survey, May 1994, Sub Balai Penelitian Ternak Lili

Note: ⓐ Amount of fodder needed for Beef Cattle (body weight 250kg) for 3 months period = 562.5kg (daily 2.5% of body weight)

ⓑ Consumption capacity = Existing dry weight - 150kg (remaining amount)

ⓒ Grazing capacity = b/a

C-11 Body Weight of Beef Cattle



Source: CHAPS BOOK A, Sub Balai Penelitian Ternak Lili, May, 1994

C-12 Spatial Plan

A spatial plan is a long-term plan which provides the framework for land use in Indonesia and which is supposed to be prepared on different administrative levels, such as province, kabupaten and kecamatan. A plan was prepared for East Nusa Tenggara Province in 1994 with the title of Spatial Adjustment and Structural Plan (hereinafter referred to as the Spatial Plan) which is composed of a planning paper (report) and a planned land use map (scale: 1/250,000). This Spatial Plan is described below.

The Spatial Plan ranks second to national plans and sets forth land use criteria addressing areas to be protected, areas which can be used and priority areas, etc. In this sense, the Spatial Plan also sets target indices for investment by the public sector and private sector to ensure the balanced development of the entire province.

In addition to constituting the guidelines for spatial plans at the kabupaten level, the Spatial Plan is expected to provide the framework for the formulation and implementation of 5-year plans and annual plans, etc. of local offices of central government ministries and agencies.

(1) Establishment of Protected Zones

Protected zones are an important component of the Spatial Plan and are sub-classified as protected areas, localised protected areas, wildlife and nature conservation areas and landslide hazard areas. The classification criteria are listed in Table 1.

(2) Designation of Utilisation Zones

Utilisation zones are sub-classified as forestry areas, farming areas, fishery areas, recreation areas and settlement areas, etc. The classification criteria are listed in Table 2.

Table 1 Protected Zone Classification Criteria

Area Type	Criteria
o Protected Area	
- Protected Forest	Forests with a minimum score of 175 in terms of gradient, soil type and rainfall factors and forests of which the gradient is 40% or more
- Loamy Soil	Areas consisting of loamy soil with depth of 3 meters or more
- Swamp	Ponds and swamps, etc.
o Localised Protected Area	
- River Bank	River banks within 100 m of a large river channel or 50 m of a creek
- Dam/Lake	Areas within 50 - 100 m of the highest water level
- Area around a Spring	Areas within a 200 m radius
o Wildlife and Nature Conservation Area	Areas where nature reserve is needed
o Landslide Hazard Area	While it is possible to specify hazard areas in a volcanic zone, it is impossible to do so in other landslide areas

Note: The score means the indexed soil and water conservation functions (in accordance with the Notification of the Ministry of Agriculture).

Table 2 Utilization Zone Classification Criteria

Area Type	Criteria
o Production Forest	
- Limited Production Forest	Forests with a score of between 125 and 174
- Production Forest	Forests with a score of less than 125
- Conversion Forest	Forests with a score of less than 125
o Agriculture Area	
- Paddy Field	Farming fields where irrigation facilities are provided, with an elevation of less than 1,000 m, a gradient of less than 40% and a minimum top soil thickness of 30 cm
- Dry Crop Field	Elevation of less than 2,000 m, a gradient of less than 40% and a minimum top soil thickness of 30 cm
- Perennial Crop Field/Plantation	Same as above
- Stock Raising Area	Elevation of less than 2,000 m, a gradient of less than 15% and suitable soil and climate
o Fishery Area	Suitable for fish culture, with a gradient of less than 8% and suitable for water supply
o Mining Area	Areas designated by the Ministry of Mining
o Industrial Area	Suitable for water supply and drainage; areas where the introduction of recreational facilities does not cause severe adverse soil impacts
o Recreation Area	Areas of high cultural and/or tourism value
o Settlement Area	

(3) Promotion of Forestry and Dry Field Farming, etc.

The principles of a spatial plan relating to the promotion of industries, which are relevant to the present Study, are outlined below.

1) Forestry

The promotion of forestry aims at achieving the production capacity of forests in full. The actual measures to achieve this objective include the implementation of industrial reforestation, establishment of buffer zones along the boundaries of protected forests, felling of forests, monitoring and control of shifting cultivation, successful adjustment with the farming and mining demand and the agricultural use of conversion forests.

2) Dry Field Farming

In addition to the qualitative improvement of dry field farming, measures should be introduced to achieve the maximum use of those dry fields which are not fully used at present.

3) Cash Crops

Suitable cash crops vis-a-vis the local climate and soil, etc. must be selected together with reforestation using coffee, coconut palms and/or kemiri, etc. and the expansion of existing forests of these useful trees. Moreover, the planting of perennial crops should be encouraged to improve the agricultural climate, to prevent soil loss and to develop an integrated farming system.

4) Stock Raising

In addition to intensification and diversification, the introduction of more advanced raising methods and the rehabilitation of grassland should be conducted to improve the productivity and production volume of stock raising. The preservation of vegetation on pasture and the maintenance of drinking water sources should be implemented to ensure a healthy environment to prevent a decline of the stock raising capacity of the land. Furthermore, an integrated stock raising system, including the use of tethers and an efficient raising method, should be developed to suit the productivity of local land and space availability.

5) Recreation Areas

For recreation areas, efforts should be continuously made to improve the facilities and to increase the subject areas to attract more domestic and foreign tourists.

(4) Land Area by Use Category

The land area by use category in Kab. Kupang based on the above-mentioned principles is shown in Table 3.

Table 3 Land Area by Use Category in Kab. Kupang

Category	Area (ha)	%
Paddy Field	15,187.5	2
Dry Crop Field	1,312.5	-
Orchard	19,812.5	3
Stock Raising	197,562.5	27
Fishery	8,750.0	1
Limited Production Forest	57,312.5	8
Production Forest	82,937.5	11
Conversion Forest	2,562.5	-
Settlement	12,187.5	2
Industry	8,062.5	1
Tourism	1,500.0	-
Shrub Land	123,712.8	17
Protected Forest	202,959.7	28
Total	733,860.0	100

(5) Priority Areas

A total of 15 priority areas for rapid development have been designated, including troublesome areas from the viewpoint of land conservation, tourism areas such as Komodo and areas subject to special development such as the Timor Trench site for oil field development. The Oesao Watershed in the Study Area is, in fact, designated a priority area with emphasis on the active promotion of farming, plantation, stock raising and tourism. The critical issues to be dealt with in the Oesao Watershed range from the general development of the area and the construction/restoration of irrigation facilities to full-scale work to improve landslide hazard sites.

D-1 Survey Findings on Reforestation

(1/2)

Survey Site No.	1	2	3	4	5	6	7
Survey Date	Nov. 8, 1994	Nov. 9, 1994	Nov. 9, 1994	Nov. 10, 1994	Nov. 10, 1994	Nov. 15, 1994	Nov. 15, 1994
Location							
- Kecamatan	Amarasi	Amarasi	Amarasi	Amarasi	Amarasi	Kupang Tengah	Kupang Tengah
- Desa	Kotabes	Kotabes	Kotabes	Nekmese	Sonraen	Oelpuah	Oelpuah
- Site Name	Sismeni	Bisoni	Ekam	Bikoro	Hinmat	Nefosmeni	Oelnasi
Site Conditions							
- Elevation (m)	630	620	620	450	590	100	70
- Bearing	N15°W	N40°E	S86°E	S30°E	N65°E	-	-
- Gradient (%)	3	5	10	5	3	0	0
- Soil Type	Chromic Luvisols	Chromic Luvisols	Chromic Luvisols	Humic Cambisols	Chromic Luvisols	Chromic Luvisols	Chromic Luvisols
Land Use before Planting	Grassland (Alang-Alang)	Shrub	Grassland (Alang-Alang)	Shrub	-	Grassland (Alang-Alang) & Shrub	Shrub
Stand Conditions							
- Planted Species	Jati (Tectona grandis)	Kemiri (Aleurites moluccana)	Johar (Cassia siamea)	Jati (Tectona grandis)	Mahoni (Swietenia macrophylla)	Mahoni, Johar, Gmelina arborea	Johar, Mahoni, Gmelina arborea
- Time of Planting	Feb.-Mar., 1967	Dec., 1974	Feb., 1965	Dec., 1976	Dec., 1971	Dec., 1993-Jan., 1994	Dec., 1992
- Stand Age (yrs)	26	20	28	17	22	0	1
- Planted Area (ha)	25	25	20	100	15	100	100
- Planting Body	RPH Amarasi	RPH Amarasi	RPH Amarasi	RPH Amarasi	RPH Amarasi	RPH Kupang Tengah	RPH Kupang Tengah
- Planting Purpose	Soil Conservation	Soil Conservation	Soil Conservation	Soil Conservation	Soil Conservation	Soil Conservation	
- Planting Method	Seedlings, Tumpangsari System (combined with Jagun, Kacang tanah, Kacang merah and Ubikayu)	Direct Seeding (2 seeds in each hole), Tumpangsari System	Seedlings, Tumpangsari System (combined with Jagun, Kacang tanah, Kecang merah and Ubikayu)	Seedlings, Tumpangsari System	- Tumpangsari System	Pot Seedlings, 3 species planted separately, Tumpangsari System (combined with Jagun and Kacang tanah)	
- Planting Distance	2m × 3m	3m × 4m	2m × 3m	2m × 3m	3m × 1m	2m × 3m	

Survey Site No.	1	2	3	4	5	6	7
Tending							
- Supplementary Planting (Rate)	Twice (40% first time and 30% second time) in March of the first two years	Twice (20% for first time and 10% for second time) in March of the first two years	Twice (35% for first time and 15% for second time) in March of the first two years)	Twice (45% for first time and 35% for second time)	Twice (25% for first time and 10% for second time)	Not yet conducted (planned once a year for the first two years, current survival rate of 50%)	60% for first time
- Weeding	Full Weeding: 3 times (in March of the first three years)	Full Weeding: 3 times (in March of the first three years)	Full Weeding: 3 times (in March in the first three years)	Full Weeding: 3 times (in March in the first three years)	3 times in the first three years		
- Thinning	None	None	None	None	None		
Cutting							
- Upto Present	None	None	None	None	None	None	
- Future Plan	None	None	None	None	None	None	
Current Stand Conditions							
- Average Tree Height (m)	17	21	17	19	17		
- Average DBH (cm)	23	32	16	25	21		
- Tree Density (tree/ha)	596	380	710	400	1,310		
- State of Growth	Good	Good	Good	Good	Good		
- Vegetation Distribution	Arbor: H = 0.5 - 1m, 20%	Arbor: H = 1.5 - 6m, 40%	Arbor: H = 1 - 6m, 50%	None	Arbor: H = 2 - 5m, 20%	Arbor: H = 0.5 - 1m, 10%, Lontar, Gewang and Kosambi: H = 6 -15m, 10%	
- Ground Cover	Litter: 30% Grass: 5% (H=0.1-0.5 m) Stones & Gravel: some are Ø50-100 cm	Litter: 100% Grass: 0% Stones & Gravel: some are Ø50-100 cm	Litter: 100% Grass: some Stones & Gravel: Ø20-100cm, 5%	Litter: 40% Grass: 0% Stones & Gravel: Ø10-100cm, 5%	Litter: 100% Grass: 0% Stones & Gravel: Ø20-150cm, 5%	Litter: 50% Grass: 0% Stones & Gravel: Ø20-200cm, 20%	

D-2 Survey Findings on UP-UPSA

(1/2)

Survey Spot No.	1	2	3
Date of Survey	Nov. 28, 1994	Nov. 29, 1994	Nov. 29, 1994
Location - Kecamatan - Desa - Dusun - Site	 Amarasi Ponain Dusun III Bekun	 Kupang Tengah Bokong Dusun II	Kupang Tengah Oelnasi Dusun III Kaniti
Area (ha)	10	10	10
Project Year	1991/1992	1984/1985	1992/1993
Land Conditions - Elevation (m) - Bearing - Gradient (%) - Soil Type	 250 S5°E 5 Chromic Luvisols	 220 N40°E 20 Humic Cambisols	 90 N70°E 2 Chromic Luvisols
Pre-Project Land Use	Alang-Alang Grassland & Shrub	Grassland	Shrub
Land Ownership	Private	Private	Private
Number of Participating Households	40	20	30
Project Area/Household	0.25 (ha)	5 a - 2 ha	2 a -
Origin of Participating Households	Ponain	Dusun II & Bokong	Dusun III & Oelnasi
Distance Between Home and Site (km)	0	0 - 1	1
Project Contents	- Terracing (teras kredit) - Planting of trees - Planting of fruit trees - Crop cultivation - Workshop construction	- Terracing (teras bangku) - Planting of trees - Planting of fruit trees - Crop cultivation - Workshop construction	- Terracing (teras gulud) - Planting of trees - Planting of fruit trees - Crop cultivation - Workshop construction
Tree Planting - Species - Time of Planting - Planting Method - Planting Distance	 Gamal, Turi, Lamtoro Dec., 1991 Gamal: stump seedlings (50cm tall) Turi and Lamtoro: seeds Gamal and Turi: line planting of alternative species at 50cm intervals	 Acacia auriculiformis, Lamtoro Dec., 1984 Acacia: pot-grown seedlings (30cm tall) Lamtoro: seeds Acacia: 2m by 3m Lamtoro: line planting along contour lines	 Gamal, Mahoni, Jati Dec., 1990 pot-grown seedlings (30cm tall) 2m by 3m

Survey Spot No.	1	2	3
Fruit Tree Planting - Species - Time of Planting - Planting Method - Planting Distance	Jeruk, Papaya, Manga, Nangka, Apokat, Pisan December, 1991 Pot-grown seedlings and direct seeding 5m by 5m	Manga, Jeruk, Nangka December, 1984 Pot-grown seedlings (30cm tall) 5m by 3m	Jambu mente,, Manga, Kelapa, Nangka December, 1990 Pot-grown seedlings (30cm tall) 5m by 5m
Nursery	None	None	None
Crops Cultivated	Jagung, Kacang tanah, Kacang turis, Kacang hijau, Labu, Ubi Kayu	Jagung, Kacang tanah, Kacang turis, Kacang hijau	Jagung, Ubi kayu, Kacang tanah, Kacang turis, Kacang hijau
Government Assistance (Supply)	- Gamal stump seedlings - Turi seeds - Jeruk seedlings	- Acacia and fruit tree seedlings - Lamtoro and crop seeds	- Tree and fruit tree seedlings - Crop seeds
	- Jagung, Kacang tanah and Kacang turis seeds - Fertiliser	- Fertiliser	- Fertiliser
Current Conditions	- Gamal: dead - Turi: H = 3m - Jeruk: H = 1 - 1.5m - Ubi Kayu: H = 0.5 - 1m - Papaya: H = 2 - 5m	- Acacia: mainly dead except scattered trees along roads: H = 6 - 8m; DBH = 12 - 15cm - Lamtoro (Hawaiian): H = 2m, DBH = 2 - 3cm - Lamtoro (Salvadorian): H = 8m, DBH = 9 - 13cm - Fruit trees: all dead - No crop production	- Trees: mainly dead except small number of Gamal (H = 1m) - Fruit Trees: mainly dead except small number of Jambu mente (H = 0.5m) - Some crop harvests

D-3 Survey Findings on Private Forests (Hutan Rakyat)

(1/2)

Survey Spot No.	1	2	3
Date of Survey	Nov. 16, 1994	Nov. 19, 1994	Nov. 19, 1994
Location - Kecamatan - Desa - Dusun - Site	 Kupang Tengah Bokong Bokong	 Amarasi Kotabes Dusun I Oefafi	 Amarasi Kotabes Dusun IV Oeapot
Area (ha)	50	25	50
Project Year	1989/90	1991/92	1992/93
Land Conditions - Elevation (m) - Bearing - Gradient (%) - Soil Type	 230 N60°E 17 Eutric Cambisols	 500 N60°W 20 Chromic Luvisols	 500 Humic Cambisols
Pre-Project Land Use	Grassland (Alang-Alang)	Farmland	Farmland (Maize, Cowpea and Cassava)
Land Ownership	Desa-Owned	Private	Private
Number of Participating Households	No land distribution as Gotong Royong system was adopted	25	50
Project Area/Household		1 ha	0.5 - 2 ha
Land Distribution Method		Owned by Farmers	Owned by Farmers
Origin of Participating Households	Dusun: Tulubaun, Tilobaun, Bakibaun	Dusun I, Dusun II	Dusun IV
Distance Between Home and Site (km)	0.05 - 1	0.3 - 0.4	4
Tree Planting - Species - Time of Planting - Planting Method - Planting Distance	 Jati Dec., 1989 Pot-grown seedlings 3m by 3m	 Jati, Kemiri Dec., 1991 - Jan., 1992 Jati: pot-grown seedlings Kemiri: direct seeding (one seed/hole) Mixed planting of 5 parts Jati to 1 part Kemiri 2m by 3m	 Jati, Kemiri Dec., 1992 Jati: pot-grown seedlings Kemiri: direct seeding Mixed planting of 5 parts Jati to 1 part Kemiri 2m by 3m
Supplementary Planting and Its Rate	None	Once (Feb. - Mar., 1992), 20%	Once (Feb. - Mar., 1993), 20%

Survey Spot No.	1	2	3
Weeding	Once (area of 1m by 1m around each tree in May - June)	Full-scale weeding once (Mar. - Apr., 1992)	Full-scale weeding once (May, 1993)
Thinning	None	None	None
Tree Owner	Desa Authority	Farmers	Farmers
Cutting - Past Records - Future Plan	None (all trees dead) None	None Kemiri: collection of fruit from 7 years onwards	None Kemiri: collection of fruit from 7 years onwards Jati: regeneration cutting at 40 years
Nursery - Area (ha) - Distance to Project Site (m) - Duration of Use	0.25 300 Project Year	KBD 0.06 500 Project Year	KBD 0.06 2,000 2 years
Crops Cultivated - Species - Time of Planting - Harvest	None - -	Maize, Beans Dec., 1991 Apr., 1992	Maize, Beans, Cassava Dec., 1992 Maize & Beans: Apr.-May, 1993 Cassava: Oct., 1993
Government Assistance	Supply of tree seeds (once)	Supply of tree seeds and seedlings	Supply of tree seeds and seedlings
Current Conditions - Planted Trees - Ground Cover	- All planted trees: dead - Scattered spontaneous trees: H = 15m - Litter: none - Grass: dead grass (95%) - Stones & Gravel: Ø5-50cm (5%)	- Kemiri: H = 2m, DBH = 3 - 4cm - Jati: H = 3m, DBH = 3-4cm - Banana: H = 4m - Lamtoro: H = 0.2m - Litter: 30% - Grass: 30% (king grass) - Stones & Gravel: Ø5-20cm (40%)	- Kemiri: H = 1 - 3m - Jati: H = 1 - 2m
Remarks	The failure of the project was confirmed in June, 1991. The cause was drought (no fire occurred)		Based on interview with head of Desa Kotabes

Note: KBD - village nursery (kebun bibit desa)

D-4 Survey Findings on Nurseries

(1/3)

Survey Spot No.	1	2	3
Date of Survey	Nov. 30, 1994	Dec. 1, 1994	Dec. 3, 1994
Location - Kecamatan - Desa - Dusun - Site	 Amarasi Tesbatan Dusun II Tesbatan	 Kupang Timur Fatukanutu Mukiana Mukiana	 Kupang Tengah Oelpuah Dusun II Oelpuah/Oelnoni
Area (ha)	0.5	0.1	0.1
Project Year	1991/92	1991/92	1993/94
Land Conditions - Elevation (m) - Bearing - Gradient (%) - Soil Type	 230 N35°E 5 Chromic Luvisols	 120 S55°E 3 Chromic Luvisols	 40 N65°E 3 Eutric Cambisols
Pre-Project Land Use	Farmland (Red Peppers, Cabbages, Tomatoes, Fruit)	Shrub	Shrub
Land Ownership	Private (farmers)	National Forest	Desa
Type of Nursery	Village Nursery (KBD)	Nursery run by Kupang Forestry Office	Nursery run by Kupang Forestry Office
Production Duration	One Year	4 years and still in operation	2 years and still in operation
Water Source	Fountain Water	Mukiana River (all year round)	Nisnae River (all year round)
Water Supply Method	Gravity Method	Pumping	Pumping
Distance from Road (m) (Vehicle)	500	0 (adjoining)	10
Planting Site(s)	UPSA at Ponain, private forest site at Tesbatan	-	National forest reforestation sites at Oelpuah and Nefosmeni
Wind Break Facilities	Surrounding Trees: H = 6 - 10m	Surrounding Forest	Surrounding Forest
Building(s)	Workshop (cum-seed storage) Reservoir (5m(W) × 6m(L) × 1m(D))	Workshop (cum-seed storage) Reservoir (2m(W) × 2m(L) × 1m(D))	Workshop Reservoir (2m(W) × 2m(L) × 0.5m(D)) 3 sites
Machinery	-	Water Pump and Hose	Water Pump and Hose (50m)
Tools - Crowbars - Spades - Hoes - Hatchets - Sieves - Watering Cans	 5 5 5 - - -	 25 8 15 5 - 6	 Yes Yes Yes Yes No Yes
Number of Workers	10	-	10

Survey Spot No.	1	2	3
Nursery Beds - Pot Beds - Stump Beds	 Size: 1m(W) × 20m(L) for 2,000 pots Size: 1m(W) × 20m(L) × 0.2m(H)	 Size: 1m(W) × 5m or 20m(L) stone, bamboo, palm or wooden frame Size: 1m(W)× 2 or 10m(L) × 0.1-0.2m(H) stone, bamboo, palm or wooden frame	 None: (pots are not used as this nursery is for supplementary planting) Size: 1m(W)× 5 or 10m(L) × 0.1-0.2m(H) stone, palm or wooden frame
Irrigation Facilities	Manual sprinkling using a hose	Manual sprinkling using a hose or watering can	Manual sprinkling using a watering an
Shading	Use of coconut palm leaves (H=2m)	None	None
Procurement of Seeds	Jati and Kemiri: purchased in Kotabes Jambu mente: purchased in Oesena	Johar: purchased from farmers of Desa Fatukanutu Mahoni: obtained from CDK Gmelina arborea: purchased in Desa Fatukanutu or obtained from CDK	Johar: purchased in Kecamatan Fatuleu Mahoni: purchased from Kabupaten TTS Gmelina arborea: purchased in Kecamatan Kupang Barat
Pot-Grown Seedlings - Pot Size - Pot Soil - Fertilizer	 Jati, Kemiri, Jeruk: Ø9cm, H = 13cm Manga, Jambu mente, Jeruk: Ø15cm, H = 16cm Local soil collected on site Mixture: soil (4 parts) and animal manure (one part) Pots: animal manure Beds: urea fertilizer, animal manure	 Ø = 7 cm, H = 15cm Ø = 10cm, H = 15cm 3 holes (Ø = 2mm) at the bottom Local soil collected on site or from nearby forest Mixture: soil (10 parts) and animal manure (one part)	
- Seeding		- Direct seeding in pots - Seeding in beds and replanting in pots	
Sun Cover	None	None	None
Watering		Twice daily (morning and evening) for a 6 month period	Twice daily (morning and evening) for an 8 month period (May - Dec.)
Weeding	Yes	Yes (for a 6 month period)	
Insecticide Application	At the time of seeding for Jati and Kemiri	Use of Gusadrin every 3 months for a 6 month period	Use of Endlin in July and Aug.

Survey Spot No.	1	2	3
Nursing Duration	- Jati: 4 months - Kemiri: 4 months - Gamal: one year - Lamtoro gung: one year - Jeruk: 12 - 18 months - Nangka: 3 months - Manga: 6 months - 2 years - Jambu bangkok: 6 months - Jambu mente: 3 months - Rambutan: one year - King Grass: 6 - 12 months - Rumput gaja: 6 - 12 months	[Pot-Grown Seedlings] - Johar: 50cm in length, grown for 6 months - Mahoni: 50cm, 6 months - Gmelina arborea: 60cm, 6 months [Stump Seedlings] - Johar: minimum height above ground: 80cm, grown for one year - Mahoni: 80cm (with a minimum basal diameter of 2cm), one year - Gmelina arborea: 80cm (2cm), one year - Seedlings are cut back to 20cm above the ground and 10cm below the ground	[Stump Seedlings] - Johar: minimum height above ground: 40cm, grown for 5 - 12 months - Mahoni: 40cm, 5 - 12 months - Gmelina arborea: 40cm, 5 - 12 months - Seedlings are cut back to 50cm in length [Growth at Time of Survey] - Johar seeded in May, 1994: basal diameter of 1.5cm and ground height of 1.2m - Gmelina arborea seeded in May, 1994: basal diameter of 2 - 3 cm and ground height of 1.5m - Nitas seeded in June, 1994: basal diameter of 0.7 - 1cm and ground height of 0.2 - 0.3m
Seedling Standards (length in cm, height above ground for stump seedlings)	- Kemiri: 50 cm (pot) - Jati: 20cm (pot) 50cm (stump) (minimum diameter of 1cm) - Gamal: 50cm (stump) - Lamtoro gung: 50cm (stump)		
Annual Seedling Production Figures	- Jati: 70,000 - Kemiri: 30,000 - Gamal: 10,000 - Jeruk: 3,000 - Nangka: 5,000 - Jambu bankok: 2,000 - Rambutan: 2,500 - Jambu mente: 4,000	[Pot-Grown Seedlings] - Johar: 2,000/bed - Mahoni: 2,000/bed - Gmelina arborea: 2,000 bed (bed size: 1m × 10m, pot size; Ø7cm, H = 15cm) [Stump Seedlings] - Johar: 3,000/bed - Mahoni: 2,600/bed - Gmelina arborea: 2,300/bed	[Stump Seedlings] - Johar: 1,200/bed - Mahoni: failed - Gmelina arborea: 1,200 bed (bed size: 1m × 10m) [Bare Root Seedlings] - Nitas: 1,200/bed

Note: CDK = Cabang Dinas Kehutanan; TTS (Kabupaten Timur Tengah Selatan)

E-1 Specifications of Dam Pengenedali and Dam Embung in Study Area

(Aug. and Nov., 1994 Survey)

No	Location		Year of Construction	Dam Dimension (m)			Catchment Area (ha)	Water Storage (m^3)			Water Source	Month Dried up	Remarks
	Desa	Working Area		Height	Length	Crest width		Capacity	August	November			
1	Oenoni	Oesao East	82/83	8	71	4	56	-	-	0	Rain Water	June	
2	Tesbatan (Neofmee)	Oesao East	85/86	8	42	4	20	-	-	0	Rain Water	End of March	
3	Tesbatan (Pangkoto)	Oesao East	85/86	8	80	4	11	6,800 E	1,900 E	55 A	Rain Water	-	
4	Ponain	Oesao East	92/93	6	45	4	27	7,734 E	108 A	0	Rain Water	Sept.	
5	Babau No.1	Oesao West	85/86	8	77	4	19	-	-	0	Rain Water	June	
6	Babau No.2	Oesao West	85/86	6	40	4	20	22,000 E	4,00 E	465 A	Rain Water	-	
7	Nonbes (Oeteum)	Oesao West	92/93	7	42	4	16	10,835 E	7,100 A	7,100 A	Fountain and Rainwater	-	Fountain water: 0.2 liters/sec. (Dec, 1994)
8	Tuatuka	Oesao West	80/81	7	100	4	85	-	-	0	Rain Water	July	The spillway destroyed in 1990
9	Oefafi	Oesao West	87/88	7	88	4	40	-	-	0	Rain Water	July	
10	Embung Babau	Oesao West	90/91	10	82	4	47	53,000 E	45,100 A	27,000 A	Rain Water	-	Dam compaction conducted
11	Oefafi (Tasipa)	Olio	85/86	6	90	4	14	-	-	0	Rain Water	Aug.	
12	Tuapukan	Olio	82/83	8	90	4	14	-	-	0	Rain Water	July	
13	Oelpuah (Haosisi)	Oebelo	85/86	7	46	4	19	-	-	0	Rain Water	June	
14	Merdeka	Oebelo	84/85	8	70	4	21	-	-	0	Rain Water	July	

Note: 1) E; Estimated value A; Actual amount of water estimated during surveying.

2) Except for dams No. 8 and 10 the catchment areas of other dams were estimated using the topographical maps (Scale 1/10,000).

3) Data source on construction year and dam dimension is the Cabang RLKT, Kupang and Sub Dinas Pengairan PU, Prop, Dati I NTT.

E-2 Use of Check Dams as Water Supply Source

The existing dam pengendalis (earth check dams) in the Study Area were manually constructed to control sedimentation and to supply local inhabitants and their domestic animals with drinking water etc. Except for one dam where the water is supplied by a fountain, the level of water stored by these dams in the dry season is extremely low or completely dried up, resulting in the failure of the dams to fulfil their purpose (see E-1 for the amount of water stored by the check dams). Seepage through the dam body and evaporation are believed to be responsible for the low water level during the dry season although exact data on these causes is unavailable in the Study Area. There is, however, one exception. Mechanical compaction of the dam body and reservoir ground was conducted at the dam embung located at Desa Babau in order to minimise seepage, restricting the water loss to almost evaporation only. As a result, the stored water level in August in the middle of the dry season and in November at the end of the dry season (usually the month of the severest water shortage in the Study Area) stands at approximately 85% and 51% of the storage capacity of 53,000 m^3 respectively.

Although the exact performance of each check dam will depend on the dam site conditions, mechanical compaction at the planned 23 earth check dam sites should secure some 293,000 m^3 of water in August and 175,000 m^3 of water in November in their reservoirs based on the above example provided that each reservoir has a storage capacity of 15,000 m^3. Given the severe water shortage in the Study Area during the dry season, the water stored in the compacted earth check dams will constitute an important new water supply source.

In regard to the water consumption side, the Irrigation Section of the Kabupaten authority estimates that the minimum daily water requirement of a household (5 - 6 family members) during the 270 days of the dry season in East Nusa Tenggara Province is as follows.

Household consumption	:	300 litres
Animal consumption	:	150 litres
Domestic garden consumption	:	250 litres
Loss	:	300 litres
Total	:	1,000 litres

This estimate results in a total water supply requirement per household during the dry season (270 days) of 270 m^3. The volume of water stored by the planned 23 earth check dams will, therefore, meet the water requirement of some 600 - 1,000 households.

According to the Cabang RLKT, Kupang, the construction cost of an earth check dam based on the fiscal 1994 cost will be 36,570,000 Rp without mechanical compaction while the Kabupaten's Irrigation Section puts the mechanical compaction cost for fiscal 1994 at 2,169.13 Rp/m^3. Assuming the compaction of some 5,000 m^3 of soil, the compaction cost based on the fiscal 1994 cost will be approximately 11,000,000 Rp. The total construction cost of an earth check dam with compaction will, therefore, be some 48,000,000 Rp, a 30% increase of the cost without compaction.

Earth check dams are currently constructed manually without reliance on machinery as part of regreening projects to provide employment opportunities for local inhabitants. Nevertheless, the Ministry of Forestry should consider the introduction of mechanical compaction for earth check dams to exploit their water storage potential to the maximum in such places as the Study Area and East Nusa Tenggara Province where the long dry season causes a severe water shortage.

As the Kabupaten's Irrigation Section has sufficient technical expertise in compacting work, the establishment of close cooperation between the Sub-Balai RLKT, which plans the construction of earth check dams, the Plan implementation body and the said Irrigation Section on the subject of compacting these dams should prove useful. The Irrigation Section is currently planning the distribution of water from reservoirs for household and animal consumption in the lower reaches via pipeline. It will be necessary to examine the introduction of a similar scheme for the water stored by the earth check dams to facilitate the water supply for local inhabitants.

E-3 Main Sources of Surface Erosion by Working Area, Land Ownership and Land Use Category

(Unit: ha)

Land Use Category	Slope (%)	Oesao East Working Area				Oesao West Working Area				Olio Working Area				Oebelo Working Area				Grand Total			
		State Forest Land	Enclave	Private land	Total	State Forest Land	Enclave	Private land	Total	State Forest Land	Enclave	Private land	Total	State Forest Land	Enclave	Private land	Total	State Forest Land	Enclave	Private land	Total
Shrub and Bush Land	0-8	1,084	128	308	1,520	192	0	396	588	16	0	140	156	56	0	532	588	1348	128	1,376	2,852
	8-25	524	176	528	1,228	224	0	220	444	60	0	292	352	152	0	200	352	960	176	1,240	2,376
	25-45	36	12	212	260	128	0	12	140	28	0	172	200	36	0	8	44	228	12	904	644
	45-	0	0	12	12	8	0	0	8	0	0	0	0	0	0	0	0	8	0	12	20
	Total	1,644	316	1,060	3,020	552	0	628	1,180	104	0	604	708	244	0	740	984	2,544	316	3,032	5,892
Dry Crop Field	0-8	4	48	32	84	32	0	316	348	0	4	140	144	8	0	264	272	44	52	752	848
	8-25	60	48	148	256	40	0	116	156	0	0	88	88	60	0	12	72	160	48	364	572
	25-45	0	0	56	56	28	0	4	32	0	0	48	48	4	0	4	8	32	0	112	144
	45-	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
	Total	64	96	244	404	100	0	436	536	0	4	276	280	72	0	280	352	236	100	1,236	1,572
Mixed Garden	0-8	44	24	32	100	36	0	272	308	8	0	60	68	24	0	112	136	112	24	476	612
	8-25	24	4	40	68	8	0	36	44	0	0	24	24	4	0	64	68	36	4	164	204
	25-45	0	0	0	0	0	0	0	0	0	0	4	4	0	0	28	28	0	0	32	32
	45-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	68	28	72	168	44	0	308	352	8	0	88	96	28	0	204	232	148	28	672	848
Open grass land, grass land with scattered trees of palm and other trees	-	3,000	460	1,664	5,124	1,828	0	2,928	4,756	844	572	1,452	2,868	2,632	104	2,252	4,988	8,304	1,136	8,296	17,736
Natural/Secondry forest and man-made forest with a crown density of less than 70%	-	136	4	448	588	100	0	0	100	12	0	4	16	128	0	5252	380	376	4	704	1,084
Grand Total		4,912	904	3,488	9,304	2,624	0	4,300	6,924	968	576	2424	3,968	3,104	104	,3728	6,936	11,608	1,584	13,940	27,132

E-4 Conditions of Landslide Sites

(November 1994 Survey)

No.	Location		Size			Ave. Depth	Initial Estimated Sediment Discharge	Gradient of Landslide Site	Land Use	No.of Years (estimated)	Target(s) for Protection		Remarks
	Desa	Sub-Watershed (Tributary)	Length (m)	Width (m)	Area (m^2)	(m)	(m^3)	(%)	in Vicinity	After Landslide	In Vicinity	Lower Reaches	
1	Oelpuah (Haosisi)	Oebelo (Oelelo)	50.0	28.0	1,400	6.0	8,400	41	palm tree forest	8 - 10	none	Noelbaki intake weir	Some 20% of former landslide site has been invaded by Casuarina sp. (H=3.5m), Acacia sp. (H=2.5m) and Bunga kuining (H=3.2m)
2	Oelpuah	Oebelo (Oelelo)	90.0	30.0	2,700	5.0	13,500	42	"	3 - 5	"	"	Some 5% of former landslide site has been covered by grass
3	Oelpuah	Oebelo (Oelelo)	85.0	40.0	3,400	2.0	6,800	42	"	5 - 6	"	"	Casuarina sp. (H=1.2m), bamboo (H=1.5m) and grass have invaded former landslide site
4	Bokong	Oebelo (Oelelo)	210.0	90.0	18,900	12.0	226,800	43	"	2 - 3	"	"	Casuarina sp. (H=0.6m) and Buga kuining (H=0.7m), etc. have invaded former landslide site
5	Kotabes	Olio	180.0	25.0	4,500	5.0	22,500	38	shrub; mixed garden	lower part: 10-15; upper part: 1992 & 1993	mixed garden	Tasipa intake weir	-

E-5 Current Conditions of Gully Erosion in Naben of Desa Oelpuah (Surveyed in December, 1994)

State of Progress	Shape	Gully Length (m)		Gully Depth (m)	Gully Bed Gradient (%)		Catch-ment Area (ha)	Existing Erosion Control Facilities	Remarks
		Main Channel	Tributary		Main Channel	Tributary			
Active and continuos. Especially active along some 70% of the entire length (particularly in the upper parts)	U and V	3,200	5,000	0.7 - 5.0 2.5	2 - 6	1 - 8	550	none	Acacia spp. was planted in the early 1970's (present H=3-4m; density: some 30%)

Notes: 1) U Shape: is formed when the erosion resistance of the subsoil equals that of the top soil.
V Shape: is formed when the erosion resistance of the subsoil is stronger than that of the top soil.
2) The gully length, catchment area and affected area are estimated based on the topographical map (scale: 1/10,000).

E-6 Current Conditions of River Bank Erosion

(Nov and Dec., 1994 Survey)

Location		Bank Erosion Length	
Working Area	Main Tributary	With Conservation Objects Requiring Direct Protection	Without Conservation Objects Requiring Direct Protection
Oesao East	Mukiana	-	2,000
	Noabiana	-	1,000
Total		-	3,000
Oesao West	Kaobnonoh	1,500	2,000
	Taklale	4,000	7,000
	Oesao	1,000	2,000
Total		6,500	11,000
Olio	Olio	3,500	7,000
Total		3,500	7,000
Oebeli	Oelelo	800	2,500
	Noel Tilon	1,000	5,000
	Oebelo	2,000	5,500
Total		3,800	13,000
Grand Total		13,800	34,000

E-7 State of River Erosion in the Study Area

(Surveyed in August, November and December, 1994) (1/2)

Survey Site No.	River Name	Tributary Name	Stream Bed Width (m)	Water Surface Width (m)	Water Depth (m)	Bank Slope (‰)	Water Colour	Bed Slope (%)	Stone and Gravel Conditions			Land Use in Vicinity	State of Erosion, etc.
									Size (cm)	Shape	Coverage Ratio (%)		
1	Oesao	Mukiana	7.0	Dry River	Dry River	30	Dry River	2	-	-	-	Mixed garden	No bank erosion
2	Oesao	Mukiana	7.0	1.5	0.10	35	Brown	3	3 - 4	Semi-angular; Round	40	Secondary forest (H=5-15m); mixed garden	No bank erosion
3	Oesao	Mukiana	13.0	7.5	0.05	35	Transparent & Colourless	3	3 - 50	"	80	Mixed garden	No bank erosion; flood water level=2.3m
4	Oesao	Mukiana	13.0	6.5	0.20	30	"	2	4 - 40	round	50	Man-made forest (H=3-8m); mixed garden	No bank erosion
5	Oesao	Noabiana	23.0	2.5	0.15	65	"	5	4 - 112	Semi-angular; Round	90	Shrub; mixed garden	Bank erosion (H=4.0m); many stones and gravel
6	Oesao	Noabiana	10.0	3.7	0.07	30	"	1	6 - 10	Angular	40	Mixed garden	Partial bank erosion (H=1.6m)
7	Oesao	Kaobnonoh	9.0	Dry River	Dry River	70	Dry River	2	6 - 10	Semi-angular; Angular	90	Mixed garden; man-made forest (h=2-4m)	Bank erosion (H=1.6m); PU kabupaten has established Gabion
8	Oesao	Taklale	12.0	"	"	80	"	3	4 - 50	Angular; Round	"	Shrub	Partial bank erosion (H=1.8m)
9	Oesao	Taklale	7.0	"	"	60	"	2	2 - 4	Angular	40	Mixed garden	No bank erosion
10	Oesao	Oesao	14.0	1.5	0.06	80	Transparent & Colourless	3	10 - 35	"	-	"	No bank erosion
11	Olio	Olio	5.0	0.7	0.06	30	Brown	2	2 - 6	Semi Angular	50	Shrub	No bank erosion
12	Olio	Olio	11.0	Dry River	Dry River	80	Dry River	2	3 - 5	Angular	80		Bank erosion (H=2.0m)
13	Olio	Olio	12.0	"	"	80	"	2	2 - 4	"	90	Mixed garden	No bank erosion; sand is dug out in dry season near Olio Bridge

Survey Site No.	River Name	Tributary Name	Stream Bed Width (m)	Water Surface Width (m)	Water Depth (m)	Bank Slope (‰)	Water Colour	Bed Slope (%)	Stone and Gravel Conditions			Land Use in Vicinity	State of Erosion, etc.
									Size (cm)	Shape	Coverage Ratio (%)		
14	Oebelo	Oelelo	11.0	Dry River	Dry River	90	Dry River	5	5 - 30	Semi-angular; Angular	90	Palm forest, shrub	Partial bank erosion (H=1.5m); sedimentation
15	Oebelo	Oelelo	42.0	"	"	40	"	4	5 - 40	Angular	90	"	Partial bank erosion (H=2.5m); sedimentation, many stones and gravel
16	Oebelo	Noel Tilon	23.0	"	"	50	"	1	50 - 60	"	90	Shrub	Bank erosion (H=1.2m); many stones and gravel
17	Oebelo	Oebelo	8.0	0.6	0.05	70	Transparent & Colourless	5	6 - 50	Semi-angular; Angular	90	Palm forest	Partial bank erosion (H=2.0m); flood mark=1.2m; water infiltrates into riverbed water 50m downstream from survey site
18	Oebelo	Oebelo	30.0	3.0	0.10	80	Brown	2	2 - 12	"	90	Palm forest; bamboo forest	No bank erosion, some small ponds in river channel
19	Oebelo	Oebelo	20.0	2.3	0.2	70	Colourless	2	2 - 16	Semi-angular	90	Mixed garden; palm forest, bamboo forest	Partial bank erosion (H=4.0m)
20	Oebelo	Oebelo	30.0	1.1	0.05	90	"	3	2 - 40	"	80	Paddy field; mixed garden	Bank erosion (H=5.0m); PU NTT has established Gabion (L=50m, H=4.0m) in some areas
21	Oebelo	Oebelo	29.0	5.5	0.5	90	Brown	2	2- 16	Semi-angular; Angular	90	Mixed garden	Bank erosion (H=5.6m); flood mark=2.3m; PU has established Gabion 30m upstream of survey site (Oebelo Bridge)

E-8 Soil Loss Measurement and Prediction Methods

There are several methods to measure soil loss due to erosion in a specific watershed. The selection of a particular method depends on the type of data required, feasibility of obtaining the relevant data, plan size, cost and period required to conduct measurement, etc. The measurement methods for soil loss mainly by surface erosion and specific issues relating to soil loss measurement in the Study Area are discussed below.

(1) Soil Loss Measurement by Erosion Test

The most accurate method of measuring soil loss involves the establishment of soil erosion measurement plots. According to this method, soil erosion test plots are established to represent different soil types, slope classes and land use, etc. and the surface loss is directly measured at each plot. The test is conducted over several years to obtain data on the annual soil loss per ha based on the actual erosion for different types of land use. The erosion pin method and nail washer method provide a rough soil loss estimate.

(2) Soil Loss Prediction Using Mathematical Equations

Several equations can be used to predict soil loss. Of these, the USLE (Universal Soil Loss Equation) given below is often used.

$$A = R \cdot K \cdot LS \cdot C \cdot P$$

where

A : annual average soil erosion per unit area (tons/ha/year)
R : rainfall factor
K : soil erodibility factor
LS : topographic factor
C : crop management factor
P : protection work factor

In the case of the USLE, the average annual soil loss per ha by different types of land use can be calculated based on surface erosion and rill erosion data. However, it cannot predict soil loss from gully erosion, bank erosion and erosion from landslides. The USLE is capable of not only predicting soil loss but also deciding suitable soil erosion control measures for different types of land use. In this case, A is replaced by the soil loss tolerance (T).

The USLE was originally formulated in the US in the 1950's to predict the soil loss of farmland. A revised USLE based on the actual situation on Java Island and Bali Island is

popularly used in Indonesia to predict the soil loss of forest land, grassland and other types of land use and also to plan soil erosion control measures.

As referred to in the Progress Report for the present Study, the USLE was used as the basis for the 25-Year Plan (Pola) prepared by the RLKT of region 7 in Bali in March, 1987. According to this plan, soil loss is expressed in terms of tons/ha/year for the Oebelo Watershed and Oesao Watershed using the USLE. The predicted soil loss is classified into 5 classes (0 - 15, 15 - 60, 60 - 180, 180 - 480 and > 480 tons/ha/year). In addition, 4 soil depth classes are introduced (< 30, 30 - 60, 60 - 90 and > 90 cm). Based on a mixture of these 2 classification groups, 15 different measures, including terracing and social forestry, are proposed. One disadvantage is that the value of each factor used for the USLE calculation has not been obtained by field tests or surveys in these watersheds but originate from Java Island.

In the case of applying the USLE to the Study Area, it is important to determine the appropriate value of each factor based on the real local conditions. As described below, there are some problems relating to the USLE factors for the Study Area.

- While the value of Factor R is obtained from the rainfall erosivity index, this index is not available for the Study Area or its surrounding area. The Ministry of Forestry is currently applying a formula but careful examination is necessary in order for the formula to be applicable under the conditions and rainfall characteristics of the Study Area.

- The value of Factor K has already been calculated through physical and chemical soil analyses as part of the present Study and is given in Table II-5 of the main text of this report.

- The value of Factor LS can be calculated using the topographical map (scale: 1/10,000) prepared for the Study. According to the FAO's Guidelines for Watershed Management, the viability of using the USLE for slopes with a gradient of 20% and a slope length of more than 150 m has not been fully substantiated. Consequently, the value of Factor LS for these slopes should be treated with caution.

- The values of Factor C and Factor P for the Study Area must be carefully determined by conducting relevant surveys on (i) aramasi agroforestry, the traditional agroforestry in the area for dry crop fields, (ii) grassland which becomes bare land due to burning and overgrazing during the dry season, (iii) grassland with palm trees and (iv) traditional terracing sites, etc.

(3) Measurement of Sedimentation at Dams

The measurement of the sedimentation volume at multi-purpose dams, reservoirs, check dams and other dams can determine the real soil loss in a certain watershed. The greater the number of check dams, the more accurate the resulting soil loss figure is. While this method provides an actual soil loss figure for an entire watershed, the soil loss by different types of land use cannot be accurately predicted. The reasons for this are (i) the general existence of many types of land use in the catchment area of a dam makes it difficult to clearly determine how much soil loss flowing into the dam is caused by each type of land use and (ii) even if only a single type of land use exists in the catchment area at the time of soil loss measurement, land use changes are believed to have occurred between the time of dam construction and the time of measurement. For the present Study, the types of soil erosion due to different types of land use have been identified by the field survey and soil erosion measures are proposed to reduce the total soil loss in each watershed to an acceptable level.