

2) Hydrological Stations

There were six hydrological stations constructed in 1980's during the Indonesian time; four stations were equipped with automatic water level recorder and two stations were equipped with staff gauges. However, they were continually out of order and no data is available.

The location and information of each station are shown below;

Hydrological Station

Main River	Station Name	Type	Const. Year	Condition	Remarks
Caraulun	Caraulun-Same	AWLR	1984	broken	Never produced data
Saketo	Saketo-Makadiri	AWLR	1985	missing	--
Malibaka	Malibaka-Memo	AWLR	1882	broken	No data
Malubo	Malubo-Balubo Maliana-I	AWLR	1982	broken	No data
Cuha	Cuha-Viqueque	SG	1983	missing	--
Belia	Belia-Mata Hoi	SG	1983	missing	--

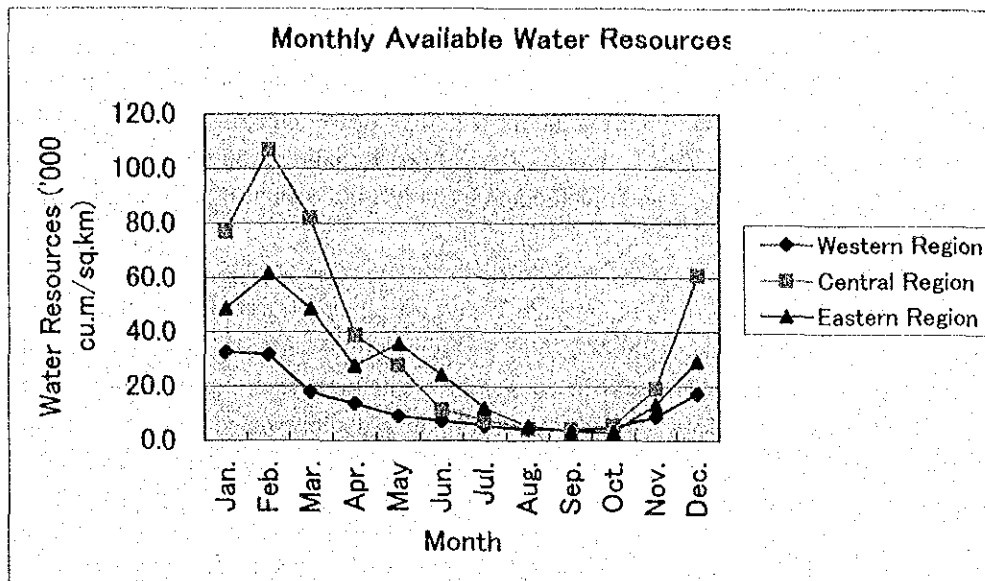
3.5 Water Resources and Utilization

3.5.1 Water Resources

There is a watershed ridge running down the middle of the country such that rain falling on the northern half flows in stream northward and the southern half southward. One of the implications of this fact on such a narrow island, along with the steep of the terrain and the infrequent rain, is that there are very few rivers, which flow regularly and usefully throughout the year.

There are as many as 100 or more rivers in the country but most of these have short courses, are dry most of the year, are not useful for navigation. Some rivers which carry water perennially are used to fulfill domestic needs such as irrigation and potable water. These include the Tono in Oecussi; Loes in Ermera and Bobonaro; Lacro in Ermera, Aileu, Dili, and Manatuto; Be-lulic in Manuhahi and Ainaro; and Boronuhó in Ainaro. There are more perennial rivers to the south like the river Tafara, Calaulun, Lacro do Sul and Clrere.

Monthly available water resources for 26 irrigation schemes (22 light to medium damaged areas and four seriously damaged areas) were analyzed, and their results at the typical schemes in case of five-year return period of draught year are shown below (refer to Table I-12);



Lakes include Lake Bemelai in Bobonaro; Maubara in Liquiçá; Lihomo in Elmera; Selo in Aileu; Uelenas and Modo Mahut in Manufahi; Tasitolu in Dili; and Ira Lalaro in Lautem. Among these, only Lake Ira Lalaro is of significant size, approximately 2,200 ha. However, the utilization of lake water has a difficulty for irrigation and potable supply because of difficulty of introducing the pump system from the view point of operation and maintenance at the present

Although there are relatively few springs or sources of groundwater they are mostly utilized for rural potable water supply. Comparing the availability of water in the country with neighboring islands shows that nearly all areas of the country were observed to be rated at relatively small. Because of the reduced availability and irregular flow of water in the country, there are comparatively few fresh water wetlands.

3.5.2 Existing Water Utilization Projects

International aid in East Timor for the reconstruction of agriculture and rural infrastructure has gone through the primary humanitarian assistance and now goes to reconstruction phase. Irrigation and water management has been identified by UNTAET, Timorese Counterparts and World Banks' Joint Donor's mission has the highest priority in agriculture rehabilitation.

1) Outline of Existing Irrigation Projects

The water sources of irrigation schemes are mostly from rivers, rainfall and spring or their combination depending upon their topography and water availability, as seen in Oecussi and

Viqueque districts.

There are about 60 main irrigation schemes (see Table I-1), of which potential areas have approximately more than 100 ha⁴. Based upon the available data obtained from MAF, the total potential areas are around 33,000 ha and 13,800 ha (40 percent of total potential area) are currently functional (see Table I-2). The Agriculture Rehabilitation Projects (ARP) of main irrigation schemes are going to be implemented by TFET and bilateral governmental funds due to the requirement of high engineering and high cost.

JICA has been carried out the study on urgent rehabilitation plan of 20 main schemes in August 2000. One scheme, namely Lacro, is under implementation among four most urgent rehabilitation project under UNOPS in cooperation with Japanese Government. On the other hand, TFET administered by the World Bank have been carried out the feasibility and engineering study in respect of rehabilitation of 26 irrigation schemes in May, 2001, and 11 schemes are going to be implemented up to December, 2003 (see Table I-1, I-2 and I-9).

The irrigation schemes are classified into the following Indonesian categories;

a) Technical Irrigation Schemes

The permanent weirs and channels have been designed by Department of Public Works of Indonesia (DPU) engineering and constructed under DPU supervision during Indonesia time. The primary, secondary and tertiary canals are facilitated with control structures, which control the water height and rate of irrigation water supply. Drainage canals are constructed to control flooding and drainage of excess rainfall runoff. The weir is constructed on a river which large enough to guarantee continuous supply of water throughout the year or during the cropping season to a relatively large irrigation area. There are 11 technical irrigation schemes under such as Seical Up, Uatolari III, Atabac/Loes, Caraulun, Beco, Oebaba, Raimean, Baedubu, Laleia, Seical down and Luro.

b) Semi-Technical Irrigation Schemes

The height of water in the river is controlled by a rock or gabion (bronjong) semi-permanent weir which is capable of standing for a number of years. Once the water in the river is high enough to enter the intake canals, there is no control over the water height and rate of irrigation water supply. The weir is built on medium-size river to supply a relatively small irrigation area. There are 30 schemes such as Maliana I, Maliana II, Batugade, Cailaco, Leoata, Tono, Rote, Naktuka, Oematahitu, Lacro, Natabora, Sumase, Uaibati, Uatulari I, Uatulari II, .Laivai, Sare, Gleno, Railaco, Besusu, Welaluhu, Caloco and so on.

⁴ Irrigation schemes less than 100 ha in size are referred to as the Communal Irrigation Schemes, and their number and areas are 16 schemes and 751 ha respectively in whole country, according to the ARP data.

Apart from main irrigation schemes, the communal irrigation maintenance projects, which are also called as a Agricultural Rehabilitation Project (ARP) and implemented by beneficiaries and TFET-CEP are under implementation. Based on the interview with MAF, the irrigation conditions on the crop intensify for each district are shown in Table I-7. From this table, average cropping intensity is 120 percent.

2) Study on Cropping Intensity Based on Available Water Resources

Potential annual cropping intensity was preliminarily analyzed based on an available water resources and crop water requirement for 26 irrigation schemes. As a result, it was revealed that an average annual cropping intensity for 26 irrigation schemes was estimated at 116 percent as shown in Table I-13 and Table I-14.

3.5.3 Existing Potable Water Supply Projects

The water sources of potable water projects are mostly from spring, groundwater and also river water.

The rural water supply project are carried out by four NGOs, namely Bia Hula, PROBEM, FORTE and HTO, and funded by international aid. Their activities and information are shown in Table I-3 to I-6. The daily water supply amount per capita is usually 30-60 liter depending upon the water availability.

3.6 Present Agriculture

3.6.1 Soils and Land Use

1) Soils

The soil of East Timor is derived from a continental fragment. The geologic formation is largely made up of limestone and sedimentary rocks. According to the soil map information gathered at ETTA-DAA, GIS section, there are 14 soil types that were identified in terms of Great Soil Groups of the United States of Agriculture Soil Taxonomy (USDA). These soils belong to any orders or Entisols, Inceptisols, Mollisols, Alfisols and Ultisols. These soils were classified further into Great Soil Groups under Entisols Ustorthents, Tropofluvents, Ustifluvents; order Inceptisol these are Tropaquepts, Dystropepts, Eutropepts, Ustropepts and Humitropepts order Mollisols these are Calciustolls and Rendols; order Alfisols these are Rhodustalfs and Haplustalfs while order Ultisols one Great Soil Groups under Tropodults and Haplustul.

Major Distribution of Soils in East Timor by USDA Order and Great Soil Groups

Order	Sub-Order	Great Soil Group	Area (ha)	Percent (%)
Entisol	Ormtenis	Ustorthents	19,180	1.31
	Fluvents	Tropofluvents	108,840	7.45
		Ustifluvents	29,205	2.00
Inceptisols	Aquepts	Tropaquepts	102,075	6.99
		Dystropepts	581,498	39.80
		Eutropepts	81,760	5.60
	Tropepts	Ustropepts	161,226	11.04
		Humitropepts	9,396	0.64
Mollisol	Ustolls	Calcicustolls	183,055	12.53
	Rendolls	Rendolls	144,436	9.89
Alfisols	Ustalfs	Rhodustalfs	5,812	0.40
		Haplustalfs	3,778	0.26
Ultisol	Udults	Tropudults	9,686	0.66
	Ustults	Haplustults	21,000	1.44
Total			1,460,938	100 %

Note : No data at Oecussi – Land Area : 81,466 ha

East Timor is predominantly mountainous soils. The topography influences the weathering processes, the soil depth, the erodibility and the infiltration rate. East Timor soils are predominantly alkaline clays derived from limestone rock or marine sediment with small pockets of metamorphic rock of volcanic origin. The significant soil problem is the highly erodible calcareous soil and relatively high pH reaction. The main fertility constraints of East Timor are soil erosion, low fertility, shallow soil depth and some micro nutrient deficiency of major soil groups such as sulfur (S), zinc (Zn), iron (Fe) and molybdenum (Md).

According to FAO report by Dr. S.H.R Lampe, the chemical analysis of most soils in East Timor are relatively high in calcium (Ca) and magnesium (Mg), but very low in potassium (K) and free-iron (Fe). In calcareous soils with high magnesium (Mg) and low potassium (K) and cation exchange capacity, plant availability with K, as nutrient will be restricted through negative interaction between Mg and K. The organic matter of East Timor practically is low indicating low availability of nitrogen for plant growth.

2) Land Use

Total area of East Timor is about 1,461 thousand hectare consisting mainly of arable land of 174 thousand hectare, bushed garden of 123 thousand hectare, bushed forest of 1,113 thousand hectare and residential and public area of 50 thousand hectare, respectively. Arable land further divided into four categories, i.e., wetland with ponded area (mainly paddy land), bare-land and mixed garden for upland crops, grazing land and fruits plantation, and estates (mostly plantation area). The bushed forest land includes protected and recreation forest, jungle forest, forest stable products, forest limit product and forest converted product areas.

The existing land use in 13 districts of East Timor is summarized as shown below;

District-Wised Land Use

(unit : ha)

District	Arable Land					Bushed Garden	Bushed Forest	Others	Total
	Wet Land	Bare Land	Mix. Garden	Estates	Sub-Total				
Lautem	1,387	3,579	2,120	5,411	12,497	19,850	135,147	2,739	170,233
Baucau	5,565	2,364	7,272	1,494	16,695	13,238	114,952	4,495	149,380
Viqueque	4,310	3,180	6,420	3,430	17,340	19,850	137,028	3,832	178,050
Manatuto	6,597	2,343	56	961	9,957	7,425	146,311	6,852	170,545
Manufahi	2,971	5,053	1,508	8,371	17,903	7,864	103,510	3,214	132,491
Dili	178	2,123	1,970	0	4,271	1,342	28,593	2,954	37,160
Aileu	367	1,753	0	54	2,174	237	67,340	3,198	72,949
Ermera	1,809	6,730	0	17,003	25,542	4,103	42,249	2,706	74,600
Ainaro	1,038	5,661	0	1,464	8,163	9,841	56,773	5,110	79,887
Liquica	5,592	1,124	4,040	4,953	15,709	1,905	35,910	1,288	54,812
Bobonaro	5,867	8,288	464	944	15,563	25,591	92,183	3,475	136,812
Covalima	4,274	7,669	2,625	1,579	16,147	9,871	94,195	2,340	122,553
Oecussi	1,950	10,489	0	10	12,449	2,261	59,083	7,673	81,466
Total	41,905	60,356	26,475	45,674	174,410	123,378	1,113,274	49,876	1,460,938

Note : Wet land defines paddy land and ponded area

Estates include mostly plantation area.

Source: National Board of Land of East Timor Province, Dalam Angka, 1997

Maize considered as the staple food in East Timor covers of about 53,400 ha, and rice is 14,200 ha⁵. All the cropped areas mostly consisting of rice, green peas, peanuts, soybeans, cassava, sweet potato, kidney beans, and other plants are cultivated in the lowland, upland and high plains with a combined area of about 180,200 ha⁶.

The plantation land-use by district such as coconut, hybrid coconut, coffee, clove, cashew, vanilla, tamarind covers an area of 84 thousand hectare.

3.6.2 Cropping Pattern and Crop Production

1) Cropping Pattern

In East Timor, major crops are maize, rice, cassava and sweet potato. Common cropping patterns are single or double cropping as rice + rice, rice + maize or maize + maize. In particular area like in Bobonaro district, triple crops are farmed as rice + maize + maize or rice +

⁵ Statistic Pertanian (Agricultural Statistic), 1997

⁶ East Timor in Figure, BPS, Central Board of Statistic of East Timor, 1997

maize + cassava. In any cases, seasonal labor intensive at the continuous works between harvesting and subsequent cropland preparation becomes to be serious issue.

In November, at the beginning of the west monsoon rainy season, the majority of the maize crop, which is a staple food in East Timor, is planted in both the uplands and lowlands. The land is prepared by burning the grass or shrub cover during the dry season from August to October. Upland soil is sometimes plowed by turning over the soil with long iron bars but it is never plowed by animals and rarely by tractors. In areas with a large number of cows or buffalo the maize area is also fenced using material from the forest or more often from the Gewang palm. Inter-cropping is the standard method of upland maize production. Beans, cassava and squash plants are almost always planted with the maize and it is rare to find maize mono-cropped.

In areas where paddy rice is grown, farmers often plant an upland maize crop first and then move down to the lowlands to work on the rice crop after finishing planting their maize crop. The rice fields are prepared using animal trampling (rencah) rather than using a plow. Some tractors are used for land preparation but the majority of the rice land (90 percent) is still prepared by animals (from estimates of working tractors via UNDP Mobile Brigade, from the Don Bosco Technical High School in Fatumaca, Baucau and MAF staff).

The national East Timor harvest months for Rice Cassava and Maize are given in Figure 3.6-1. These are a blend of the central uplands and north and south coast harvests. The north and south coasts, differ by a few months for rice harvest, but less so for maize. On the northern coast, rice is usually planted about March/April with later plantings June/July more common in the in the southern coast (Figure 3.6-2 and Figure 3.6-3).

The main reason for delaying rice planting is to avoid the threat of flash floods that can wipe out the rice crop. Since rice is usually planted after the peak of the rainy season, the potential for a second crop is limited if irrigation is not available. Only on the wetter southern coast the farmers will plant mung beans or cowpeas after rice with no land preparation. This planting after the main rice crop is not possible on the northern coast without technical irrigation.

It would generally appear that the area planted to rice is declining slightly because of lack of markets or rice buyers in the rural areas. It is often difficult to find working rice mills and as a rule no inputs (fertilizer and pesticides) of any sort are available in local markets. Maize production in the uplands and lower areas is apparently stable or perhaps slightly increasing since it is mostly consumed by the growers and not sold to the Dili market.

2) Crop Production

Crop production estimates for 2001/2002 are difficult because conditions and the population of farmers in some areas close to the western border have decreased significantly since September 1999, while in other areas that are no significant changes in population or crop yields.

Figure 3.6-1 Rice, Cassava and Maize Harvest Months (National East Timor)

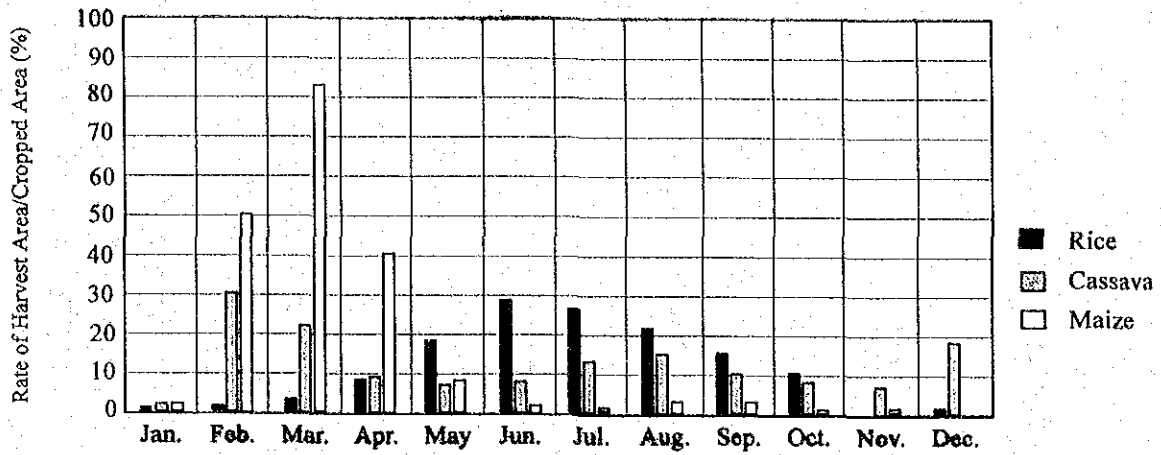


Figure 3.6-2 Rice, Cassava and Maize Harvest Months (North Coast: Baucau)

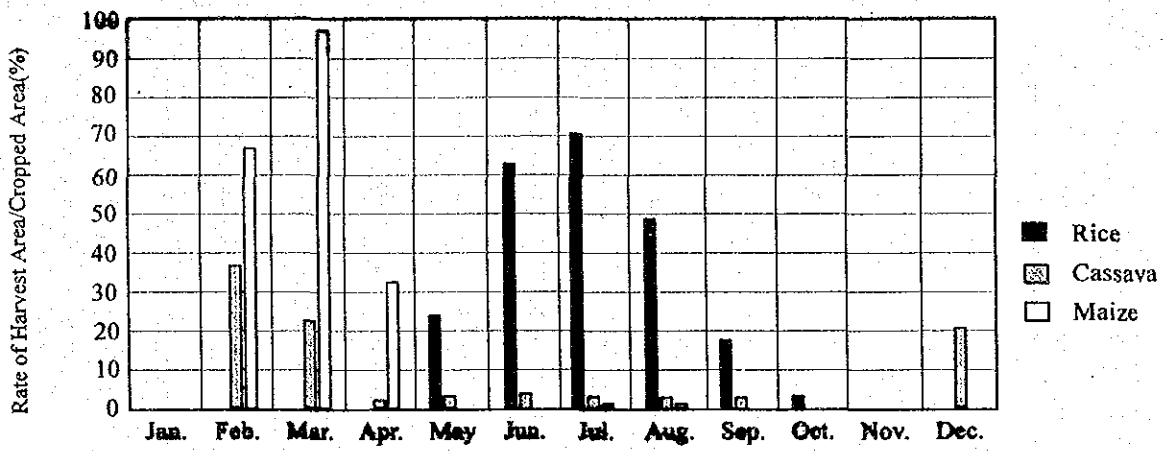


Figure 3.6-3 Rice, Cassava and Maize Harvest Months (South Coast: Viqueque)

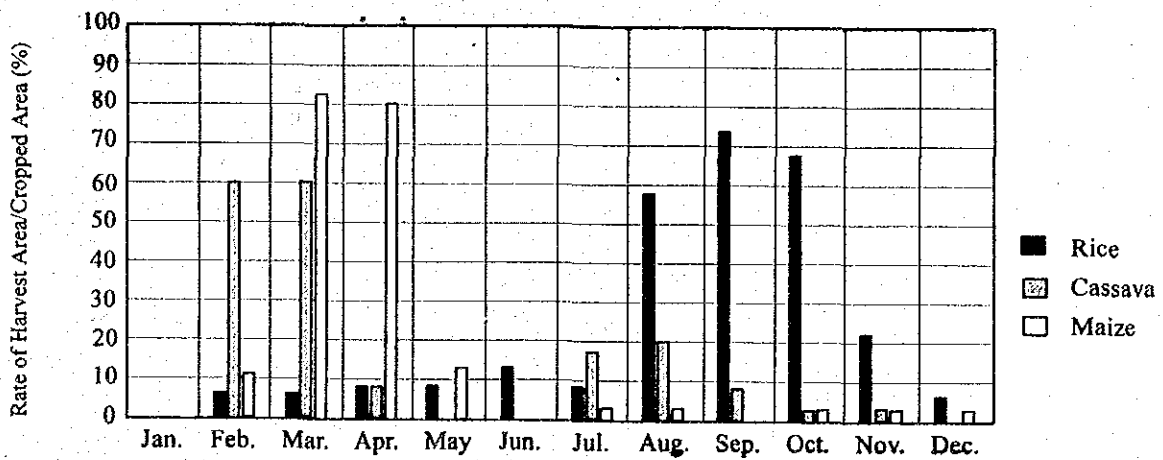


Figure 3.6-4 Upland Rice, Cassava and Maize Harvest Months (North Coast : Liquica)

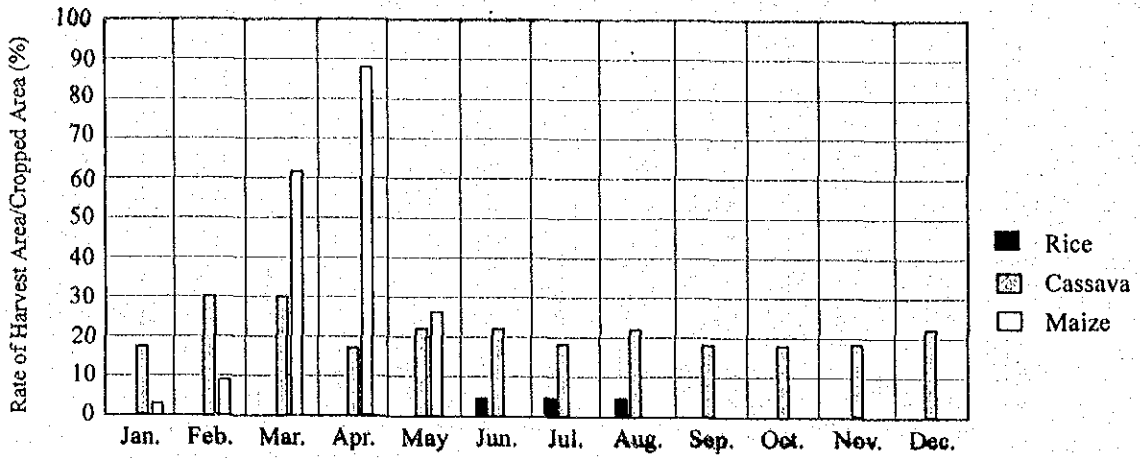
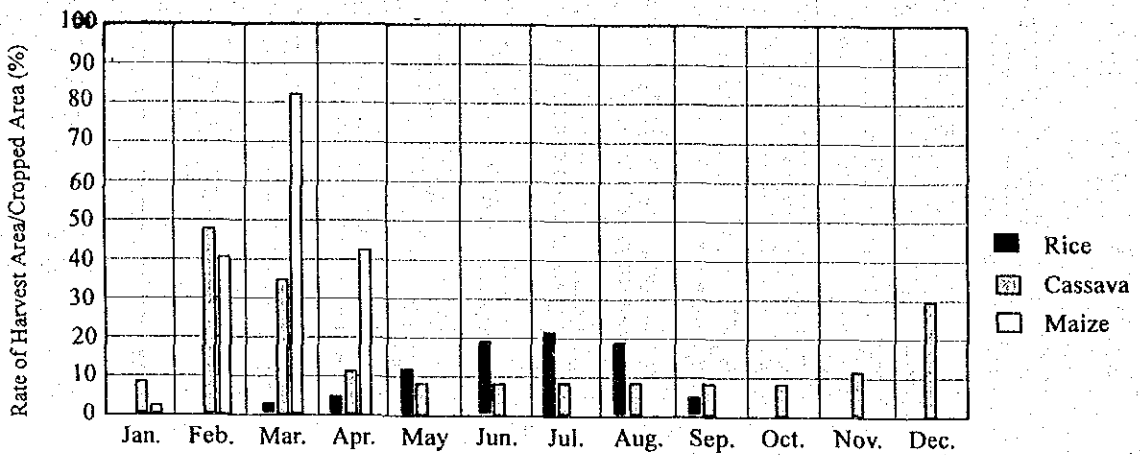


Figure 3.6-5 Upland Rice, Cassava and Maize Harvest Months (Mountain Central Coffee : Ermera)



Generally the crop production data for 1999/2000 as estimated in the FAO/WFP report of April 2000 appear to be valid for the year 2001 (see paragraph 3.5.10). This data set estimates maize 94,565 ton and paddy rice production of 50,920 tons (30,552 ton milled). Given the uncertainties of these estimates and the uncertain storage, it is difficult to be more precise about yields. Most certainly the post harvest losses for rice are higher now than in the past because of the decrease in milling capacity

Maize and Rice Production

(unit : ton)

District	1999		2001	
	Maize ^{1/}	Rice ^{2/}	Maize ^{1/}	Rice ^{2/}
Lautem	7,689	3,140	7,392	2,880
Baucau	13,747	11,937	13,300	9,720
Viqueque	13,067	17,152	14,000	13,760
Manatuto	4,034	4,850	3,680	3,984
Manufahi	4,752	2,228	5,000	1,848
Dili	1,852	207	1,900	172
Aileu	10,170	1,729	9,240	1,411
Ermera	6,033	3,275	4,774	2,838
Ainaro	4,157	1,559	3,195	1,072
Liquica	4,806	481	1,400	210
Bobonaro	28,571	15,035	15,444	8,100
Covalima	15,969	5,089	12,160	3,600
Oecussi	8,687	5,276	3,080	1,325
Total	123,534	71,958	94,565	50,920

Source: 1/: Timor Timur Dalam Angka, 1997

2/: Special Report, FAO/WFP Crop and Food Supply Assessment Mission to East Timor

If the cereal equivalents using cassava and sweet potato are added in appropriately the overall cereal equivalents appears somewhat more attractive. However, there is still little or no regard for the extensive plantings of squash as an intercrop with maize nor for the wide spread plantings of root crops such as yams or taro in home gardens, under coffee, under scrub forests and on roadsides. The squash yield could conservatively be estimated at 10-20 percent of the maize crop or 15,000 tons cereal equivalents. For the non-cassava/sweet potato root crops i.e., taro and similar root crops including forest yams, the overall yield is in the range of 10,000-15,000 tons (Village Survey (Suco Survey) – Household Survey preliminary data).

Surveys of the squash and root crop yields are part of the Village Survey (Suco Survey) conducted by JICA Study Team. The ability of East Timor to provide for carbohydrate rich foods appears to be secure. The major deficiencies in the overall diet appear to be in protein, fats and vitamins and not in calories. Most of the rural households have home gardens that have the potential to provide sufficient additional nutrition to provide an adequate diet.

Figure 3.6-4 and Figure 3.6-5 illustrates the importance of root crops for the upland areas where rice can only be grown in valleys and has a limited area planted to it. Cassava is harvested in every month of the year and is especially important in December to February - just

prior to the main maize harvest in March. This period is often called the hungry months when farmers have no more rice and maize to eat. Typically all parts of the country do not have enough maize or rice to eat in these months but it is especially important in the drier north coast districts. In the mountainous coffee growing district of Ermera cassava and root crops are also important (the data for January is abnormally low and can be considered higher if extrapolated from the December and February data).

3.6.3 Farming Practices and Input Supply

1) Farming Systems

a) Rice Farming System

In East Timor, farmers seldom use animal drawn equipment widely. It is important to consider for farm mechanization in East Timor that rice farmers in the lowlands did not start transplanting practices of rice for about two thousand years after the Chinese Timorese changed practices, furthermore, such practices have never happened even during Indonesian time. Indonesian government tried to introduce animal draft equipment but failed to spread draft animal farming. Although such systems are seen in Asian countries in most popularly, animal drawn carts can not be seen in field in East Timor but manual-push two-wheel carts are used. Rice farming systems in East Timor are characterized as follows;

Land Preparation

The farmers do not use animal drawn plow but continue to use buffalo and cattle to trample the soil by walking in circles so called "rencah", or plow and puddle by means of trampling by human power group together with mutual help group members in the muddy field after watering sometimes with poles. However, the advanced rice farmers just started to operate hand tractors or four-wheel tractor with attachment for land preparation skipping the animal-drawn plow stage.

Planting

In the lowland rice area, transplanting is most popular ways, but not so correct in line. However spreading still there are in the upland. More than 50 percent of farmers depend on community mutual help group or contracted laborers together with land preparation work.

Weeding

Manual weeding is widely done several times in every field. Mechanical weeders are also done at some districts.

Chemical Application

Fertilizers and agro-chemicals are seldom applied due to difficulty in purchase and high price in rice production area..

Harvesting

All paddy stalks are cut by small (tudik) or large (katana) knife by men, women and children in every field in East Timor. Cutting depth is, however, from high 100 – 200 mm to low 60-70 mm stubble at different field.

Threshing

Three kinds of threshing method can be observed, dancing or trampling on the paddy stalks on the mat under the shelter in the field by farmers, striking stalks to standing bar or plate and then mechanical threshing on the field by mobile engine-driven thresher. Rough estimates are of 20 percent mechanical, 30 percent dancing and 50 percent striking threshing.

Drying

Harvested paddy stalks are commonly dried on the field and then threshed paddy on the mat at farm yard or alongside road, the same as in other Asian countries.

Milling

Due to slow introduction of rice milling unit, more than 90 percent are milled by manual pounding, which causes low milling rate and poor quality rice and may intervene market access. Karung (sack), Hoka (large storage sack), Tan (small handling basket) or tin can are traditionally used for weighing weight/volume of intake and milled rice volume, which varies depending on millers, from community to community or district to district. Milling charge by machine (Kiskisan, cono and rubber roll type) is at the range of Rp.220-340/kg-intake paddy.

Storage

Usually stored inside house, "hoka", or "karung" but causing quantitative and qualitative depreciation loss. Storage loss for paddy is quite low, usually less than two percent. Serious damage by rats and mice are reported on the field before harvesting in some districts.

Regarding women roles in agriculture, women have specific roles in rice and maize production. These include planting, weeding and harvesting. During planting of rice, women are involved in the seeding, uprooting, tying, transporting and transplanting of seedlings. The women are, however, not involved in the decision-making with regards to seeds to be sowed, fertilizer and pest management. In livestock production women are mostly involved in the raising of pigs, chicken and only occasionally feeding of goats and cattle. Women roles in agriculture will increase as farmers' productivity improves from subsistence to commercial level.

b) Maize Farming System

Most maize farming practices from land preparation to storage are worked by hand tools. Mechanization is particularly applied only to land preparation in some lowland and shelling in some area. Development of mechanization for maize farming in East Timor takes longer time technically and economically since maize is in general cultivated at the slope and the terrace in upland. Maize farming system could be described as follows;

Land Preparation

Manual cultivation in general and mechanical plowing can be seen at flat wetland.

Planting

Making holes and drilling seeds into them by hand.

Application of Fertilizer

One month after planting during Indonesian time but seldom now.

Ditching

Also one month after planting.

Harvesting

Manual by family labor especially of women and children.

Drying

Solar drying on the mat, tin roof, concrete or drying platform whether ear maize or shelled maize.

Shelling and Pounding

Manual and partially mechanical by women or children.

Storage

Storage loss for maize can reach 70-80 percent with an average 20 percent if the harvest is stored from harvest to the subsequent planting season. Maize is traditionally stored in bundles of unshelled ear hung from the roof beams over the kitchen fire so that the smoke and heat can protect it. This is apparently effective in some areas and considerably less so in others. Timorese maize varieties have been genetically selected over the years to protect against post harvest losses more than for yield. The ears of traditional varieties of maize are usually small with a very strong multi leafed husk with the tip of the corn ear covered by at least four centimeter of leaf sheath. This makes it more difficult for insects to enter.

The destruction of housing during the disturbances of 1999 has made this traditional storage less possible and many modern maize varieties have been rejected by Timorese farmers more because of lack of proper husk properties than for any other reason. The introduced varieties that have a thick husk with well-covered ears are generally well received. More modern methods include storage in 220 liter drums. Well-dried maize seeds can last up to two years in this type of storage with negligible losses and retain an acceptable percentage. Maize seeds are stored in the rice straw umbrella on the top of pole, what is called "fatin batal fini" to secure better ventilation in Manufahi and Ainaro districts.

In addition to maize, bean crop losses are more difficult to estimate but appear to be closer to the maize average with storage weevils as the major pest. Beans are often stored in smaller closed containers with acceptable results. Long-term storage in closed containers is well received but this type of container is difficult for many to obtain since it is not a normal commercial product. The Don Bosco Technical High School in Fatumaca, Baucau district uses hundreds of 220 liter drums for successfully storing maize and bean crops.

2) Input Supply

Present farming practices for the vast majority East Timor farmers are very traditional with only a limited use of mechanical power for land preparation, little use of commercial fertilizer and only very a limited amount of pesticides are used. At the present time, neither fertilizer nor pesticides are freely available in the district marketing system although they are available in Dili. There is a common misconception that pesticides were available and subsidized during the Indonesian times. This was true in the 1970s and early 1980s but pesticide subsidies were drastically reduced in the mid 1980s and removed totally in the late 1980s.

What fertilizer that was used in East Timor during Indonesian times, was mostly used on high value vegetable crops for sale to urban markets and paddy rice along with some large-scale producers of mono cropped maize. Since marketing of rice to government agencies in each district at a known and published floor price was not a problem. Under these circumstances, there were clear economic benefits to the use of fertilizer. Under the present marketing conditions, good economically rational reasons for using fertilizer are much harder to find.

In Indonesia the fertilizer subsidy on potassium chloride (KCl) and phosphate fertilizers (TSP and SP-36) were removed in the 1990s. The only subsidized fertilizer in East Timor in 1999 was urea. The nation wide subsidy for urea existed largely to cover transportation costs and maintain a single price nation wide. The problem in fertilizer adoption is one of marketing and credit. The present price of fertilizer in Dili is now slightly higher than in Indonesian times because of shipping costs, but what little money a farmer may get from selling rice maize or fruit and vegetables into the present marketing channels, is clearly not enough to last him until the planting of maize or rice crop when he might want to use fertilizer inputs.

The difficulties in input supply could be overcome with credit and marketing assistance for some farmers in favored locations near main roads and district towns, but the farmers living far from main roads and/or agricultural supply stores will be most reluctant to purchase supplies – more likely not able because he will not have the cash to use. Subsistence agriculture is just that – agriculture that meets subsistence needs but not as a source of cash.

The use of nitrogen fixing bean crops and leguminous trees (Lamtoro and Gliricidia) will be useful in addition to other natural sources of nitrogen fixing plants and bacteria (blue green algae in the paddy water and anaerobic nitrogen fixing bacteria in the paddy soil). The leaf litter from nitrogen fixing trees has been used for increasing the supply of soil nitrogen in alley cropping situations and for home gardens but it is not a solution for field crops like mono-cropped maize or for paddy rice.

At present (March 2002), data from the household survey indicates that last year only 1.4 percent of the farmers were using commercial fertilizers. The type of upland cultivation commonly used – slash and burn or swidden agriculture- with little or no land preparation other

than fire for intercropped maize + squash + beans or root crops provides an adequate yield for subsistence farming only. There is little available for sale. The lowland wet rice farmers and commercially oriented vegetable farmers are the most likely targets for increasing fertilizer use.

However, so long as marketing and credit facilities remain under developed, the use of fertilizers will remain low. With no credit available and with difficult and under developed marketing channels for locally produced rice and maize, there is little possibility of increasing crop yields in the near future.

The East Timor's rice crop is usually a single season crop so the problems of insect pests are not serious. The only serious problem - and it is sporadic - is the stinkbug (*Leptocorisa oratoris*) which sucks on the developing grain. Other than for stinkbug control, pesticides are rarely needed on new rice varieties. Some insecticide use on high value vegetable and bean crops may be justified economically, but the general price situation makes the investment in insecticide use unlikely. Adoption of a nationwide IPM program in Indonesia (and East Timor) caused an 80 percent drop in pesticide use on rice with constant rice yield increases and a decrease in farmer health problems. It is estimated by most IRRI entomologists that rice has an economic benefit from pesticide use in only five percent of the plantings.

Rodenticides are possibly of considerable use in some areas where rice field rats are a significant problem. However studies done by ACIAR on the southern coastal plains last year indicated that vegetation control to reduce rat nesting areas would be more effective and cheaper than extensive use of poisons. Rats can and will become the most significant pest on irrigated rice if more than one crop of rice is planted per year.

3.6.4 Labor

75 percent of the labor force is employed in agriculture and subsistence farming remains the economic basis of large majority of the East Timorese⁷. Based on the dependency ratio, estimated at 86.2 percent, about 40.3 percent (297,350 persons) of the present population is available for the labor requirement of agriculture sector.

Based from the World Bank (WB) Social Assessment Report (April 2001), the whole family provides the family labor and woman provides a very significant proportion. The children as well play also important role.

Besides the usual work of preparing the food and looking after the children, women also plant corn and paddy rice, share in weeding and getting fire wood, threshing, pounding paddy rice, vegetable growing, selling vegetables and chicken, and share with children the tending of pigs, goats, chicken and carrying water.

⁷ Social and Economic Conditions in East Timor-Columbia University and IASS-Oslo, Norway

The men build house, prepare the land for corn and paddy rice, carrying corn and paddy rice, tend cattle with children, and sell rice and cattle. The children helps in weeding, getting firewood, in tending cattle, pigs, goat, chickens and in fetching water.

3.6.5 Farm Mechanization

1) Significance of Farm Mechanization and Post-Harvest Facility

Whether necessity and possibility of farm mechanization including improvement of post-harvest facility on the basis of market economy in East Timor will be studied, challenged and planned against those adverse facts:

a) Supply and Demand Balance of Staple Food

FAO/WFP estimates the supply/demand balance of grain crops in marketing year April, 2000-March, 2001 is 44,600 ton supply deficit between 131,000 ton supply (94,600 ton maize and 30,500 ton rice plus 5,900 ton carryover stock) and 175,600 ton demand (132,200 ton maize and 43,400 ton rice),

b) Weak Competence against Imported Rice

On the other hand, border control estimates that 11,913 ton of 25 percent broken rice have been imported mainly from Vietnam, Indonesia and Singapore during seven months from January to July, 2001 with average US\$0.14/kg price. It costs about US\$0.16/kg or Rp.1,520/kg subject to 10 percent tax, five percent service charge at port and 110% marketing cost, and retail market price in Dili average about Rp.3,419/kg (Rp.3,289/kg to Rp.3,571/kg) through actual sampling purchase by tin can during July to August, 2001.

Local rice price at Comoro and Becora market in Dili is average Rp.6,121 (Rp.3,571/kg to 7,143) also through actual sampling purchase by tin can, which is about 1.8 times more expensive than imported rice with higher quality than local rice contaminated with foreign materials. Such difference of retail price depends on the volumetric sale by tin can instead of scale. It is rather difficult to find out local rice for retail in Dili. However, local rice is sold with the competitive price against imported rice at town market in production area like Baucau and Same while price of import rice is the same nation wide in East Timor.

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It is rather difficult to find local milled rice except red or fragrant one at open market whenever in Dili and rural towns, one of which reason is considered that agriculture in East Timor is traditionally subsistence farming and most rice trade is done by barter or cash in paddy among relatives or neighborhood and then after paddy is pounded by themselves and so many expenditure such as packing, milling and transportation required for formal marketing may not be counted into white rice price.

c) Shortage of Family Labor

Farm labor force even in 1997 is estimated to be 0.19 ha planted area by a person and 0.38 ha cultivated by a man for land preparation (Table K-15). Moreover, labor shortage discourages farmers to increase production by double cropping since the timing for harvesting work for main crop and nursery/land preparation work for off-season crop or vice versa are too short or sometime overlapped (Table K-14). Farm mechanization in East Timor shall be targeted how to break the labor peak and shortage, which is accelerated by 1999 conflict. Interim results of household survey carried out under the Study endorse the fact that non-cropped portion of entire field reaches 15 percent due to lack of manpower (53 percent of full reasons).

d) No Market Access of Produced Crops

Marketing volume of such staple foods as maize, milled rice, cassava and sweet potato across district borders in 1997 in East Timor is roughly estimated to be 46.8 percent (83.1 thousand metric ton) of total volume consumed 177.7 thousand metric ton (Table K-12). Such marketing volume including imported rice and stock brought from the previous year is bigger even though in general, Timorese agriculture is understood to be subsistence farming. However, the marketing system handled those volumes both by public agencies and private traders in East Timor was completely disrupted in 1999 conflict and not yet recovered, which discourages commercial farmers to increase production. Supply and demand balance of staple foods in 2000 were kept by imported 30.1 metric ton of rice and maize (24.8 thousand metric ton through WFP and 5.3 thousand metric ton through private traders) in addition to local production (see Table K-1). Improvement of post-harvest and transport facility together with introduction of farm mechanization may accelerate the reconstruction of marketing system in East Timor.

2) Current Number of Post-Harvest Facility

Through the Village Survey (Suco Survey), current number of major post-harvest facilities are estimated as 239 units of rice mill, 139 units of coffee pulpers, 10 units of corn shellers and 12, 618 sheets of drying mats. Even now over 90 percent of threshed paddy are milled by manual pounding by women or children (refer to Table K-11)..

3) Post-Harvest Loss

If "Post-harvest" in rice farming is defined from paddy harvesting to milled rice storage in accordance with the category generally used in South East Asian countries, total post-harvest

loss is estimated at 46.4 percent as shown below through field survey done by Study Team and reviewing the report entitled "rice post-harvest technology in Indonesia" implemented by Ministry of Agriculture, Forestry and Fishery, Japan;

- Harvesting	2.0	shattering loss
- Drying on the field	0.5	
- Threshing	2.0	manual and partially by machine
- Drying after threshing	0.1	
- Milling	40.0	milling recovery 60 percent
- Storage	1.8	
Total	<u>46.4 %</u>	

On the other hand, post-harvest loss in maize farming is roughly estimated at 20 percent, most of which is occurred during storage.

4) Transportation of Products

No transporting facilities belonging to farmers except animal but no trail cart, two-wheel hand cart, motorcycle in addition to porter/walking for short distance. Two-wheel manual push carts are most popular in East Timor.

5) Post-Harvest Facility to accelerate the Re-Construction of Marketing System:

a) Marketing System prior to 1999 Conflict

All basic commodities such as rice, sugar, cooking oil, salt, flour, livestock feed etc. were historically secured from outside East Timor and their retail prices in East Timor were marginally higher than elsewhere in Indonesia as reported in Item 8. and 12 of Table K-13.

Prior to conflict in 1999, BULOG (Badan Urusan Logistik, state owned enterprise) distributed rice from producers to consumers through DOLOG (BULOG's Provincial office), Kabupaten (DOLOG's District office), SATGAS (Satuan-tugas, working unit of Sub-District) and KUD (Kooperasi Unit Desa, village unit cooperative) and secured to supply rice under a kind of social net. In 1997, DOLOG in East Timor distributed over 40,000 ton rice (see Item 1 to 5 in Table K-13) but handled only about 900 ton rice produced in East Timor. DOLOG in East Timor operated 25 storage facilities with total holding capacity around 18,000 ton in Los Palos, Baucau, Viqueque, Manatuto, Dili, Same, Maliana and Oecussi, all of which conditions are still operable.

DOLOG employed such four marketing systems as i) deliver rice to military and civil servants, ii) OPK (Operasi Pasar Khusus), special government's social safety net program to deliver 20kg/month/family of rice to the poorest, iii) OPM (Operasi Pasar Mumi), sell to traders, retailers and Yayasan, and iv) regional marketing through Kabupaten. DOLOG sub-contracted to the commercial millers for milling paddy after purchasing from farmers instead of milling by himself.

Regarding market access and transport facility, roads are more important for smooth market access but about 45.4 percent of all roads are assessed as poor and very poor condition in East Timor as reported in Item 7 of Table K-13. There were 3,066 units of truck wagons in 1996 as reported in Item 11 of Table K-13, but most of them have been disappeared, which caused sharp increase of transportation cost together with fuel currently in East Timor.

b) Present Marketing System

It is urgent issue to develop marketing system for staple food for improving the distortion between surplus production and shortage area and for encouraging farmers to increase production. Little activity being done by men and women farmers without sufficient marketing information but primitive marketing being appeared by Chinese, Vietnamese, Taiwanese or Singaporean traders. A majority of the East Timorese population is impoverished subsistence farmers and only a small minority participates in the activities of the market economy. These subsistent farmers are caught in a poverty trap where no investment could become available up to date to improve the productivity of their agriculture operation. For instance, due to no incentive existed for rice production, local rice producers may cultivate land enough to produce their family need and stop the production of an extra crop for sale, causing more and unnecessary reliance on import and more migration of farm population into cities.

To break this vicious cycle, the move from subsistence to a market economy necessitates a transitional developmental stage and the active measures to support this transition. Thus, during this period of transition, some sorts of Government intervention appear to be warranted. Issues to be considered shall be included i) support to rice mills and other post harvest articles (it is much economical to ship milled rice rather than paddy to reduce high transportation cost), ii) support on transportation network, and iii) temporary higher tariff protection. Donor investments could be directed at supporting for local farmers to gain the competitiveness and thus, reduce the heavy reliance on the import in a long run.

c) WFP Assistance in East Timor

WFP's humanitarian assistance started on September 15, 1999 was continued to April 30, 2002 under emergency operation and emergency assistance as an immediate response to food aid needs (rice, maize, oil, bean, canned fish, etc.), and special operation in order to support and strengthen the logistic capacity. Delivery of foods in some districts were supported by NGOs activities. Total WFP food importation from August, 1999 to April, 2001 reached to about 47.4 thousand ton and distribution from September, 1999 to July, 2001 exceeded 46 thousand ton (see Table K-1 and Table K-3).

6) Farm Machinery and Draft Animal Power

a) Animal Drawn Equipment in East Timor

Animal drawn plow and leveler, even a cart most popular in Asian countries are not widespread adoption in East Timor. All conventional farming works for all crops have been done only by crowbar (linggis or aisual), hoe (cangkul or enxada) and knife (tudik, machete or katana) except "rencah" (land preparation system for rice utilizing cattle and buffalo to till and puddle the soil ready for planting instead of any equipment). The reason why animal drawn equipment were not introduced is considered that agriculture in East Timor is subsistent farming, which does not require increase of crop production by increase of labor efficiency and release from heavy works, and no technology to develop farm equipment there is.

b) Traditional Custom and Livestock Productivity

In East Timor, livestock may be sold for cash, kept as a saving bank, or slaughtered for feast. At life cycle ceremonies such as "korametan" (a ceremony to honor the dead), livestock is exchanged from one extended family to another and a number of livestock is slaughtered for the feast. This non-production oriented management of livestock is a severe constraint to improving livestock productivity

c) Dilemmas to introduce Animal Drawn Plows

Viewing from the facts experienced in West Timor to introduce animal drawn plows during 1970's to 1980's, those technical and economic disadvantages are reported as follows;

- Uneven finish of land preparation

The cows hooves for rencah fail to turn the soil over to sufficient depth and work the field unevenly. As a result, the rice especially high yielding varieties, grows poorly and harvest are not good. Besides this, the weeds, which have not been destroyed, thrive particularly if fertilizers are applied. This makes big demands on time and energy in an area where labor is in short supply. One the rainy season begins, the demand for cattle to open the fields is high.

- Limited use of animals

The continual use of the cattle exhausts them and their condition deteriorates. It is not uncommon also for young calves, deserted for hours by their mothers, to die.

- Hard to cultivate second crop

Fields are usually only planted once a year. As the owners do not want to risk loosing cattle in their weakened conditions in the dry season. They loose the opportunity of obtaining a second crop, which would be possible in some areas.

- Small scale farmers and socio-economical unjust system
Looking at the situation of small-scale farmers, socio-economical unjust system is found. A small-scale farmer has not enough cattle, and his landlord can plant first his own field when the first rains come and then decide the order of small farmers' cultivation. Eventually a small-farmer obtains the use of a herd of cattle and plant late hoping against his rice plant will not dry up and die due to lack of rain. Some seasons, it is too late to plant at all.
- Land tenure and land preparation
At harvest, they must pay the cattle lord one third of the rice as payment if he has some land. If not, he has to pay another one third of the harvest as rent and one third of any increase goes to the cattle lord. He can not plant a second crop as his land is used for grazing the cattle load livestock.
- Longer period required for introduction
It is required over 10 years longer period and continuous extension activities to introduce animal drawn plows

d) Strength and Weakness by Human Labor, Animal and Machinery

Strength and weakness among human labor (trampling by mutual-help farmers), animal (rencah) and machinery are summarized as follows;

Compared farming among Human Labor, Animal and Machinery

	Strength	Weakness
Human Labor	<ul style="list-style-type: none"> - Cheapest payment - Increase of employment 	<ul style="list-style-type: none"> - Heavy works - Easy to be tired - Lowest efficiency
Animal	<ul style="list-style-type: none"> - Farmers' own property - No fuel cost - Not break down easily - No spare parts - Get milk and yield next generation 	<ul style="list-style-type: none"> - More labor involved - Soil is not prepared properly - Can not work for half day - Can not work during dry season - Lower efficiency
Machinery	<ul style="list-style-type: none"> - Less labor involved - Soil is properly prepared - Never tired & possible to cover bigger area - Versatile - High efficiency 	<ul style="list-style-type: none"> - Heavy initial cost - Fuel & maintenance cost - Technical acknowledgement

e) Animal Power for "Rencah"

Draft animal power is roughly estimated about 29,000 heads buffaloes (60 % of total number), 4,800 heads cattle/Bali (5 %) and 1,020 heads horses (5 %). Considering such present system of typical "rencah" is done by the team of 20 animals combining buffalo, cattle and horse

with mixed ages for lowland rice cultivation, which requires four days per hectare and one team available to cultivate only 7.5 ha during a season. 8,680 ha or 70 percent of 12,400 ha lowland paddy in 1997 was cultivated by draft animals. The remained 25 percent by human labor trampling and five percent by machines.

7) Farm Mechanization assisted by Foreign Aid

Current progress of international support related on farm mechanization by donors is as follows;

a) Mobile Brigade

During the period of 15 months from March, 2000 to May, 2001, Mobile Brigade (MB) was carried out to achieve such goals as i) to decrease level of dependency of the farmers to the international aid, ii) to empower the people to reconstruct themselves and fulfill their basic needs, iii) to increase income of the farmers, and iv) to accelerate the reconstruction of agricultural sector by utilization of farm machinery (25 units of 4-wheel tractors and 318 units of hand tractors provided with basic implements respectively) and administration cost (one year operation cost and staff salary) funded by Government of Macau, Norwegian Government, JICA and Australian Phillips Petroleum Company. Details can be referred to Table K-6, Table K-9 and Table K-10. MB was promoted by the structure of head office with three staffs at Dili and six local offices each with average 11 staffs at Baucau, Viqueque, Manatuto, Manufahi, Bobonaro and Covalima districts, total 58 staffs both under National and District Steering Committee.

As the results performed by MB, 1,027 ha in total land (706 ha wet and 321 ha dry land) was cultivated and farmers' contribution reached to the amount of approx. cash Rp.235.8 million, credit Rp.57.1 million and total Rp.292.9 million. After the completion of one year MB under emergency foreign assistance on the end of May 2001, all organization and staffs had to be dismissed and no plan, no budget and no staff how to sustain the MB program there is. Most farm machinery is idled without any play of rolls. Subsequent gives the outline of the MB.

- Project Name : Mobile Brigade (MB)
- Fund
 - Government of Macau fund to purchase 200 units of American made John Deere hand tractors, 20 units of medium size and five units of big size 4-wheel tractors directly by CNRT
 - Norwegian fund to purchase 100 units of Korean made Ton Yang hand tractors and 12 units of motorcycles with their operation cost including staff salary for one year through UNDP
 - JICA donate 30 units of Siam Kubota hand tractors together with attachments, and workshop tools, warehouse and garage together with 6,000 liter diesel fuel and 200 liter engine oil to Baucau and Manatuto

- Australia Phillips Petroleum Company donate 13 units of pick-up truck
- Implementation Agency : Mobile Brigade
- Period : March 2000 - May 2001 (15 months)
- Goal
 - Goal which was desired to achieve by an embryo of semi mechanization of agriculture was;
 - To decrease level of dependency of the farmers to the international aid,
 - To empower the people to reconstruct themselves and fulfill their basic needs,
 - To increase income of the farmers, and
 - To accelerate the reconstruction of agricultural sector.
- System of Work

Mobile Brigade was formed on the early March, 2000, with total number of personnel of 58 persons which consisted of 55 personnel assign to different district and three personnel based in Dili. Six Mobile Brigade were formed in Manatuto, Baucau, Viqueque, Manufahi, Covalima and Bobonaro. The structure of Mobile Brigade in district consists of one agronomist cum leader, two extensionists, one mechanic, one hand tractor operator and some operators for 4-wheel tractors. While central structure was made up of one national coordinator, one secretary and one treasurer. National Steering Committee and then District Steering Committee were formed.
- Farmers' Contribution (Renting Charge)
 - John Deere Hand Tractor : Rp.200,000/ha in wet and dry land
 - Tong Yang Hand Tractor : Rp.300,000/ha in wet and dry land
 - John Deere Medium Size Tractor : Rp.350,000/ha in wet land
 - John Deere Big Size Tractor : Rp.500,000/ha in wet and dry land
- Farmers Contribution System

Contribution by farmers could be as group or individually and could be paid in cash or in kind as paddy/rice naturally.
- Farm Mechanization suggested by Mobile Brigade Implementation

Together with NPC evaluation report, many suggestions for farm mechanization in East Timor are given by work results under Mobile Brigade.

 - Technical Skill and Management Performance

During 14 months from April, 2000 up to the end of May, 2001, cultivated 1,027 ha (wet land 706 ha and dry land 322 ha) and farmers' contribution reached to the amount of cash 236 million Rp. and credit 57 million Rp., total 293 million Rp. On emergency phase the work of Mobile Brigade in field still minimum, working system is not business oriented, over consumption of fuel, lack of responsibility of some staff, and lack of transparency manner, etc. Mobile Brigade in the future ahead can be sustainable if work system is changed in accordance with specific condition of

each district and business orient. Broken down of equipment distributed to districts are as follows (See Table K-10).

4-Wheel tractor John Deere	:	25 units
Hand tractor John Deere	:	188
Hand tractor Tong Yang	:	100
Hand tractor Siam Kubota	:	30
Pick-up trucks	:	3

Utilization of equipment is in wide difference among districts during 14 months period depending on the district-wise strategy and performance as follows:

Cultivated area : from 8.88 ha to 420.41 ha

Cultivated also dry land : 0 (9 districts) to 166.71 ha

Selection of tractors : In six districts cultivated by combination of hand tractor and 4-wheel tractor for wet land

- Operators Experience and Technology

Followings are reported although it will be affected by distance to the field, soil type and its conditions;

Dishonesty of operator and negligence of operator in operation

Reports of using fuel do not consider farmers' contribution, specially total hectare ploughed and fuel used. Overuse of fuel (64.7 liter/ha) happens to be against 25-30 liter per ha under normal condition.

- Preparation of Consumable Materials

Broken down equipment are left without repair due to lack of spare parts and repairing technology except machinery supplied with spare parts and trained for repairing by JICA. Most engine oil purchased is also left without use.

- Payment Manner of Farmers' Contribution

19.5 percent of all farmers' contribution depends on credit or payment by produce after harvest, which requires skilful marketing experts, suitable capacity milling and transportation facility and warehouse to manage paddy effectively

- Final Expenditures Required

Total direct cost required for cultivation is wide difference among districts from about Rp.245,000/ha to Rp.610,000/ha.

Evaluation on the above said farm mechanization in East Timor suggests and teaches lots of directions how to promote furthermore farm mechanization in East Timor as follows;

- Technical skill and performance on management

Reviewing such results as minimum of cultivated area and farmers' contribution, no business oriented working system, over consumption of fuel (64.7 liter/ha against normal 25-30 liter/ha), idling of broken down equipment, and wide difference of equipment

utilization among districts (cultivated area: lowest 8.8 ha to highest 420.4 ha and cultivated dry land: 0 to 166.7 ha, total direct costs: Rp.245,000/ha to Rp.610,000/ha), training human power, equipment operators and mechanics are firstly required for self-reliance and sustainability.

- Training farmers

Many farmers are not yet familiar with farm machinery and also special farmers training shall be conducted.

- Preparation of consumable materials

Spare parts and repairing technology shall be provided.

- Reasonable farmers' contribution

Considering the expenditures required for fuel, depreciation and management cost, reasonable farmers' contribution shall be collected.

b) Farm Machinery granted by the Republic of China

30 units of 4-wheel tractors and 150 units of hand tractors provided with attachments respectively, each 100 units of thresher, rice mill, grain blower, mist duster, 400 units of hand sprayer, 50 units of tipcart, and three units of excavator have been delivered to UNTAET District Headquarters (see Table K-6). However, all machinery are now stored under the sun and no use. The following models may be modified for more easy utilization in East Timorese farming;

- Grain drill : 24-rows special machine for maize but too big with 3,830 mm in width
- Thresher : Replacement from motor to engine driven usable on field without any additional transportation to farm yard
- Separate rice mill : replacement from motor to engine driven
- Grain blower : replacement from motor to engine driven
- Hand tractor attachment 4-rows harvester : Reaper but not so wide field transplanted in line correctly and necessity of particular operation training

c) Hand Tools donated by Republic of China

Total 4,950 pieces of hand tools together with pesticides and other materials under Chinese donation arrived at Dili before the end of October, 2001 and are delivered to farmers as soon as possible by MAF in cooperation with NGOs (refer to Table K-8).

d) Distribution of TFET Funded Hand Tools

As summarized in Table K-7, total 77,972 pieces of hand tools funded by TFET are distributed to farmers by MAF in cooperation with NGOs or PKFs before the end of 2001.

e) Training Rice Farmers for Moderating Labor Shortage and Increase of Production

Farmers training for land preparation by machinery and water buffalo, and for machinery repair together with rice hull stove are effectively conducted by CARE International in East Timor funded by JICA as one objective under Community Empowerment Program for Improvement of Agricultural Production in Manatuto and Lautem districts from February 2000 to March 2,003. Targets are 36 farmers' groups and 1,080 farmers. Hand tractors, threshers and rice mills are distributed to farmers' groups to assure sustainability.

f) Related Foreign Assistance for Farm Mechanization :

Not less than eight international and local NGOs support to develop and improve farm mechanization and distribution of high yield seeds as well as marketing of agricultural produce in East Timor in cooperation with international ODA agencies (see Table K-17).

3.6.6 Marketing of Agricultural Products

During the Indonesian period, marketing of agriculture products, especially paddy rice and corn were made through the Cooperative Units of Desa (known as KUD). Those were provided support by the District Logistic (DOLOG), which is the marketing arm of the Bureau of Logistics (BOLOG) of the Indonesian Government. There are limited numbers of private traders involved in the marketing of agricultural crops.

Marketing of staple food crop (rice, maize, cassava, etc.) and more especially rice presently become serious socio-economic problems with the complicated marketing of rice, because of the extensive importation of cheap Vietnamese and Thai rice. Rice sales from districts far from Dili (Viqueque, Lautem and Covalima) have largely stopped because of high transportation and milling costs. Cheap imported Vietnamese rice is also for sale in these rice surplus districts and local producers find it difficult to compete. The sale of cheap imported rice has also decreased maize sales. Because rice is the preferred staple food, it usually enjoys a price premium over maize but now consumers who normally would buy maize can afford to buy imported rice.

From districts like Viqueque about 180 km from Dili the cost of rice milling and transport to Dili is about US\$ 0.075-0.08/kg while imported rice is about US\$ 0.14/kg. Clearly with the cost of milling and transport taking up 53 percent of the cost of local rice against imported rice, the prospects are not good for local rice production. The sale of cassava, which is even cheaper than rice or maize, is still competitive since there is no importation of cassava. Sales of cassava are reported to have increased but quantitative data is still difficult to obtain. The present MAF does not have a specific duty to collect agricultural data and there is no longer any specific agency that collects normal agricultural data.

Other than the staple food crops the marketing system is returning to normal. Locally produced vegetables are in strong demand and these markets have resumed normal production. Because all the generating sets for the pumps were destroyed in September 1999, about 80 ha of ground-water irrigated vegetable production in the Liquisa district close to Dili is still not in production and this has benefited other producers. This area was the main supplier of tomatoes to the Dili market in previous years.

The sale of eggs, chickens, pigs, goats and sheep apparently remain strong and profitable, although no statistical gathering system is in place to give precise data. For the majority of subsistence agriculture farmers, animal sales have traditionally been the most common methods of raising cash. Cows and buffalo sales are not a usual item of sale but are often related to emergencies to raise money for specific and important family needs i.e., health emergencies, school tuition or for building houses and similar expenses.

3.6.7 Agricultural Research and Extension

Very little agricultural research and extension has taken place during the early emergency and recovery phases of development. In February 2001 the Australian Council for International Agriculture Research (ACIAR) started a long-term project (seeds for life to last for 10 years). The project is working cooperatively with the International Agriculture Centers (IAC) in a large-scale variety trial covering all the major agro-ecosystems in East Timor. The IAC are providing the genetic material for evaluation. At present ACIAR is working with two International NGOs (World Vision and Catholic Relief Service), but intends to work cooperatively with the National University of East Timor (UNTI) after independence as it becomes able to do research. The early stages of this project are strictly variety adaptation trials.

Some lines of sweet potato, cassava and soybeans and kidney beans are showing large and significantly higher yields than local ones yield increases. Varietal testing will continue for at least two years prior to testing on farmers' fields. Intercropping trials on farmers' fields will start after the first two years of varietal testing and multiplication and varieties should be available for wide spread field testing under intercropping conditions.

Some limited extension work has been done by NGOs as part of their agricultural recovery funding and some by FAO through its Japanese funded seed multiplication project for rice and maize. The food crops district extension officers have had no motorcycles for transportation and no funding for extension work until July 2001. Motorcycles and some funding should become available in August of 2001. Forestry and fisheries extension officers have also lacked motorcycles for transportation and inadequate funding for fieldwork.

3.6.8 Agricultural Credit

During the Indonesian period, credits in agriculture are provided by the Cooperative Units of Desa (known as KUD). Private persons involved in trading agricultural crops also provided credit but on a limited basis.

Since most of those in control of the KUD and the private agricultural traders are Indonesians, there are no readily available sources of credit for agriculture in the rural area except for the Pilot Agriculture Service Center (PASC) being initiated under the First Agricultural Rehabilitation Project (ARP-I) of TFET administered by World Bank (WB). However, the PASC has still to be developed to its full level of operation. This shall form part of the components of the Second Agricultural Rehabilitation Project (ARP-II) that is about to commence.

Although there are on-going micro-financing programs, those are limited to small community business endeavors. An non-government organization (NGO) once get itself involved in micro-financing by lending funds for coffee-buying business. However, as it takes sometime before the borrower can sell their procurement to the main coffee business traders, the NGO suspended its financing program and concentrated its program on short gestation micro-financing projects.

3.6.9 Related Institution

Agriculture programs in East Timor is administered by the transitional government through a structure that basically similar to that during the Indonesian period. Central administration of Ministry of Agriculture and Fisheries in East Timor Government has five divisions; Directorate of Agriculture, Divisions of Agriculture and Rural Extension, Geography and Cadastral, Irrigation and Forestry. Below the district is the District Field Officer (DFO) at the sub-district level.

Prior to its dissolution, the CNRT (Conselho Nacional Resistencia de Timorese) had a political organization parallel to that mentioned above. It had parallel organizational units from the national level to the district down to the sub-district, village and hamlet levels. In view of the on-going political exercise and although the CNRT national level organization were dissolved, the units below its level are still operating closely with the transitional administration.

The group of non-government organizations (NGOs) can be considered as an important institution in East Timor because of the many roles that it played during the emergency and welfare support phases of nation re-building. The NGOs in the country consist of a large number of both national or local, and international organizations. Because of the limitations of government resources, in funding and manpower, the NGOs could provide the necessary support in the government rural and agricultural development programs.

3.6.10 Supply and Demand of Agricultural Products

There is no government controlled statistical service collecting the data and it is difficult to determine the actual supply and demand of cereal crops and equivalents in East Timor, because of the varying assumption used for population, production, consumption and post-harvest losses. In addition there is a large segment of the population, mostly in the upland areas, who use root crops as the staple food. The preference for cereal foods is clear, however, rice is the preferred food followed by maize and then root crops.

The added complication is the importation of cheap foreign rice that now reaches about 41,800 tons/year in 1997 against the local production of 38,000 tons/year of paddy rice. It could be assumed that the maize supply would be about 99,200 tons/year depending on the degree of post-harvest losses that can be exceptionally high. The root crop estimates are also problematic. Much of this crop yield is not recorded and since it is a low status food it is not stressed in official statistics. However, field observations and interviews indicate that it is very significant part of the diet. Root crops are especially important for the highland population and these root crops need to be accounted for supply since they are the reserve source of carbohydrates for much of these highland populations. Rice and maize crops fail; root crops rarely fail. They are also an essential food supply safety mechanism for the poorer segment of the population. However, it needs to be stressed rice is the preferred food, and if money is available, rice will be purchased in preference to other foods.

Supply and Demand of Cereals and Equivalents (1997)

Crops	National Production (ton/year)	Calories (Kcal/day)
Rice local	37,900	228
Rice imported	41,850	473
Maize	99,200	711
Cassava	41,380	146
Sweet potato	17,650	51
Others	-	531
Total	-	2,140

Source: Statistic Pertanian 2000

Naraca Bahan Ma Kanan Provinsi Timor Timur 1999

Clearly the major source of calories continues to be maize. Calories from rice (both domestic and imported) are in second place and are roughly equal to calories obtained from root crops. Estimations of the bean crop yields and losses are very difficult to estimate as is the production and consumption of animal protein and vegetables. Although clear generalizations are difficult to make, it appears that the national carbohydrate supply is adequate but that protein, fats and vitamins may be deficient in the poorer segments of the population. The consumption of rice will continue to rise, as it has over the past 50 years, and replace maize and root crops as the staple food if it is available in the local markets at a price the people can afford.

3.7 Livestock

Livestock production is predominantly smallholder in scale, and integrated into individual household farm systems. Virtually no commercial livestock project operates except for a poultry farm located in Dili on the way to Ermera and a part of piggery. Except for some large herds of buffalo, cattle, sheep or goats, typical animal holdings per household are from one to several heads each of one, or all kinds including pigs and chickens. Post-conflict economic difficulties have made livestock more important as cash income source, to the point of limited consumption by households, even for chicken eggs.

Animals are generally raised through extensive feeding, with little or no supplementation. Ruminants and horses are allowed to graze freely on fallow cropland or grasslands up to mountainous forests. Pigs, chickens and some ducks are likewise mostly free to forage for their feed, and then given extra from kitchen leftovers, crop by-products, etc. Few animals are confined or tethered in households in busy areas, near standing crops and vegetables, or in urban centers as this requires more hand-feeding with supplemental feeds and gathered fodder. Except for available rice and corn bran, there are no locally produced commercial mixed feeds. Only the commercial poultry and some piggeries use mixed feeds, part of which are imported from Indonesia or Australia. As of July 2001, Don Bosco piggery in Los Palos was feeding kitchen leftovers from the Korean battalion.

The MAF/Livestock division has estimated the livestock populations as follows (by year in relation to Conflict);

Livestock Population, Pre- and Post- Conflict

Livestock	1997(Pre-)	2000(Post-)
Cattle	146,557	96,662
Buffalo	73,818	48,452
Horse	32,792	20,396
Goat	202,934	131,125
Sheep	33,191	20,391
Pig	362,473	23,912
Local Chicken	585,355	350,422
Improved Chicken	503,183	n.a
Duck	28,559	n.a

Source : MFA and Statistic Indonesia, 1998

The above estimates reflect the pre- conflict situation from Indonesian data and post-conflict one based on continuing field verifications by MAF. The MAF in turn estimated an average 40 percent reduction in animal numbers from 1998 to 2000, but the said base year of 1998 had the highest animal numbers. For a rough comparison, cattle were reduced by 34 percent from 1997 to 2000; but from the Village Survey (Suco Survey), key informants estimated a 62 percent reduction from 1997 to December 2000. Buffaloes were reduced by about 34

percent, either from the above Table (1997 to 2000) or from the Suco Survey (1997 to 2000). The Village Survey (Suco Survey) also showed no reduction in sheep, and 27 percent reduction in native chickens. All these estimated reductions resulted from a combination of animals that were killed and/or consumed during the conflict, replacements from ETTA animal distributions, mortality, sales and subsequent animal births.

Nevertheless, livestock statistics have always been difficult to obtain because people hesitate to reveal the actual number for fear of tax assessments. During the conflict, animals were killed, and people (including the militia) consumed animals for lack of other food. At that time, it is conceivable that animal owners also hid the large animals (cattle, buffalo and horses) in the mountains.

3.8 Forestry and Watershed Management

3.8.1 Forestry

1) Present Forest Area

According to the obtained data by National Board of Land of East Timor Province (1997), out of the total land area of 1,460,938 ha in East Timor, forest land area is 1,113,275 ha which shares 76 percent of the total (see Table G-1). Forest land areas are divided into two categories of inside forest area (national forest) and outside forest area (private forest). Based on the Land Utilization Design (TGHK) by Indonesian system, inside forest areas were divided by functions based on the following forests; production forest, protection forest/conservation forest, park and preservation forest, and convertible forest.

On 30th June 2000, UNTAET promulgated Regulation No.2000/19 which was designated Protected Natural Area (NPA). These protection areas are based on park and preservation forest areas.

There is no remarkable activity on forest sector in East Timor. The Sandal wood resources are almost exhausted, and now the trial breeding of their seedling and planting activity are executed. The nursery tree should be needed to rehabilitate these tree species, therefore there is a difficulty to plant the Sandal wood tree. The big Teak trees that were planted in Portuguese age are reduced now and the small second growth is seen in the several areas. In the Western region such as Covalima, Bobonaro and Oecussi districts, there are Sandal wood trees, Teak trees and Nara trees which are very useful tree species.

During the Indonesian age the industrial plantation was started to promote the production of the commercial wood in Aileu, Ermera, Baucau and Manatuto districts, but now these activities are stagnant. In the Western region such as Ermera and Liquicia districts, where are characteristic of coffee production, there are the dense forests by many big Sau tree (Sengon) as shade trees for coffee trees. In the areas having a dense population such as Dili and Manatuto

districts, the big trees such as Eucalyptus trees were already cut down for the fuel woods, moreover the growth of natural seedling is very difficult because of the custom of burning, therefore deforestation is remarkable.

In the Central region such as Mantuto, Ainaro, and Manufahi districts, there are still big trees of Eucalyptus trees and Mountain Ru trees, but they are already old age trees with parasite, so that the regeneration of these trees are expected. In the areas of Covalima, Bobonaro, Baucau and Viqueque districts in the Central region, the plantation of Candle-nut tree has been promoted during Indonesian time. In the Eastern region such as Lautem district there are still Sandal wood trees and Nara trees, which are useful species because of the thin population.

Generally speaking for the condition of forest in East Timor, the northern part of Timor Island where are divided by mountains which are existed from west to east in Timor Island has poor forests, while the southern part of Timor Island there is still seen the forests. Anyway the potential for forest resources is unknown. Therefore, the forest resource inventory will be executed as soon as possible, then the sustainable forestry plan will be drawn up. There are potential of timber production from Sengon as shade tree, old age Eucalyptus and Mountain Ru. But for the present, the reconstruction materials should be depended on import from Indonesia.

2) Forest Production

The important tree species in East Timor are Sandal-wood/Cendana (*Santalum album*), Teak/Jati (*Tectona grandis*), Kayu merah (*Pterocarpus indicus*), Mountain ru/Cemara (*Casuarina junghuhniana*), Poplar gum/Hueh (*Eucalyptus alba*), Jemuju (*Podocarpus imbricatas*), Fiji longan /Kayu sapi (*Pometia pinnata*), Levan/Leban (*Vitex pinnata*), etc. (Dinas Kehutanan Timor Timur)

In accordance with UNTAET Regulation No.2000/17 (8, February 2000), logging operation and the export of wood are prohibited for purpose of reducing deforestation and establishment of a sustainable forestry industry (refer to paragraph G-3 for present forest production).

3) Production of Non Timber Forest Products (NTFP)

Sandal wood is very valuable tree species to use as timber but also sandal-wood oil and sawdust. Another NTFP are Candle nut, Honey, Tamarind, Candle, Bamboo, Woven panal, etc.(see Table G-4). Especially coffee is a famous products in East Timor.

4) Distribution of Tree Species

Distribution of main tree species are shown in Table G-5.

5) Critical Land Areas (Luas Lahan Kritis)

There are many forest land where should be rehabilitated to prevent the erosion and

deforestation (Critical land⁸). Based on Seventh Five Year Development Plan (PELITA VII) (Draft) prepared by Ministry of Forestry and Estate Cops during Indonesia time, critical land areas are 483 thousand hectare (43 percent of all forest land), and 177 thousand hectare (24percent of inside forest area) and 306 thousand hectare (85 percent of outside forest area) (see Table G-6).

6) Distribution of Non Timber Forest Product (NTFP)

Main Non Timber Forest Products (NTFP) are coffee, coconut, cashew-nut, candle-nut, tamarind, etc. Especially coffee is famous product. Distribution of Non Timber Forest Products (NTFP) shows in Table G-7.

7) Reforestation and Regreening Activities

To rehabilitate the critical land as mentioned above, reforestation (around 400 ha every year) and regreening (production of seedlings, check dam development and community forest plantation 2,000 ha every year) activities have been done (see Table G-8).

8) Demand of Forest Products

Domestic demand of forest products is estimated roughly as timber (0.1 cu.m/capita/year) and fuel wood (0.5 cu.m/capita/year) by Indonesian Government. Based on these estimation, timber was needed around 70,000 cu.m and fuel wood around 350,000 cu.m in 1999.

Estimation of Product ability is 49,000 cu.m for timbers and 337,000 cu.m for fuel wood per year (*Rencana Umum Kehutanan Propinsi Timor Timur 1984 s/d 1999*: Kanwil Kehutanan Timor Timur, Maret 1987) (see Table G-9). The shortage of timber should be supplied from another country, and the shortage of fuel wood will be supplied from community plantation area or private forest.

And now the logging operation is prohibited ground of the UNTAET Regulation No.2000/17 (8 June 2000). However fuel wood production is still implemented. But now to ensure of kerosene is very difficult, because of no production of kerosene and very high price in East Timor. According to the result of Village Survey (Suco Survey) conducted by JICA Study Team another estimation for demand of fuel wood for whole country shows more than 1,200,000 cu.m/year (see: Table G-9).

⁸ Critical land is defined as "a land that physical condition could not support its function as the medium of production and water net", and determined by two factors of land coverage and soil erosion in Indonesian system.

3.8.2 Watershed Management Conditions

The land that can be defined as watershed is in significant proportion of the total gross area of 14,609 sq.km, out of which about 6,000 sq. km has slope exceeding 40 percent. There are 27 watersheds in East Timor (SNC-Lavalin International, May, 2001), and named according to the major rivers. The Loes, Comoro, Lacro, Laleia, Vemassee, Seical, Nemui, Laivai, Radmoko, Malaelada, Tono, Namaluto, Irebere, Bebui, Cuha, Wetuai, Luca, Dilor, Sahem, Clere, Lacro do sul, Caraulun, Barulu, Mola, Loumea, Raiquita and Tafara are the 27 watersheds (Table T1-1). However, upon careful verification on topographic map 27 major watersheds were identified (Figure T1-1). Major downstream watershed problems are as follows:

- Loss of agricultural productivity due to erosion
- Deforestation
- Population and poverty
- Downstream sedimentation
- Flush flooding

1) Evolution of Conservation Technology in East Timor

The concept of conservation oriented upland farming, in which farming system and individual production treatment to conserve soil and water, and improve total production and sustainability is non-existent in East Timor. The specific techniques that can be adapted in the upland are grouped into structural and vegetative/cultural. However, the structural control for its high cost is not (terracing, cross dams, etc.) economically/culturally appropriate for East Timor. They are also not recommended for inappropriateness of design, inadequate drainage and shallow subsoil.

The vegetative/cultural measures are recommended to improve upland agriculture and soil erosion problems in East Timor. This includes contour cultivation, techniques to reduce tillage, addition of new crops and changes in timing or cropping pattern (intercropping etc.), or stand architecture to provide for more continuous and effective soil cover. Vegetative system has the following advantages over the structural system of erosion control;

- Cost : Vegetative measure of conservation is the low cost.
- Adaptability : Planting across the slope is enough for vegetative control
- Farmers Control : Vegetative method do not require use of machinery or sophisticated surveying, individual farmer can take the initiative in adopting conservation measures.

2) Treatment of Forested Area in East Timor

Following activities to treat the forest land have been planned and carried out in East Timor;